DEVELOPING SUSTAINABILITY

A collection of selected papers compiled by the
Dorich House Group of European Universities

İSTANBUL BİLGİ ÜNİVERSİTESİ YAYINLARI

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The Editors

JACQUES COMBY
Prof. Dr., President of Jean Moulin Lyon 3 University, France

KATHERINE A.T. EAMES
Dr., Sustainability Hub Research and Curriculum Lead, Kingston University, London, UK

LAURENT GUIHÉRY
Laboratoire d'Economie des Transports (LET-ISH), Université Lumière Lyon 2, France

JORGE MARX GÓMEZ
Prof. Dr.-Ing., Chair Business Information Systems I, Carl von Ossietzky Universität, Oldenburg, Germany

AYŞE UYDURANOĞLU ÖKTEM
Associate Prof., Director of the Research Centre for Environment, Energy and Sustainability Studies, Istanbul Bilgi University, Turkey

VALENTINA TIRLONI
Dr., IRPhiL, Jean Moulin Lyon 3 University, France

The Authors

FRANK AHLHORN
Centre for Environmental and Sustainability Research (COAST), Carl von Ossietzky University of Oldenburg, D-26111 Oldenburg, Germany

IRENE ANTONI-KOMAR
Department of Business Administration, Economics, and Law; Carl von Ossietzky University of Oldenburg, Oldenburg, Germany

JINGLING BAO
Tianjin Environmental Protection Bureau, China

BENJAMIN WAGNER VOM BERG
Department of Business Informatics I, Carl von Ossietzky Unversity Oldenburg, Germany

PHILIPPE BILLET
Institute of Environmental Law, Jean Moulin Lyon 3 University, France

AMÉLIE BOHAS
Group SICOMOR – Research Team MAGELLAN – Jean Moulin Lyon 3 University, France

HELGE BORMANN
Department of Biology and Environmental Sciences, Carl von Ossietzky University of Oldenburg, D-26111 Oldenburg, Germany

LAÏD BOUZIDI
Group SICOMOR – Research Team MAGELLAN – Jean Moulin Lyon 3 University, France

NIJOLĖ BURKŠAITIENĖ
Institute of Humanities, Mykolas Romeris University, Lithuania

WENTAO CHANG
Tianjin Academy of Environmental Sciences, China

JOHN L. CLARKE
Faculty of Art, Design & Architecture, Kingston University, London, UK

JOHN CORKINDALE
School of Surveying and Planning, Kingston University, London, UK

SAMUEL DEPRAZ
Jean Moulin Lyon 3 University, France

BERENICE DREUX-GERPHAGNON
IRPhiL – EA 4187 Lyon Institute for philosophical research, Jean Moulin Lyon 3 University, France

AISTĖ DROMANTAITĖ
Management Department, Policy and Management Faculty, Mykolas Romeris University, Vilnius, Lithuania

JUDITH V. FARREN-BRADLEY
School of Surveying & Planning, Faculty of Art, Design & Architecture, Kingston University, London, UK

ZHENZHEN FENG
Tianjin Academy of Environmental Sciences, China

ROBERT GANT
Faculty of Science, Engineering and Computing, Kingston University, London, UK

JORGE MARX GÓMEZ
Carl von Ossietzky University, Very Large Business Applications, Oldenburg, Germany

PHILIPP GRINGEL
OFFIS Institute for Information Technology, Oldenburg, Germany

MEIZHU JIN
Sino-Singapore Tianjin Eco-city Administrative Committee, China

HORST JUNKER
IMBC GmbH, Germany

KOSTAS D. KARATZAS
Aristotle University, Department of Mechanical Engineering, Informatics Systems and Applications Group, Thessaloniki, Greece

THOMAS KASPEREIT
M.A., Accounting and Corporate Governance, University of Oldenburg, Oldenburg, Germany

THOMAS KLENKE
Centre for Environmental and Sustainability Research (COAST), Carl von Ossietzky University of Oldenburg, D-26111 Oldenburg, Germany

JAN KÜHLING
Department of Economics, University of Oldenburg, Germany

CORINNA V. LANG
Anhalt University of Applied Sciences, Department Ecomonics, Bernburg, Germany

XUEFENG LIN
Sino-Singapore Tianjin Eco-city Administrative Committee, China

XUEQIANG LU
Tianjin Academy of Environmental Sciences, China

CATHERINE MERCIER-SUISSA
IAE (Institut d'Administration des Entreprises), Jean Moulin Lyon 3 University, France

INGO MOSE
ZENARiO – Centre for Sustainable Spatial Development, Carl von Ossietzky University, Oldenburg, Germany

PERE FULLANA I PALMER
UNESCO Chair in Life Cycle and Climate Change,
Escola Superior de Comerç Internacional, Universitat Pompeu Fabra, Barcelona, Spain

ALEXANDRA PEHLKEN
Bremen University, Institute for Integrated Product Development, Bremen, Germany

REINHARD PFRIEM
Department of Business Administration, Economics, and Law; Carl von Ossietzky
University of Oldenburg, Oldenburg, Germany

JEAN-PHILIPPE PIERRON
IRPhiL – EA 4187 Lyon Institute for philosophical research, and SIS – EA 4129, Jean
Moulin Lyon 3 University, France

STASYS PUŠKORIUS
Management Department, Political Sciences and Management Faculty,
Mykolas Romeris University, Vilnius, Lithuania

LEI QI
Tianjin Environmental Protection Bureau, China

MARCO RAUGEI
UNESCO Chair in Life Cycle and Climate Change,
Escola Superior de Comerç Internacional, Universitat Pompeu Fabra, Barcelona, Spain

DENISE RAVET
IAE de Lyon, Jean Moulin Lyon 3 University, France

JAMES RITSON
School of Survey and Planning, Faculty of Art, Design and Architecture,
Kingston University, London, UK

JÜRGEN SAUER
Carl von Ossietzky University of Oldenburg, Oldenburg, Germany

SARAH L. SAYCE
School of Surveying & Planning, Faculty of Art, Design & Architecture,
Kingston University, London, UK

HEDDA SCHATTKE
Department of Business Administration, Economics, and Law; Carl von Ossietzky
University of Oldenburg, Oldenburg, Germany

JOLITA ŠLIOGERIENĖ
Institute of Humanities, Mykolas Romeris University, Lithuania

TAO SUN
Tianjin Academy of Environmental Sciences, China

ROSALIND TAYLORN
Sustainability Hub, Kingston University, London, UK

BRIDGET TOWERS
Faculty of Arts and Social Sciences, Kingston University, London, UK

HEINZ WELSCH
Department of Economics, University of Oldenburg, Germany

JUAN WEN
Tianjin Academy of Environmental Sciences, China

XIOCHUN ZHANG
Tianjin Environmental Protection Bureau, China

Preface

The Dorich House Group of seven universities from six European countries was established in 2008. The member universities actively cooperate in educational, cultural and enterprise activities, including research, exchange and development collaborations. Subsequently in 2009 the Ecology and Sustainability Research Group was formed with researchers from each institution coming together to engender closer working relationships and to create more opportunities for international collaborations on European-wide projects. Sustainable Development is a global issue but one which has many regional and local nuances that can be more thoroughly investigated and understood by a multidisciplinary and multinational team. The Ecology and Sustainability Dorich House Research Group is ideally suited to explore these issues and work towards finding the ideal solutions to the sustainability challenges we face today.

This publication showcases research into sustainability being conducted across the Dorich House Group member Universities and some of their partner institutions and will provide a foundational reference base for continued research collaborations. The book has also in itself provided an opportunity for researchers in the Dorich House Universities to form new partnerships, both within and outside the group, and contribute jointly to the publication.

The book forms a solid reference for students and researchers in all partner universities and their home nations. Contributions to this book have

been arranged within themed chapters coordinated by different chapter editors, and cover the latest research on Sustainable Development in the areas of:

- Economic Behaviour and Sustainability
- Knowledge to Action
- Material Manufacturing and Design
- Mobility and Energy
- Spatial Governance

Each of these themes is a key issue of Developing Sustainability and the research taking place in our institutions can help in working towards a sustainable future.

We hope you enjoy the book and that it sparks further innovation within and outside the Dorich House Group.

The Editors
October 2012

CHAPTER 1

Economic Behaviour and Sustainability

Edited by Associate
Ayşe Uyduranoğlu Öktem

Chapter Introduction

Ayşe Uyduranoğlu Öktem

Increased use of natural resources places a pressure on the environment and thus raises the question of sustainability, which needs answering. The literature provides many various definitions of sustainable development, which can help in answering this question. The most quoted definition is that provided by the World Commission on Environment and Development (1987) that defines sustainable development as development that 'meets the needs of the present without compromising the ability of future generations to meet their own needs'. Work into sustainable development is generally focused on three considerations:

1- Environmental sustainability.
2- Economic sustainability.
3- Social-political sustainability.

For a better understanding and achievement of environmental sustainability, the link between the environment and economic activities must be recognised. There is a strong interdependence between these two. The environment plays a vital role in economic activities. The environment generates natural resources for production activities and serves as waste assimilator and can potentially be seen as a limiting factor in this way in economic considerations. Thus, in order to achieve environmental sustainability we must not exceed the regeneration capacity of the environment and the assimilative

capacity of the environment. These are the two main fundamental conditions of environmental sustainability.

In order to fulfill the conditions of sustainable environmental development, sustainable production and consumption must be promoted. To ensure this, government intervention is necessary. If environmental sustainability is not achieved, we will face environmental problems deemed as negative externalities in the economics literature. Environmental impacts occur due to the use of non-marketable resources such as our atmosphere, oceans, ozone layer. Since these resources are non-marketable, economic agencies (producers and consumers) do not pay anything for using them and the cost of using them is, therefore, not reflected in the price charged in the market. As a result of this lack of charging, these resources are over or carelessly-used. This situation violates the first condition of environmental sustainability stated above. Further, over-production and/or consumption lead to over-waste, which cannot be tolerated by the environment. Thus, the second of the two conditions of environmental sustainability cannot be fulfilled. This causes negative externalities, which are a typical example of market failure. In the presence of market failure, the need for government intervention to make the market function properly is inevitable. To ensure environmental sustainability, governments can implement policies, which deliver environmental practices yielding sustainable production and consumption. Economists assume that sustainable production and consumption will lead to an increase in utility (well-being) of individuals and the welfare of society. Economists also suggest the use of cost-benefit analysis when environmental values are measured. The papers in this chapter present some of the research being conducted in this area at the Dorich House Group of Universities.

Whilst Heinz Welsch and John Corkindale concentrate on environmental sustainability, a completely different approach to sustainability is used by Aiste Dronmantaite-Stanccikiene who examines sustainable development of equal gender inclusion in the Lithuanian labour market. Specifically the paper focuses on factors preventing women from equal participation with men in the labour market and exploring the reasons behind these factors. The conclusion of this study points out that the labour market in Lithuania is far from being mature in terms of offering equal opportunities for both genders.

The paper by Heinz Welsch and Jan Kühling considers the link between pro-environmental behaviour and utility i.e. the total satisfaction received by a consumer from consuming a good or service. They have present-

ed results from the employment of a utility model that show that the impact of pro-environmental consumption on utility function is positive. They have found that people could derive higher utility/satisfaction by consuming more environmentally friendly goods while reducing the quantity consumed.

Finally, the study by John Corkindale takes a critical look at the suggestion of the use of cost-benefit analysis, which is a useful but not completely adequate way to measure environmental values. He argues that when human beings are an integral part of the environment and environmental values offer benefit for the next generation, cost-benefit analysis is not an adequate method to measure environmental values.

To achieve sustainable development, social-political, economic and environmental sustainability must be addressed. Sustainable behaviour can increase the welfare of society including the next generation. Economic prosperity, environmental quality and social equity are the three dimensions of sustainable development. The papers in this chapter focus on these three dimensions.

1

Economic Blueprints for Sustainability - A Critique

JOHN CORKINDALE

ABSTRACT

Since the publication of the Brundtland report in 1987, there has been an explosion of interest in the subject of sustainable development and how it can best be achieved. This interest has been lively amongst economists and, in the last twenty years or so, a number of popular economic tracts with titles including the word 'blueprint' have appeared. Conventional economic analysis, focusing on the assessment of the costs and benefits of marginal changes to the environment, is always open to the objection that its scope is limited and somehow cannot take account of the environment's intrinsic value. Economists might protest that cost-benefit analysis is 'fit for purpose'. This begs the question of precisely what that purpose is. It is argued in this paper that, as conventional economic analysis does not address the fact that humans are an integral part of the environment and not just an agent making use of the environment, it cannot hope to deliver policy prescriptions other than in a rather limited, albeit useful way.

Key Words: Sustainability, Economic Blueprints, Intergenerational Equity, Natural Capital

INTRODUCTION

The publication, in 1987, of the Brundtland report and its advocacy of 'sustainable development' (World Commission on Environment and Development, 1987) marked something of a turning point in the debate about how to integrate development and environment. In the UK, it led directly to

the publication of the 1990 environment white paper (H M Government, 1990). Internationally, it led to the Earth Summit in Rio de Janeiro and the conventions on climate change and biodiversity conservation. There were, of course, precursors to the Brundtland report, notably the World Conservation Strategy (International Union for the Conservation of Nature and Natural Resources, 1980). This had already advanced the concept of sustainable development and had recognised the challenge of integrating development and environment.

As far as setting alarm bells about the threat to the environment is concerned, Rachel Carson's 'Silent Spring' (Carson, 1966) and a highly influential article in 'The Ecologist' published under the title 'A Blueprint for Survival' (Goldsmith *et al*., 1972) were seminal. Although not then making use of the term 'sustainable development', economic debate about environment and development can be traced back at least to the late 1960s and '70s. Two significant milestones were economic texts drawing attention to the costs of economic growth (Mishan, 1969) and defending the need for it (Beckerman, 1974).

The conditions for the economically efficient exploitation of exhaustible resources had been set out by Hotelling as long ago as 1931, long before publication of the Brundtland report (Hotelling, 1931). Since Brundtland, various popular economic tracts have addressed the question of how to make the concept of sustainable development useful for operational policy purposes. Probably the most famous of these was published in 1989 under the title 'Blueprint for a Green Economy' (Pearce *et al*, 1989) later updated as 'Blueprint for a Sustainable Economy' (Pearce and Barbier, 2000) 'and most recently as 'A New Blueprint for a Green Economy' (Barbier and Markandya, 2012). In between, a number of other 'Blueprints' appeared from the same source on related subjects (Pearce, 1991; 1993; 1995). More recently, 'A Blueprint for a Safer Planet' (Stern, 2009) has been produced by the author of 'The Economics of Climate Change' (Stern, 2007). Clearly, the expression 'blueprint' is almost as much in vogue amongst economists writing about sustainable development as the latter expression is more generally! This article takes a critical look at some of the arguments deployed.

EFFICIENCY VERSUS EQUITY

An important feature of the 1980 World Conservation Strategy was its drawing attention to the intergenerational aspect of sustainable development. This idea was not new: writing as long ago as 1849, John Ruskin advocated '*The*

idea of self denial for the sake of posterity'. This kind of aspiration is easier to state than to analyse in public policy terms. Economists have grappled with the problem for a long time. For example, Heady (1952), writing about the economics of conservation, a concept closely related to sustainable development, asked: '*What...is the optimum level of conservation for an intergeneration society? Existing scientific logic can only state this: The optimum level of conservation is what each succeeding generation thinks it to be...The values of discrete generations cannot be linked together ex ante into a single index for all time to give one optimum level of conservation into eternity... (T)he level of conservation which is ideal or optimum changes with the values of each succeeding generation.'*

Left to the market and individual decision-making, matters would be determined by the value of the bequests they make to their offspring, to voluntary conservation bodies, etc. In principle, whatever the actual problems of quantification, the economic concept of bequest value can capture the monetary value of these bequests. However, a key message of the Brundtland report is that, left to individual decisions and to the market, not enough will be done for future generations. The implication is that more resources than this should be passed onto future generations. These additional resources should, in effect, be regarded as a kind of merit good.

The Stern review (2007) observed that '*if you care little about future generations you will care little about climate change....that is not a position which has much foundation in ethics and which many would find unacceptable'*. Stern went on to refer to the distinction between the 'prescriptive' and the 'descriptive' approach to judgements of how to weigh the welfare of future generations. He makes clear he lines up with those who see the matter as a prescriptive or ethical issue rather than one that depends on the revealed preference of individuals in allocating their own consumption and wealth.

Statements of this kind beg the question of how to determine the nature and extent of the resources that should, rather than actually will, be devoted to the interests of future generations. At once, therefore, we are in the realm of normative rather than positive economics (see, for example, Lipsey, 1989). Governments take a somewhat paternalistic view of environmental conservation as a merit good the provision of which is determined partly by the ethics of (intergenerational) equity rather than entirely on the basis of consumer preferences. As it happens, things are probably a bit more complicated than this statement might suggest. There are reasons for believing the

way the market in environmental conservation operates might not even adequately reflect consumer preferences. A couple of examples will have to suffice to illustrate the point.

First, aspects of the environment fall into the category of open access resources or common property resources; access to the fish in the oceans is an example. As it is difficult if not impossible to prevent anyone from fishing who wants to, even those people who want to conserve to world's fish stocks are in something of a prisoner's dilemma. It is not really worth their while reducing their own catches if they can see that others will move in to take advantage of the more abundant fish stocks thus negating their efforts. Secondly, it might be that not everyone understands the need for environmental conservation. If they did, so the argument goes, they might be more willing to devote resources to it. This kind of information deficiency is another reason for market failure in the provision of conservation goods. The distinction between the normative and the positive is therefore not simple. However, what is clear is that publication of the Brundtland report provided a powerful stimulus to search for an answer both to the question of how to address problems of market failure and also how to determine what should be done for the environment purely in the interests of future generations.

DISCOUNTING AND THE ENVIRONMENT

Of all the environmental problems with which man is confronted, the problem of climate change mitigation is perhaps the most intractable. One reaction of economists has been to resort to option appraisal and to try to apply the methods of cost-benefit analysis (CBA) (Stern, 2006). Not surprisingly, given the lengthy time periods involved, economic appraisal using the conventional tools of CBA, including discounting techniques, strongly suggests that preventative strategies for climate change are only marginally, if at all, beneficial. In fact, using conventional discounting procedures, it seems hard to justify preventative action on climate change at all. For example, one of the economists working for the Stern review is on record as stating that, even with a discount rate as low as 4-5%, no preventative investments of this kind could be justified (Personal Communication with Dietz, 2007). It is not difficult to see why: preventative strategies will be costly in the short term but the pay-off will be a long way in the future. If so, it is hardly surprising they have run into opposition not least from developing countries with more pressing priorities.

Discounting has, of course, long been criticised on the grounds that the higher the discount rate the less likely it is that investments, such as climate change mitigation, with short-run costs and long-run benefits will be sanctioned by CBA. Conversely, investments with short-run benefits and long-run costs, such as neuclear power stations, are correspondingly more likely to be sanctioned by CBA. In both cases there is a danger that the interests of the present generation will override those of future generations. Therefore, such a procedure seems to be at odds with one of the fundamental tenets of sustainable development, namely intergenerational equity.

Various possible solutions to the problem of discounting and the environment have been proposed (Winpenny, 1995; OXERA, 2002):

- Low or zero discount rates;
- The application of lower discount rates to environmental projects or specific environmental effects;
- Applying distributional weights to costs and benefits accruing to future generations;
- The application of discount rates that decline over time.

Of these possibilities, it is the last that seems to be currently most fashionable. For example, the January 2003 version of H M Treasury's Green Book on investment appraisal and evaluation states '*Where the appraisal of a proposal depends materially upon the discounting of effects in the very long term, the received view is that a lower discount for the longer term (beyond 30 years) should be used*'. On close examination, this reference to 'the received view' turns out to mean the view expressed by OXERA (Oxford Economic Research Associates) in a report prepared for three UK government departments in 2002. More recently, the case for declining discount rates over time has been discussed at some length in the Stern review of the economics of climate change (Chapters 2 and 2A). In both cases, the analytical arguments are so complicated one can be forgiven for wondering whether the authors are trying to defend the indefensible. Perhaps the best that can be said of the idea is that people seem more likely to be indifferent between a £ in 50 years as compared to a £ in 51 years than they are between a £ now and a £ in one year's time.

One of the most telling statements in the OXERA report is to be found on page 13:

> "Probably the most important message to emerge from the philosophical and economic critique of positive discounting is the separation of rules about the allocation of resources....across generations from rules about allocating resources over time within a [single] generation. The latter issue is addressed by adopting a social discount rate with the usual adjustments for market distortions. The former, it is argued, cannot be addressed efficiently by choosing a discount rate. Rather some rule for intergenerational wealth transfers is required, independent of the choice of discount rate.... The sustainability literature argues that loading the task of achieving both efficiency and equity goals onto one parameter, the discount rate, is itself inefficient."

This is precisely the position of 'Blueprint for a Green Economy' (Pearce *et al.*, 1989). Here the view is taken (page 150) that the burden of accounting for future generations' interests should not fall on the discount rate. As the OXERA report says, loading the task of achieving both efficiency and equity goals onto the discount rate will not work. However, OXERA go on to argue that '*formulating intergenerational wealth transfer rules is not straightforward. The alternative would appear to be to adopt the same approach as in the past (i.e. use the discount rate to reflect both goals) but not demand the discount rate to be constant through time*'. The problem with this statement is the words in brackets; it is not really true to say the discount rate has been used in the past to pursue both efficiency and equity goals. The justification for discounting has had to do with the objective of economic efficiency only.

WHAT ARE WE PASSING ON TO FUTURE GENERATIONS?

No doubt partly in recognition of the discounting problem, Pearce *et al.* (1989) advocated a policy of passing onto future generations intact the stock of natural capital embodied in the environment. In principle, and given the difficulties of assessing the benefits associated with intergenerational equity, this approach suggests an important role for economists in deploying the tools of cost-effectiveness analysis (CEA) to try to work out how most cheaply to do this. Concepts such as 'safe minimum standards', 'ecological carrying capacity', 'species richness', 'areas of endemism' are determined essentially by scientific and ecological research rather than by economic analysis. Once accepted, the economic problem then reduces to one of how to maintain safe minimum standards most cheaply, how most cheaply to ensure that ecological carrying capacity is not exceeded, and how most cost-effectively to maintain species richness, etc. Although there are no doubt important data prob-

lems to be overcome, conceptually this approach does not appear to present too many difficulties.

However, in economics, conventionally the focus of analysis has been on cost-benefit rather than cost-effectiveness analysis with benefits being defined as the benefits to human beings. This is hardly surprising; economic analysis has traditionally focused on issues to do with use and consumption. Even as long ago as the Old Testament, Genesis 1:28, man was enjoined to '*Be fruitful and increase in number; fill the earth and subdue it. Rule over the fish of the sea and the birds of the air and over every living creature that moves on the ground.*' (NIV Study Bible, 1987).

The problem is that Genesis was written long before the advent of global environmental problems. True, there were unfortunate accidents of nature in those days such as Noah's flood, but nobody suggested such problems were caused by human activities (except in the traditional sense that man was being punished by God for wrong-doing). The first part of the quotation above, in particular, 'Be fruitful and increase in number' seemed axiomatic. In those days, the prospect of global over-population seemed remote if not inconceivable.

Even the advent of the sustainability agenda has not really focused attention on this issue. It is a remarkable fact that the size of the world's human population has never been properly addressed within the context of discussions about sustainable development. It was, for example, not even on the agenda at the Earth Summit in Rio de Janeiro, and this seems to have set some kind of precedent for what has happened subsequently. No doubt the problem is too politically inconvenient to have on the agenda, at least for international negotiations. Yet the next generation is itself a key part of what the present generation is passing on to the future. The Optimum Population Trust (2008) argues that 'based on the best biocapacity and ecological footprint research available' the UK is already 'overpopulated' by 70 per cent. The Trust advocates national strategies on sustainable human population not only in the UK but also in all countries around the world.

POPULATION GROWTH AND AGRICULTURAL DEVELOPMENT

Of course, concern about the size of rate of growth of population is not new. More than two hundred years ago, Thomas Malthus (1798) famously argued that population had a natural growth rate determined by geometric progres-

sion, whereas the natural resources necessary to support the population grew at a rate similar to an arithmetic progression. Without restraints, therefore, there would be continued pressure on living standards, both in terms of room and in terms of output. He advocated moral restraint on the size of families.

The most immediate concern of Malthus was his belief that the supply of food for the human race is inherently inelastic, and that this lack of elasticity is the main factor governing the rate of population growth. Thus, population growth were to be explained as the dependent variable, determined by preceding changes in agricultural productivity which, in their turn, was to be explained as the result of extraneous factors, including the fortuitous factor of technical invention and imitation. From the Malthusian perspective, there is a warranted rate of population increase with which the actual growth of population tends to conform.

Perhaps the most thoroughgoing debunking of Malthus' ideas has been by the Danish economist, Ester Boserup (1965). She argued that the mainline of causation between population growth and agricultural production was opposite to the one espoused by Malthus. In other words, far from agricultural production determining the growth of the human population, the direction of causation was the other way around; on this view, population growth is regarded as the independent variable that in its turn is a major factor determining agricultural developments. As an example she quotes the case of Africa since World War Two where large increases in the population have been facilitated by better health care resulting in lower death rates.

Boserup's thesis can be seen as an example of the old adage that 'necessity is the mother of invention'. Whilst appealing, particularly perhaps to economists, it has a dangerous tendency to encourage complacency. If human ingenuity is always sufficiently great to overcome, through the workings of the market, problems such as ensuring security of food supply, there would perhaps be no need for governments to concern themselves about whether this will be so always and everywhere. Such complacency is encouraged by a view of human population growth that assumes that falling death rates will necessarily be followed, after a time lag, by falling birth rates and that the size of the population will eventually stabilise at a new albeit higher level.[1]

It is possible Boserup **might** be right in her belief that human popula-

1 Even quite early analyses of population trends and birth and death rates suggest that matters may well be a good deal more complicated. See, for example, Deane and Cole (1962) on long run British experience.

tion growth will stimulate necessary improvements in agricultural productivity. However, common-sense – to say nothing of the law of diminishing returns – suggests there must be a limit to how far this process can go. Even if she is correct, it seems clear the costs in terms of environmental degradation will be high. As an example, witness the substantial and widespread reduction and even local extinctions among British farmland bird populations (see, for example, O'Connor and Shrubb, 1986). The widespread threats to tropical rainforests and the species dependent upon them surely need no introduction.

OPTIMUM POPULATION POLICIES

Of course, there is little doubt that discussion of the problem of human population growth very quickly runs into political opposition. It is not necessary to raise the spectre of draconian controls on the number of births per married couple as practised in China for this to happen. The very suggestion that doing something to reduce (the rate of growth of) the human population might be necessary and/or desirable seems to be sufficient to generate opposition among various religious faiths. It is the view of the author that sooner or later, and preferably sooner, this particular nettle will have to be grasped within the context of the sustainability debate.

Unfortunately, economists persist in giving the impression that population policies are not of the highest priority. For example, in the last of his 'Blueprint' books before his untimely death, David Pearce commented:

> 'The debate about the beneficial effects of population change will continue...The question is whether we can expect that level of adaptation to pervade the three billion extra people anticipated to be on earth in 50 years time. Our central massage remains. Gloomy as the prospect is for the world's environments in the face of this increase in human numbers, the prospects are gloomier still if we fail to address the underlying economic causes of environmental degradation' (Pearce and Barbier, 2000:151).

Pearce then immediately went on to discuss the problem of financial subsidies, the implication being there is nothing that can be done directly about population growth so we might as well think about other things! How can such an attitude be justified? Pearce argues (pp 146-7) that a considerable part of the projected population growth will come about because of projected declines in mortality. He also argues that, even if the current number

of children per woman of childbearing age fell to a level where new births just offset deaths, population growth would not stop – population does not stabilise immediately. This is because the effects of past population change still have to work their way through the system. Past cohorts of new births mean large increases in the number of young people and hence a high absolute number of births. At the time Pearce was writing, the UN was projecting fertility rates to fall to 2.1, the replacement rate, by about 2040. Sustained over about 70 years, this projection implied the global population would stabilise at a little over 11 billion by 2100. This implied roughly twice the number of people then alive.

Essentially, the reason for believing fertility will decline is that, as real incomes grow, people choose to have smaller families. This is partly because they see the logic in terms of the costs and benefits of family size, and partly because the need for children as labour and as a means of family care in old age declines. The implication is that one of the surest means of lowering population growth rates is to raise incomes and improve education. However, Pearce's main conclusion is that the world simply has to accommodate a substantial increase in the number of people. Against this, he argues that addressing the many economic causes of environmental degradation will buy time to address the problems brought by a rising population. *"Allowing population to rise above its projected unavoidable level and neglecting to address the underlying causes of degradation is the surest recipe for disaster"* (Pearce and Barbier, 2000:148).

If addressing the problem of world population growth is so important, as it obviously is, the logic is that alternative ways of doing this should be appraised systematically. It is surely not enough to hope the problem will eventually go away as incomes rise and education improves. Population growth is an environmental problem of an immensely serious kind; if possible, it should therefore be addressed as other environmental problems are addressed. What is needed is a serious economic appraisal of the options for population control, from the direct regulation of family size as practised by the state in China to the wide range of policies that might be put in place to raise education and incomes, particularly among women in the Third World. Of course, assessing the benefits of population control is by no means straightforward. Not everyone will accept the approach favoured by the Optimum Population Trust based on biological capacity and ecological foot printing data.

THE HUMAN CONSEQUENCES OF INDUSTRIALISATION

One of the interesting aspects of Boserup's thesis on the relationship between the growth of human population and agricultural development is in the way she tracks the radical changes in human lifestyle. Where population is sparse, shifting cultivation is the most economical way of living. Once population becomes denser, so periods of fallow become ever shorter and the problem of declining soil fertility has to be addressed, usually through the introduction of domestic livestock for manure, etc. Under pressure of increasing population, there is a shift from more extensive to more intensive systems of land use. At a later stage still, increasing specialisation in the use of labour leads to industrialisation.

What Boserup does not do, however, is to draw attention to how this gradual process of industrialisation has tended to divorce humans from their environment. Of course, novelists including, for example, D H Lawrence in 'Women in Love' and composers, notably Richard Wagner in 'Der Ring das Nibelungen', have drawn our attention to the way the process of industrialisation has damaged the human psyche. And 'Death in the City' seems to be something of a favourite subject among theologians (Schaeffer, 1969). Views differ as to how far these are realistic portrayals of what actually happens during industrialisation. After all, it is generally believed that before industrialisation the lot of many was short, nasty and brutish. On the other hand, few would dispute that the traditional lifestyle of the Bushman of the Kalahari or the Indian of the Amazonian rain forest is more obviously in tune with the natural environment than that of the residents of the world's major cities.

Yet, even in the unlikely event it were felt desirable, there can be no going back to traditional lifestyles in the Kalahari or the Amazon. The sight of Bushmen giving up their traditional lifestyle for the paltry material benefits to be had in the townships of Botswana and other countries in the region is a sad one. However, it has to be recognised that they would not have made the change had they not, rightly or wrongly, perceived it as an improvement. No, there can be no going back to traditional lifestyles; once gone, they are gone forever. The problem is how to recapture the sense of humans as an integral part of the environment. One feels that, if it is to be done at all, it will be as a result of starting from first principles. But what are those principles?

HAVING OR BEING

A feature of conventional economics is the extent to which it is focused on what people **have** and **want** rather than on what they **are**. Perhaps the most

fundamental aspect of economic theory has to do with the demand for and supply of goods and services. Yet, once it is accepted that man does not simply make use of the environment but is also an integral part of that environment, the justification for addressing long-term environmental problems using only the tools of conventional economic analysis surely falls away.

A key to this conundrum may lie in the ontological distinction between 'having' and 'being' as analysed, for example by Fromm (1978). On one level, this might appear to amount to no more than playing with language. For example, if I say 'I **have** a body, therefore I cannot actually **be** that body', what on earth do I mean? The foolish response is to ask 'What then **am** I?' And the answer to that question is that the verb 'to be' has no object. On another level, however, this ontological distinction is fundamental. It is the focus of much religious philosophy including; for example, the writings of Thomas Aquinas, probably the most revered religious philosopher of the Roman Catholic Church (see, for example, Coppleston, 1955).

A related issue is the distinction between **how** things happen and **why** they happen. Science has been very successful in explaining **how** things happen. Unfortunately, it has been less successful, and arguably has made no progress whatever, in explaining **why** they happen. There is an ancient distinction in religious understanding between *logos* and *mythos*. Since the time of the Enlightenment and the Industrial Revolution, *logos*, otherwise known as rational argument and logical debate, has been very much in the ascendant. On the other hand, except perhaps in the performing arts, *mythos*, and the belief that man will never explain everything and must necessarily look to myth and legend for guidance, has withered on the vine. Karen Armstrong (2004) argues that religious fundamentalism with its misguided emphasis on the precise meaning of words in the Bible, the Koran, etc has been a direct consequence of this. In a way perhaps reminiscent of C P Snow in 'The Two Cultures', she argues for more balance between the exercise of intuition on the one hand and the deployment of reasoned argument on the other.

Given the extent to which conventional economic analysis is focused on the having mode, this might seem dangerous territory for the economist to try to move into. On the other hand, it might not be too fanciful to suggest that the very fact economists are so focused on matters to do with 'having' provides reason for believing that it might be from among their number that progress on 'being' will ultimately come. For example, Schumacher's book, 'Small is Beautiful', is well known for its radical prescriptions. Yet, his anal-

ysis implies the importance of the distinction between 'having' and 'being'. For example in discussing the essentially economic concept of 'the division of labour', Schumacher contrasts it with what he describes as the Buddhist view of the function of work: to give man a chance to utilise and develop his faculties; to enable him to overcome his egocentricity by joining with other people in a common task; and to bring forth the goods and services needed for a becoming existence (Schumacher, 1973).

Strictly speaking, only the last of these has to do with the role of the division of labour in the efficient production and distribution of goods and services (although many employers would be interested in the others as a way to maintain a contented workforce). The truth is that Schumacher in 'Small is Beautiful' was not entirely clear about the distinction between personal philosophy on the one hand and economic and political philosophy on the other. However, it might be significant that his next book, 'A Guide for the Perplexed', was explicitly about religious belief and personal philosophy (Schumacher, 1977).

CONCLUSION

The publication of the Brundtland report in 1987 has focused attention among policy-makers, as never before, on the interests of future generations. Traditionally, of course, this is a subject in which everybody has a stake, if only because of their interest in their children's future. Economists setting out blueprints for sustainable development have interpreted the interests of future generations in terms of passing on a stock of natural capital; in other words in terms of environmental conservation as a merit good. As such, they have interpreted the problem of sustainable development as implying the need for government intervention, and they have sought to deploy the tools of option appraisal and CBA to justify it. It is the contention of the author that the tools of CBA, being grounded in the theory of welfare economics, and therefore conducted in the interests of the present generation cannot really hope to meet sustainability objectives. For example, simply tinkering with the discount rate in the interests of future generations will not work. Emphatically, however, this is **not** to argue for the jettisoning of CBA altogether. Two distinct possibilities present themselves:

- if, for reasons of market failure to do with the prisoner's dilemma, information deficiency, etc., the market does not deliver an eco-

nomically optimum level of environmental conservation even for the present generation, option appraisal and CBA might have an important role in trying to ensure that it does; and

- if, on the other hand, governments conclude – as they seem to have done since Brundtland - that environmental conservation is not simply a matter of economic optimality and market failure but also a matter of intergenerational equity, then some conservation goods at least will be treated as 'merit goods'. And the efficient provision of such merit goods, once it is established precisely what they are, is a matter for CEA rather than CBA.

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2

Sustainable Consumption and Subjective Well-Being: Is Pro-Environmental Behaviour Utility-Maximising?

Heinz Welsch - Jan Kühling

ABSTRACT

This paper studies whether pro-environmental consumption is consistent with utility maximisation and what role the consumption behaviour of reference persons and one's own past behaviour play in this context. By combining data on pro-environmental consumption from a unique data set with data on subjective well-being, we find that people could attain higher well-being (utility) by consuming in a more environmentally friendly manner while reducing the *quantity* consumed. The distortions identified are smaller when people's reference persons consume more environmentally friendly and when the individual has a longer environmental friendly consumption history. We therefore conclude that learning from one's own past consumption experience and the consumption behaviour of others may help alleviate decision-making errors.

Keywords: sustainable consumption, consumer choice, utility maximisation, well-being, life satisfaction

INTRODUCTION

Following the famous definition of sustainable development by the World Commission on Environment and Development (1987), sustainable consumption can be defined as consumption that satisfies the consumption needs of present generations without compromising the needs of future generations. In a pragmatic view, sustainable consumption is consumption which is environment-friendly and resource-conserving. In this sense, examples of sustain-

able consumption goods include organic food, energy-saving consumer durables, and energy from renewable resources.

From the point of view of economics, sustainable or pro-environmental consumption falls into the category of private provision of a public good. As argued by Andreoni (1990), an important motive for such behaviour is the 'warm glow of giving'. While some other motives of consumption are 'extrinsic' (such as a desire for status and prestige), the warm glow motive is 'intrinsic', i.e., the corresponding behaviour yields utility due to an internal reward associated with the behaviour itself.

This distinction is important because research in behavioural economics has produced evidence of an asymmetry between extrinsically and intrinsically motivated activities. While people get habituated to the former, this does not seem to apply equally to the latter (Frey and Stutzer, 2004, Meier and Stutzer 2008).[1] Moreover, people seem to have difficulties in anticipating the habituation effect when making choices, which is an example of utility misprediction or incorrect affective forecasting.[2] An immediate consequence of incorrect affective forecasting is that people's choices turn out, ex post, to be not utility maximising. Non utility-maximising decisions due to unforeseen habituation arise, e.g., in work-leisure choice (Layard, 2007).

Systematic misprediction of utility, obviously, presupposes that people are not sufficiently able to learn from experience. Utility misprediction is therefore less likely to occur in repetitive choice situations than in the case of unfamiliar choices. While it has been argued that there may be little learning even in some of the former cases (Frey and Stutzer, 2004), it is nevertheless plausible that experience should reduce forecasting errors and the associated decision errors. Moreover, in addition to learning from their own experience, people may learn to some extent from the experience of others.

This paper studies whether pro-environmental consumption is consistent with utility maximisation and what role the consumption behaviour of reference persons and one's own past behaviour play in this context. Conceptually, a simple test of whether a choice is utility-maximising involves checking whether people could raise their utility by choosing differently, within the boundaries of their budget constraint. Empirically, such a test requires hav-

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1 Psychologists refer to habituation as hedonic adaptation (see Frederick and Loewenstein 1999 for a review).

2 See Loewenstein and Adler (1995), Loewenstein and Schkade (1999), Loewenstein *et al.* (2003), Wilson and Gilbert (2003).

ing an appropriate proxy for utility. This paper uses data on self-reported subjective well-being (happiness, life satisfaction) as an empirical approximation to experienced utility.[3]

By combining well-being data with data on pro-environmental consumption in the region of Hanover, Germany, we find that people could attain higher utility by consuming in a more environmentally friendly way while at the same time reducing the *quantity* consumed in order to satisfy their budget constraint. The distortions identified are smaller when people's reference persons (friends, neighbors, relatives) consume more environmentally friendly. Sub-optimal choices of environmental friendliness may thus decrease as environmental-friendly consumption becomes more widespread in society. We also find evidence that the distortions decrease when the individual has a longer environmental friendly consumption history. Our qualitative results are robust to controlling not only for individual socio-demographic characteristics but also for personal attitudes and values.

While the implications of findings from behavioural economics for environmental economics and policy have attracted some attention in recent years, similar issues as those studied in this paper have rarely been addressed in the literature. Ferreira and Moro (2010) use happiness data to study whether the utility equalisation condition of the hedonic pricing model is satisfied. Frey and Stutzer (2004) and Stutzer and Frey (2010) apply well-being regressions to investigate whether commuting choices are utility-maximising. Similarly, Welsch and Kühling (2010) study whether some forms of pro-environmental consumption are utility maximising. Given data limitations, however, they are unable to address the issue of learning from past behaviour and the behaviour of reference persons.

The paper is structured as follows. Sections 2 and 3, respectively, present the theoretical and empirical frameworks. Section 4 presents the empirical results. Section 5 concludes.

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3 Following much of the literature, we use the terms 'subjective well-being', 'happiness', and 'life satisfaction' interchangeably. Using data on subjective well-being permits to separate consumption decisions from the utility thereby produced, that is, 'experienced utility'. Using subjective well-being data follows a recent line of research in economics (see Frey and Stutzer, 2002, Layard, 2005, Di Tella and MacCulloch, 2006, Bruni and Porta, 2007). A thorough discussion of the relationship between 'utility' and 'happiness' and of methodological issues in using happiness data is provided by Frey and Stutzer (2002) and Clark *et al.* (2008). Using subjective well-being data in environmental economics mainly refers to environmental valuation (see Welsch and Kühling, 2009 and Ferreira and Moro, 2010).

THEORETICAL FRAMEWORK

Effects of Unforeseen Habituation

We start by setting up a simple illustrative model which shows how unforeseen habituation to the level (quantity) of consumption may bias the choice between the quantity and the quality (environmental friendliness) of consumption. Consistent with the literature discussed in the introduction, we assume that habituation is stronger with respect to quantity than with respect to quality.

We consider the following utility function:

$$u = U(z, q) = U(Z(x,),q), \tag{1}$$

Where u is utility, q is an index of environmental friendliness, x denotes the quantity consumed, and the increasing and concave sub-utility function $Z(x)$ takes habituation into account. The utility function $U(z,q)$ has the usual properties of monotonicity and strict concavity

$(U_z > 0, U_q > 0, U_{zz} < 0, U_{qq} < 0, U_{zq} = U_{qz} > 0)$.[4]

Habituation implies that a person evaluates her current consumption level relative to her past consumption level. For illustrative purposes, we specify a simple linear form $z = x - \alpha\, x_{-1}$, where the parameter $\alpha \in (0,1)$ measures the strength of the habituation effect.

We assume that the individual's income y is exogenous and that the unit price of the quantity consumed is a function of environmental-friendliness:

$$p = P(q),$$

Which is strictly positive, increasing and strictly convex:

$$P(0) > 0, P_q > 0, P_{qq} > 0.$$

The budget constraint can then be stated as follows:

$$P(q) \cdot x = y.$$

4 We use subscripts to denote partial derivatives.

Rearranging allows us to express the quantity as a function of income and quality, which is increasing in the first and decreasing in the second argument:

$$x = \frac{y}{P(q)} =: X(y,q) > 0, \quad X_y > 0, X_q < 0. \tag{2}$$

To demonstrate the choice implications of unforeseen habituation, it is important to note that the utility function in (1) refers to *experienced utility* (the ex post hedonic quality associated with an act of choice) whereas choice itself depends on the *decision utility* function, which describes the ex ante expectation of experienced utility (Kahneman *et al.*, 1997). When the decision maker takes habituation correctly into account, the two concepts coincide.

We first consider a 'naïve' decision maker, who disregards the habituation effect and acts as if $\alpha = 0$ (or $z = x$). She thus strives to maximise the decision utility function $u = U(x,q)$ with respect to x and q subject to the budget constraint. The first order conditions of this optimisation problem can be rearranged to yield

$$U_z \frac{P_q x}{P} = U_q.$$

Since, from equation (2), $P_q x / P = -X_q(y,q)$, this can be restated as

$$U_z(-X_q) = U_q.$$

In this condition, $-X_q$ is the amount of quantity foregone (due to the budget constraint) in response to a marginal increase in q. The condition says that for a utility maximum the marginal utility of increasing q (right hand side) should be equal to the marginal utility of x foregone (left hand side). This condition together with the budget constraint determines the quantity-quality configuration (x,q). Assuming that income is constant, x and q will be constant.

In contrast to the above scenario, a 'sophisticated' decision maker will take the habituation effect into account. With constant income, x and q will again be constant in a steady state, that is, $x = x_{-1}$. The problem to be solved is thus to maximise $u = U(x - \alpha x,q)$ with respect to x and q subject to the budget constraint. The first order condition now is

$$U_z(1-\alpha)(-X_q) = U_q. \tag{3}$$

It is obvious that the marginal utility of quantity foregone (left hand side), against which the marginal utility of quality (right hand side) has to be balanced is now smaller. Given the strict concavity of the utility function, this implies that the quality is larger than in the scenario of 'naïve' optimisation, whereas, due to (2), the quantity is smaller.[5]

A similar logic applies when the habituation effect is not entirely but only partially disregarded, that is, if the decision utility function involves a smaller habituation parameter $\alpha\% \in (0,\alpha)$ than the experienced utility function. A smaller 'assumed' habituation parameter means that the marginal utility from quantity is over-rated when the decision is made. As the consumer ultimately evaluates her choice not according to the decision utility function but according to the experienced utility function, the chosen quantity-quality configuration is not utility maximising.

The assumed asymmetry in terms of (unforeseen) habituation between quantity and quality implies the hypothesis that pro-environmental consumption may be less than utility maximising.

A Test of Utility Maximisation

The preceding subsection has presented a rationale for why people may choose levels of environmental friendly consumption that are not utility maximising according to their own hedonic evaluation. Our aim is now to gain empirical evidence on whether or not pro-environmental consumption is utility-maximising. This will involve a test of whether a condition like equation (3) holds, though without restricting the function $Z(.)$ to the linear specification chosen for the purpose of illustration.

Our empirical approach will involve estimating a life satisfaction function which includes indicators of pro-environmental consumption q among the arguments. Since we have data on income y but not on the quantity x, we will replace x according to the relationship $x = y / P(q) = X(y,q)$ stated in equation (2). Hence we get a reduced-form utility function defined as follows:

$$U(Z(x),q) = U(Z(X(y,q)),q) =: V(y,q).$$

5 This conclusion presumes that quantity and quality are sufficiently substitutable for each other.

The analog to condition (3) then is

$$U_z Z_x X_q + U_q = V_q = 0. \quad (4)$$

Assuming that the property $V_{qq} < 0$ holds, the condition $V_q = 0$ determines the utility maximising value of environmental friendliness, q^*. If at some observed value q^o, condition (4) fails to be satisfied, observed choice is not utility maximising. Moreover, $V_q(y,q^o) > 0$ (<0) implies $q^o < q^*$ ($q^o > q^*$), as illustrated in **Figure 1**. The sign of the derivative $V_q(y,q^o)$ will thus allow us to determine the direction of decision error, that is, whether the choice of pro-environmental consumption is distorted downwards or upwards (if at all). The magnitude of the derivative $V_q(y,q_o)$ measures the size of the decision error.

EMPIRICAL FRAMEWORK

The Data

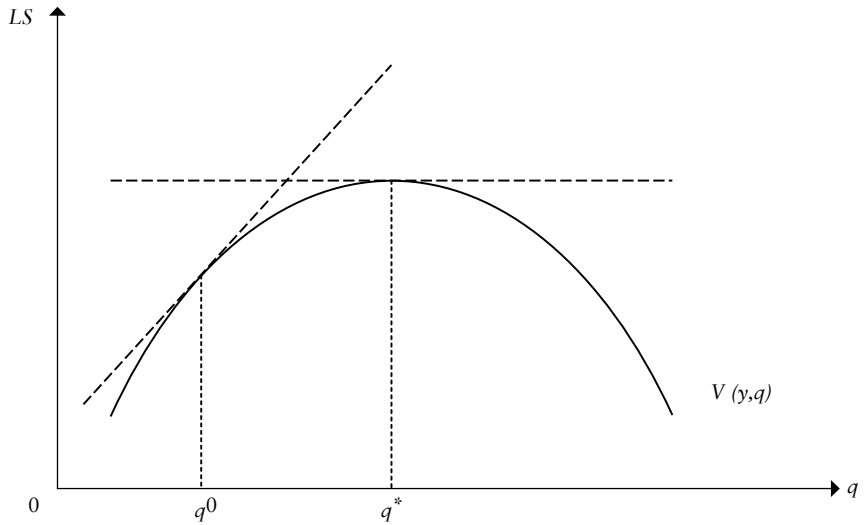
Our empirical analysis is based on a survey conducted from July to September 2007 in the region of Hanover, Germany (Clausen, 2008).[6] The sample consists of 494 valid observations.

One set of items in the survey refers to respondents' socio-demographic characteristics (age, sex, marital status, household size, employment status, housing situation, educational attainment, health status, household income) and their environment-related attitudes. Household income is measured on a scale from 1 to 10, which refers to 10 income brackets (from less than 1.000 to more than 5.000 Euros per month). Environmental attitudes are captured by respondents' opinions on the severity of environmental problems, the necessity of a change to renewable energy sources, and the danger from nuclear power. In addition, we control for materialistic attitudes, which are captured by a question on how much respondents enjoy consumption.

With respect to pro-environmental consumption, the survey includes questions on whether respondents buy organic food, low-energy light bulbs, and low-energy household appliances, whether they possess a solar thermal unit, and whether they are subscribers to 'green' electricity. Respondents who buy organic food shall state whether they do so 'sometimes', 'often' or 'al-

6 The region of Hanover has about 1.1 million inhabitants, of which about 500.000 live in the city proper.

FIGURE 1
Reduced-Form Utility Function: Net Utility from Pro-Environmental Consumption



Note: u = utility, q = intensity of pro-environmental consumption.

ways', and, in cases 'often' and 'always' for how long they have been buying organic food ('less than one year', ..., 'more than 10 years'). People were also asked to state whether their friends and relatives display those types of pro-environmental behaviour.

In order to construct an indicator of the intensity of pro-environmental consumption, we coded the consumption-related responses as binary variables in the following way. Organic food: no = 0, yes = 1; low-energy light bulbs: no = 0, yes = 1; low-energy appliances: no = 0, yes = 1; 'green' electricity: no = 0, yes = 1; solar thermal unit: no = 0, yes = 1. Our index of *p*ro-*e*nvironmental *c*onsumption (*PEC*) is then defined as the sum of those binary variables: *PEC* = organic food + low-energy light bulbs + low-energy appliances + 'green' electricity + solar thermal unit. *PEC* takes the values 0, 1, 2, 3, 4, 5.

In addition to the consumption-related items, the survey includes a 10-point life satisfaction question of the following form: "All things considered, how satisfied are you with your life as a whole these days?" Respondents are presented a scale from 1 to 10, where 1 is labeled "not at all satis-

fied" and 10 is labeled "very satisfied" and are asked to indicate their level of satisfaction using that scale.

The Empirical Model and Strategy

We assume that life satisfaction of individual i, LS_i, can be explained according to the following model:

$$LS_i = \alpha \cdot INCOME_i + \beta \cdot PEC_i + \gamma \cdot CONTROLS_i + \varepsilon_i \quad (5)$$

Equation (5) gives the empirical analog to the reduced-form utility function, linearised at the point of observation.

The vector of CONTROLS comprises socio-demographic characteristics (age, sex, marital status, household size, educational attainment, health) on the one hand and indicators of attitudes (pro-environmental attitudes, non-materialistic attitude) on the other hand. Attitude indicators are included because attitudes may be correlated with both life satisfaction and pro-environmental behaviours, such that their omission leads to biased estimates.

The crucial parameter in the above specification is the coefficient on PEC. This coefficient measures the derivative of the reduced-form experienced utility function, that is, the marginal utility from pro-environmental consumption net of the marginal disutility from quantity foregone. As explained in subsection 2.2, utility maximisation would imply that this net marginal utility be zero. In the event of utility maximisation, the coefficient on PEC should thus be insignificant.

The basic model stated above will be augmented to include interactions of pro-environmental consumption with education levels, attitude indicators, the pro-environmental consumption of friends and relatives, and the history of the respondents' pro-environmental consumption behaviours. Such interactions permit to check whether, if at all, distorted choice is linked to education levels, attitudes, and the behaviour of others and of oneself in the past.

The model from equation (5) will be estimated by means of an ordered profit maximum likelihood estimator.

EMPIRICAL RESULTS

Table 1 presents the results of several versions of our life satisfaction regressions formulated in equation (5). The results concerning the control variables (not shown) present no surprises: life satisfaction is positively related to

health and being female, and there is a U-shaped relationship of life satisfaction to age. These findings are consistent with other data sets for industrialised countries (see Frey and Stutzer, 2002), which enhances confidence in the quality of our data.

Concerning our main variables of interest, regressions (1) – (4) in Table 1 contain positive, significant coefficients for income and for the index of pro-environmental consumption, PEC. This applies both to the basic regression (1) in which PEC appears only in uninteracted form, and to regressions (2) – (4) in which there are several interaction terms with PEC. The significantly positive coefficients on PEC are consistent with the idea that people could raise their satisfaction by consuming in a more environmental friendly way while reducing the quantity consumed. The coefficient on PEC is larger when the education level (EDU) and an interaction of PEC with education are included (regression (2)). In this case, the coefficient on the education level is significantly positive, while the coefficient on the interaction term is weakly significantly negative. Similar results are obtained when we include a proxy for non-materialistic attitudes (NONMAT) and a corresponding interaction term with PEC (regression (3)).[7] In terms of our theoretical framework, decision error to the disadvantage of pro-environmental consumption thus seems to be smaller in better educated and less materialistically oriented people.

While similar results as these have already been obtained in other data sets (Welsch and Kühling, 2010), the unique data base used in this paper allows us to investigate the possibility of peer influence on decision error. As seen in regression (4) in Table (1), pro-environmental consumption of reference persons (PEERS) is significantly positive while its interaction with PEC is highly significantly negative. The latter indicates that people seem to commit smaller decision errors (to the disadvantage of environmental friendliness) if their reference persons consume more environmentally friendly.

Besides peer influence, the second main focus of this paper is on people's own consumption history. As described in the data section, we have data on how long people have been consuming organic food. As seen in regression (1) in **Table 2**, the coefficient on the intensity of organic food consumption, OFC (never, sometimes, often, always), is insignificant. When we extend this regression to include organic food consumption of PEERS (regression (2)), we get the same sign pattern as in regression (4) in **Table 1**: positive

7 That materialistically oriented people are less happy has been found by Sirgy (1998).

TABLE 1
Estimation Results for Index of Pro-Environmental Consumption

	(1) Basic regression	(2) Regression controlling for education level	(3) Regression controlling for non-materialistic attitude	(4) Regression controlling for pro-environmental behaviour of reference persons
INCOME	0.107 (4.17)	0.105 (4.13)	0.106 (4.00)	0.112 (3.89)
PEC	0.123 (2.09)	0.420 (2.29)	0.454 (3.11)	0.395 (2.87)
PEC*EDU		-0.524 (1.71)		
EDU		0.223 (2.13)		
PEC*NONMAT			-0.105 (2.49)	
NONMAT			0.179 (1.28)	
PEC*PEERS				-0.176 (2.71)
PEERS				0.563 (2.53)
Demographics	yes	yes	yes	yes
Env. Attitudes	yes	yes	yes	yes
N	392	392	392	321
Pseudo R2	0.1038	0.1063	0.1037	0.1057

Dependent variable: Life satisfaction. Method: ordered profit (z-statistics in parentheses)
(PEC = pro-environmental consumption; EDU = education level; NONMAT = non-materialistic attitude; PEERS = pro-environmental consumption of reference persons)

TABLE 2
Estimation Results for Organic Food Consumption

	(1) Basic regression	(2) Regression controlling for pro-environmental consumption of reference persons	(3) Regression controlling for duration of pro-environmental consumption	(4) Regression controlling for pro-environmental consumption of reference persons and duration of pro-environmental consumption
INCOME	0.111 (4.47)	0.120 (4.74)	0.108 (3.33)	0.110 (3.30)
OFC	-0.030 (0.38)	0.221 (0.87)		
OFC2			-1.191 (1.44)	0.322 (0.24)
OFC*PEERS		-0.218 (1.32)		-0.948 (1.70)
PEERS		0.812 (1.70)		1.359 (2.19)
OFC2*HISTORY			0.239 (1.28)	0.275 (1.46)
HISTORY			-0.310 (1.46)	-0.368 (1.71)
Demographics	yes	yes	yes	yes
Env. Attitudes	yes	yes	yes	yes
N	416	396	263	257
Pseudo R2	0.096	0.104	0.106	0.117

Dependent variable: Life satisfaction. Method: ordered profit (z-statistics in parentheses)
(OFC = organic food consumption (never = 1, sometimes = 2, often = 3, always = 4); OFC2 = organic food consumption (often = 0, always = 1), PEERS = organic food consumption of reference persons; HISTORY = duration of organic food consumption)

coefficients on one's own consumption of organic food and on organic food consumption of PEERS, and a negative interaction term between the two.

Though the coefficients on OFC and its interaction with organic food consumption of PEERS are insignificant, this sign pattern supports our main conclusion concerning the influence of PEERS. Regression (3) refers to people who buy organic food 'often' or 'always' (binary variable OFC2) and includes an indicator of how long they have been buying organic food (HISTORY) together with an interaction term. Again, the coefficients are insignificant. In spite of that, the signs of the coefficients suggest that people might initially consume too environmentally friendly, relative to their utility maximum (negative coefficient on OFC2) and get closer to the optimum with increasing experience (positive coefficient on OFC2*HISTORY). The variable HISTORY has a negative coefficient.

In regression (4) in **Table 2** we include peer consumption and the length of the pro-environmental consumption history jointly. The signs of the coefficients are consistent with regressions (2) and (3). In addition, the OFC2*PEERS interaction is now weakly significant. Overall, regression (4) in Table 2 supports the evidence from regression (4) in Table 1 that peer influence alleviates the tendency to consume too environmentally unfriendly, whereas the length of the pro-environmental consumption history alleviates any tendency to initially consume too environmental friendly, all relative to the utility maximum.

CONCLUSIONS

This paper has explored the hypothesis that, due to an asymmetry in unforeseen habituation, decision error may bias consumer choice against pro-environmental consumption. We tested this proposition by combining data on pro-environmental consumption with data on subjective well-being elicited in the region of Hanover, Germany in 2007. We found that people could attain higher utility by consuming more environmentally friendly while reducing the *quantity* consumed in order to satisfy their budget constraint. This evidence suggests that the intensity of pro-environmental consumption is less than utility maximising. The utility bias is smaller in better educated and less materialistic people.

While this evidence is consistent with some earlier literature (Welsch and Kühling, 2010), a novel finding of this study is that the utility bias is smaller the more environmental friendly is the consumption of people's refer-

ence persons. Moreover, in the case of organic food, there may be an initial 'excess consumption' which decreases with experience. Overall, we therefore conclude that learning from one's own consumption history and the consumption behaviour of others may help alleviate utility misprediction and its consequences.

Rather than being mere empirical peculiarities, our results are consistent with literature which suggests that hedonic adaptation applies more to the quantity consumed than to the environmental friendliness of consumption. Following Scitovsky (1976), people quickly get bored by 'more of the same' consumption (bigger houses, bigger cars) which ultimately will not add a lot of satisfaction. Moreover, the two dimensions of consumption affect our self-image differently (Laaksonen, 1994). The satisfaction from consuming 'more of the same' (quantity) derives from upholding our self-image as people of higher status and is constantly undermined by other people matching or overtaking us. By contrast, the 'warm glow' from consuming in accordance with our self-image as people who 'do the right thing' (quality) may be less affected by such an erosion. In addition, the quality dimension (environmental friendliness) is less visible than the quantity dimension and should therefore weigh less heavily in positional competition (Frank, 2007).

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3

Sustainable Development of Gender in the Labour Market in Lithuania

Aistė Dromantaitė

ABSTRACT

Alongside political, economic, social, cultural, information reforms not only in Lithuania, but all over the world, demographic processes are changing; as well – the number of people is increasing, migration is increasing and populations are rapidly aging. Other problems such as discrimination by gender, race, and/or religious beliefs; integration into society of disabled and convicted persons released from prisons; migration processes; lack of employment; versatile work; viewpoints; rethinking of values abound. However, the current period of economic crisis can change viewpoints regarding most of these issues.

In Lithuania gender discrimination is forbidden by law, therefore some opinions happen to be that no problems of gender discrimination exist. However, despite legislative progress, a number of indicators show that a considerable gap between formal and real gender equality is prevailing. In other words, gender equality *de jure* and *de facto* are not identical in Lithuania.

Globally, women increasingly tend to participate more actively in decision making at a management level thus in such a way strengthening positive changes in economic, social, public and political fields. However, this is less evident in Lithuanian civil society; women in Lithuania are taking part in democratisation processes insufficiently, and due to ingrained gender differences women's potential as leaders in the nation's economics, business and politics is not appreciated enough. Women's intellectual potential and input in not only the country's competitive ability is not sufficiently utilised. Thus

problems existing in different areas show that gender topics are still relevant and contain questions that still need to be tackled. In this article the gender situation in the Lithuanian labour market and participation of women in decision-making processes are analysed, also issues of gender equality in respect to family policy is introduced, and results concerning the empirical study on "Sustainable Development of Gender in the Labour Market" are presented. The object of this research is the different approach of both men and women to gender inequality, discrimination, and careers in the Lithuanian labour market. The aim is to analyse the factors governing/influencing gender inequality, discrimination regarding gender, together with career obstacles as the result of gender. The methods used include analysis of scientific literature resources and comparative analysis of statistical and secondary data.

Keywords: Sustainable development, gender, equal opportunities (jobs), labour force, stereotypes, management.

INTRODUCTION

Gender In/Equality

The aspect of gender equality encompasses various fields – economics, sociology, philosophy, history, psychology, etc. Scientific methods related to gender equality encapsulate and question both theoretical and practical issues in a broad sense regarding economic, social and governmental policies. Gender equality is understood as one of the fundamental principles of democracy in Lithuania, and it is based on equal rights, responsibility, and opportunities for genders in all spheres of life as well as equal behaviour for both sexes. It is one of the main objectives for economic, social and democratic development. The equality of men and women is essential for Lithuania's economic growth. Gender equality standards are a part of both primary and secondary EU law, which is embedded in EU treaties and directives then transferred to the legislation of EU member-states. The 13th article of the Treaty of Amsterdam adopted in 1997 has empowered the Council of Ministers to take appropriate actions in fighting discrimination regarding gender, race or ethnic origin, religion or beliefs, disability, age or sexual orientation. The main guidelines of EU equal opportunities policy that are formed according to the given situation in the area of employment are:

- Overcoming the gender gap,
- Combining family life and work,
- Facilitating (re)integration into the labour market,
- Assisting various social groups integration into the labour market.

The sphere of employment, though having a tendency to improve in a quantitative sense, still remains discriminatory. The inequality that forces women to choose between work, career and family is increasing. Thus the situation for women in the labour market is complicated by low employment, high poverty levels, and women's qualifications and resources being used ineffectively. The main reasons for this are believed to be the absence or unpopularity of flexible systems, lack of childcare and non-stationary social services for individuals nursed in families.

Therefore basically the aim of equal rights is to organise work to employ various flexible systems, ensure gender equality in employment, providing work-related guarantees, seeking to minimise differences in income while combining work and personal life and paying adequate attention to child care, etc. In other words, to pursue balanced gender representation providing equal opportunities to both men and women in the political, social, economic, cultural and informational context.

Situation of Women in the Lithuanian Labour Market

Based on data taken from Department of Statistics to the Government of the Republic of Lithuania in 2011 the estimated number of women in Lithuania was 53.6% of the population (116 women per 100 men). Since 1990 this indicator has changed only slightly – from 52.7% in 1990 to 53.3% in 2002; and from 2002 to 2006 it remained unchanged at 53.4%. In 2008 the number has increased by one more tenth of a percentage point (53.5%) and currently remains stable. This proportion in Lithuania and other European Union countries is very similar: in 2007 EU women comprised 51.7% of all population, whereas in Lithuania – 53.4%. While being the country's majority, women still are in a worse situation than men in both the public and private sectors.

Based on data taken from the Department of Statistics, women in Lithuania are still more educated than men: according to data from 2010 the number of men with higher education were 217,7 thousand whereas 330,2 thousand, or 67% of women had been education to a higher education standard. Participation of women in decision making processes is still insufficient

and it is characteristic of the majority of the countries in the world, in which men dominate decision making and management structures; Lithuania is not an exception.

In countries were women prevail in governmental positions, the priorities in politics are changing, women's interests are better protected, striving to make both genders feel safe. In the democratic society all citizens must take part in decision-making processes – both men and women. Both genders should have their representatives in governmental positions. Equal participation of men and women in decision making is not just a demand for simple social justice or democracy, it is a basis for clear and responsible government, with a gender balance reflecting the structure of a society. The equal participation of both genders in formulating policies and providing solutions helps to reflect the diversity of a society. Women's representation in all levels of authority is still insufficient; however the situation is notably changing: in 1992-1996 there were 10 women in Seimas (Lithuanian Parliament), comprising only 7.1% of the whole. The number of women elected into Seimas has increased from 7% in 1992 to 22% in 2004. In the 14th Cabinet women comprised one third of it as ministers, vice-ministers and secretaries. However, in the 15th Cabinet there was only one woman minister, and in 2007, 22% of elected women comprised municipality councils. In the European Parliament the distribution of members is also not representative: in 2004 there were 4 women (38.4%) and 8 men (61.5%), and in 2009 there were only 3 women (25%) and 9 men (75%). Therefore, participation of women in decision making in all levels in Lithuania is insufficient. Women do not make a visible impact on politics. In a global context Lithuania is currently in 63rd place according to the number of women elected in the national Parliament, while Rwanda, Sweden, South Africa, Cuba and Ireland are the top five. In 2006 Lithuania was in 38th place.

In the past work activities more or less defined an individual's status in society. In general work is a way to meet ones needs in private life. In modern society the economic system and shifting structure of opportunities creates alternatives in choosing different ways of needs' fulfilment. Decreasing birth rate, the phenomenon of marriage aging, higher level of women education and their activity in the labour market are indicators of this. Both men and women have been constantly working throughout history, however the available work and its pay depended more on cultural labels of a *man's* job and a *woman's* job, not from their individual aptitudes.

After Lithuania's independency the shift into market economy has intensified the question of discrimination. A great decline in employment of women was observed: women comprised only two thirds (68%) of total employed. A number of women after long and fruitless job searches have given up to register in local labour exchanges and decided to become housewives or continued to work in the 'grey economy' which has had a great impact on employment in the early stages of economic reforms. The role of women working in the national economy has started to decline. However, political, economic and social reforms have caused fundamental changes – the production decline had an impact on the decreasing number of employed, ultimately increasing unemployment rates. Employment gender gap differences were 8.3% smaller in Lithuania than the average index of all EU member-states, but from 2001 this number is increasing. In 19 countries of 25 member-states of the EU this index is changing in favour of women, however, in Lithuania as well as Czech Republic, Latvia, Poland, Slovakia, and Sweden it is increasing.

Statistical data shows, that the number of women, who dominate in the public sector, especially in spheres of health care, education and other 'feminine' activities, is decreasing. The data also shows women are increasingly occupying 'masculine' areas such as financial intermediation, provision of electricity, gas and water, etc. Still the private sector is considered a man's area. Thus a few reasons for a slower occupation of private sectors are distinguished:

- Patriarchal traditions and attitudes of our society: 'asymmetric' roles played in families (women are responsible for child care and housework), prevailing stereotypical attitude towards abilities of men and women
- Unfavourable business environment caused by corresponding governmental economic policy: permanent changes in laws, high taxes, lower availability of financial resources to women, etc
- Usually women's abilities to start and develop their private business are limited by the lack of knowledge, information, personal experience, specific skills in doing business

While analysing the distribution of labour force in public and private sectors, apparently more women than men are working in the public sector. In 2008 in the public sector women comprised 66.6% of the workforce, in

comparison more than half of the people employed in the private sector (57.1%) were men. Therefore, the public sector remained a more feminised area, however, a fair amount of statistical data show that women are especially discriminated against there.

In relation to pay concerning men and women, a clear-cut distinction can be noticed. Though women have a higher education level compared to men, they still are dominating in a constricted, poorly paid, limited in the terms of career development professional environment (in health, education, hotels and restaurants and other public, social and personal services). It has been proven statistically that women get paid less than men – in 2007 the average gross female wage in manufacturing and services was 9.57 litas, compared to 12.66 litas for male workers (in 2006 it was respectively 8.11 and 10.41 litas). Almost in all spheres of economic activities where women dominate, the average monthly earnings are one of the smallest (see **Table 1**).

Statistics from Lithuania show that average gross monthly earnings for the whole economy (less individual enterprises) in the fourth quarter of 2010 amounted to LTL 2121.5 and, compared to the third quarter of 2010, increased by 1.9%. In the fourth quarter of 2010, average gross monthly earnings in the public sector* amounted to LTL 2251.2 and, compared to the third quarter of 2010, had increased by 3.4%. And in the private sector LTL 2032.5 in the fourth quarter, compared to the third quarter of 2010, showed an increase of 0.8%.

Average net monthly earnings for the whole economy (less individual enterprises) in the fourth quarter of 2010 amounted to LTL 1649.8, (in the public sector – LTL 1744.4, in the private sector – LTL 1584.8). In the fourth

TABLE 1
Average Gross Monthly Earnings in Economy Sectors, LTL*

	Economic sectors		Public sector		Private sectors	
	Women	Men	Women	Men	Women	Men
2000	956	1170	980	1272	918	1087
2005	1230	1493	1290	1654	1168	1421
2006	1432	1743	1510	1913	1356	1677
2007	1677	2115	1740	2193	1621	2087
2008	2020	2505	2139	2685	1916	2440
2010	1844	2151	2038	2461	1668	2029

(*) Less individual enterprises. Source: *Statistical department data, 2009* [Labour statistics. Earnings in 2009. http://www.stat.gov.lt/en/news/view?id=9621].

quarter of 2010, compared to the third quarter of 2010, average net monthly earnings increased: in the whole economy – by 1.8%, in the public sector – 3.2%, in the private sector – 0.7%. Over a year, net earnings increased in the whole economy and in the public sector by 0.1 and 1.8%, respectively, while in the private sector it decreased by 0.9% (**Table 2**).

RESEARCH RESULTS

In order to see what respondents think about the whole gender inequality problem in Lithuania regarding different aspects of discrimination, employment in the labour market, professional careers, etc., a study 'Sustainable Development of Gender in the Labour Market' was conducted. Closed questions were submitted in the questionnaire, making the questionnaire probabilistic, the elements chosen were different gender groups: men and women.

Only the fundamental part of the study is presented in the article. The study was conducted using the concept of triangulation, when descriptive scientific theoretical analysis is combined with an interactive written questionnaire. The data was processed using SPSS 16.00 software (Statistical Package for the Social Sciences) and statistical data analysis was performed according to certain recommendations.

The main aims while comprising the questionnaire were:

1. To assess the influence of gender and age of respondents on their view that gender inequality does not exist in Lithuania.
2. To find out the reasons that the respondents think are influencing the gender inequality in Lithuania.
3. To see how respondents evaluate the situation of men and women in different social areas of life.
4. To find out respondents' opinions regarding governmental measures used to promote gender equality.

The following hypotheses were raised:

H_1 – the attitude towards gender inequality depends on the gender itself;

H_2 – attitude towards gender inequality depends on the age;

H_3 – if more women participate in politics, gender equality would become more balanced.

The study was conducted by putting the questionnaire on the website www.manoapklausa.lt, that is, the questionnaire was conducted online: the link was sent via e-mail and published in a public social network. The study was conducted from the 23rd of March 2010 to 11th of October 2010.

The Socio-Demographic Characteristics of Participants

355 people were questioned who were distributed across age groups as follows: 20-25 years old – 9.2%, 26 – 30 years old comprised 21.1%, 31-40 years old - 57.8% of total respondents, 41-50 years old – 9.8% and older than 51 – 2%. 302 or 84.1% of them were women and 53 or 15.9% were men (N = 355). The respondents were distributed according to their geographical position into districts and grouped respectively as follows: respondents from Vilnius district comprised the biggest number – 54%, Kaunas – 21%, Klaipėda and Marijampolė districts – 7%, Šiauliai district – 5%, Utena and some participants currently living abroad comprised 2% (N = 350).

TABLE 2
Indices of Average Monthly Earnings* by Sector and Sex of the Employees, for the Fourth Quarter of 2010

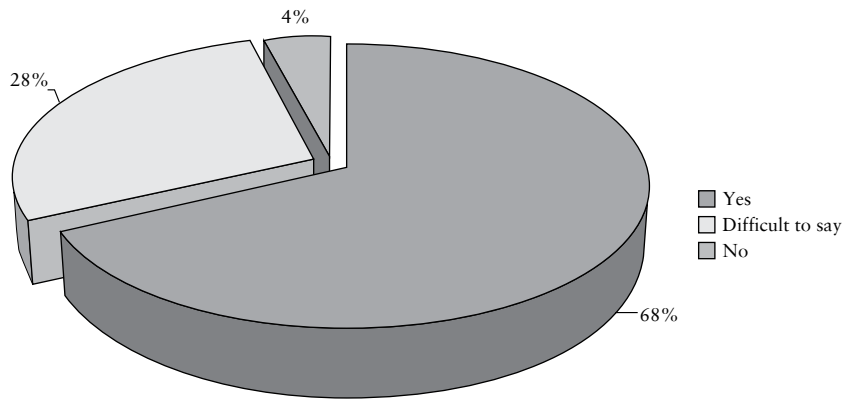
	Previous quarter - 100 per cent			Respective quarter of the previous year - 100 per cent		
	Total	Males	Females	Total	Males	Females
Gross						
Whole economy	101.9	101.5	102.4	100.2	98.5	101.5
Public sector	103.4	102.3	104.0	101.9	100.9	102.5
Private sector	100.8	101.0	100.5	99.0	97.6	100.6
Net						
Whole economy	101.8	101.4	102.2	100.1	98.5	101.4
Public sector	103.2	102.2	103.7	101.8	100.9	102.3
Private sector	100.7	100.9	100.5	99.1	97.7	100.5
Real						
Whole economy	100.8	100.4	101.2	97.1	95.5	98.4
Public sector	102.2	101.2	102.7	98.7	97.9	99.2
Private sector	99.7	99.9	99.5	96.1	94.8	97.5

(*) Less individual enterprises. Source: *Statistical department data, 2010* [Labour statistics. Earnings in IV quarter 2010.http://www.stat.gov.lt/en/news/view?id=9621].

Attitudes Towards Gender Inequality

68% of the people who answered the question "Is there gender inequality in Lithuania?" have answered "yes", 28% found it difficult to answer and only 4% think that "no". Both men and women answered this question differently. 62.5% of women believe that gender inequality exists, 13.6% to this question answered negatively, 23.9% of women were undecided. Men answered the question differently than women. Only 35.5% of men think that both genders are treated equally, 16.1% of men do not see gender inequality in Lithuania, and almost half of male respondents (48.4%) were undecided. Therefore, the first hypothesis stating that the attitude towards gender inequality depends on the gender itself is proved: points of view of men and women regarding the matter vary. Women tend to believe that gender inequality exists in Lithuania, however, noticeably fewer men agree with that (**Figure 1**).

FIGURE 1
Answers About Gender Inequality in Lithuania, percentage



Men and women of different ages answered the same question differently. Both men and women aged 15-24 tend to believe that gender inequality still exists, that is 29.2% of women and only 20% of men think that gender equality exists. Most of the respondents of this age (both men and women) remain undecided. Even 71.7% of women aged 25-54 agree that gender equality does not exist, 15.2% replied that is does exist and 13% are undecided. 39.3% of men aged 25-54 think that gender equality does not exist, 17.9% think it does and 42.9% remain undecided. 66.7% of women aged 55-64 and

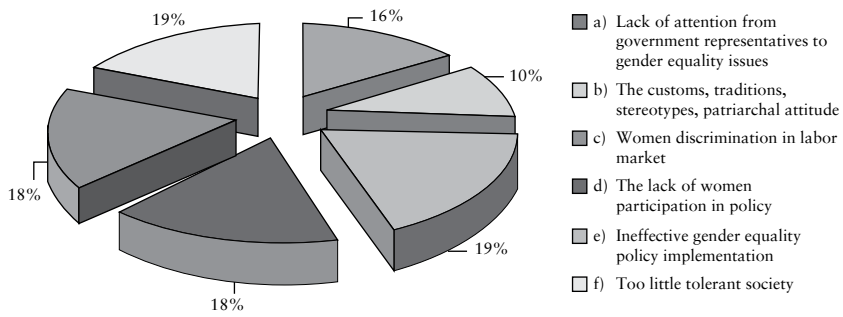
77.8% of men of the same age stated that gender equality does not exist. 11.1% of women in the same group and none of men thought differently.

Younger respondents show a lower tendency to think that gender equality exists. Most of the respondents in this group remain undecided regarding the matter. This distribution of answers can be determined by less life experience. Women in the group aged 25-54 think that men and women have different opportunities in life, many men in the same age group think the same, however many (42.9%) remain undecided. Most men having this opinion were in group aged 55-64. Therefore a conclusion can be drawn and the second hypothesis proved that age also determines the viewpoint about gender equality.

Factors Affecting Gender Mainstreaming

The joint most important factors regarding gender mainstreaming in Lithuanian women were identified as 'discrimination in the labour market' and 'too low tolerance of the society'. 19% of respondents replied for both these options. Both the fact that 'too few women take part in politics' and 'ineffective implementation of gender mainstreaming policy' were distinguished in joint second place, 18% of respondents choose each. The third group of factors which was distinguished by 16% of respondents and was 'too little attention paid to gender equality issues by government representatives' and finally 'customs, traditions, stereotypes and patriarchal attitudes' were listed by 10% of respondents (**Figure 2**).

FIGURE 2
The Most Important and Influencing Factors to Gender Mainstreaming Identified by Questionnaire Respondents (percentage)



All the factors mentioned were distinguished almost proportionally, thus a conclusion can be drawn that there is not one single factor causing the issue. It is a complex problem. If one of these factors is not overcome, it is impossible to solve the other ones. It could mean that all the factors should be dealt with simultaneously, because they are interconnected. Greater attention paid to gender equality issues in different spheres could reduce the inequality problem and government representatives shaping society's views and attitudes should consider and address the problem's complexity.

The Status of Men and Women in Various Social Spheres

The study was aimed at finding out how respondents judge the situation of men and women in various fields of life. Most of them (77%) think that men tend to pay too little attention to housework and child care compared to women. The number of men and women of this opinion was the same. 64% of respondents think that women are undervalued by their employers compared to men. Only one per cent less (63%) of respondents state that women are discriminated against more at work than men. And 61% of respondents believe that women's contribution to the economy is undervalued.

The Assessment of Measures Promoting Gender Mainstreaming

While noting different opinions of men and women to gender equality issues, work, employment, career and discrimination, we had to consider the present social and economic situations, linking it to stereotypes in society and objective and subjective obstacles preventing personal improvement. The existing stereotypes as a simplified image of a group or its members, prevailing opinions in a certain community inevitably influence career possibilities both of men and women. For instance, organisations have unwritten norms for not appointing women to higher positions because women managers are seen as being unreliable and having characteristics of risky management leading to failure. This is likely due to the stereotypical view of management positions as being 'masculine'. Berthoin & Izreali (2006) state that *"the main and only obstacle for women management (...) is an extant stereotype that management is associated with a man"*. The image of a woman is constructed as responsible, attentive, care-giving personality and these qualities have nothing in common with the qualities of a rational, powerful, strict manager and leader.

Women tend to work in non-prestigious, non-influential positions having less power and opportunities, that is, they experience 'structural dis-

crimination' in their working environment. As one of the obstacles in professional careers a 'glass ceiling' phenomenon should be distinguished, by which structural, artificial, invisible obstacles prevent well-educated and qualified women from developing careers and achieving higher posts. They are invisible boundaries or limits, which cannot be crossed due to partial attitudes of the society, false evaluation of competences, aspirations and constructed structures of cultural oppression of women. It should be noted that this huge difference between management positions of men and women cannot be explained only by their personal qualities, and that these discriminating policies are pursued by organisations themselves, influential persons and, of course, entrenched stereotypes and archetypes (Kanter, 1993, 1997). Therefore both objective and subjective obstacles exist in most societies creating discrimination factors and others. For instance, as it was mentioned before, women enter the labour market having a higher education compared to men, however, despite these apparently positive factors, female employment is still in a worse condition in certain spheres.

When answering the question "who can pursue a career easier – men or women?" half of respondents answered "men" – 50%, "both men and women" – more than one third chose (38.7%), and 0.8% of respondents thought that "women" could pursue a career more easily. 10.5% did not have a clear opinion (N = 350) (**Figure 3**). Being asked about obstacles regarding women pursuing professional careers, most respondents believed that mainly the obstacles were were family and children (65.1%). Lack of confidence was named as the main obstacle by 22.9% of respondents (N = 309) (**Figure 4**).

Due to one of the core obstacles to careers for women being identified as combining family and professional life, that is why it is very important to apply flexible working hours thus creating the possibility to combine personal life and work. It is also very important to harmonise objective and subjective factors: to develop women's strengths and leadership skills, abilities to risk and face challenges and opportunities. Usually women in management positions, having achieved professional career heights, better financial positions and status of greater responsibilities face various other factors that impede effective work and professional development. One of the reasons is a fear of greater responsibility. Women tend to see those obstacles as barriers in a negative sense, whereas men see them as professional challenges and receive them more positively compared to women (Ohlott, Ruderman and Mc-

FIGURE 3
Responses to the Question "Who Reaches the Career Easier – Men or Women?" (percentage)

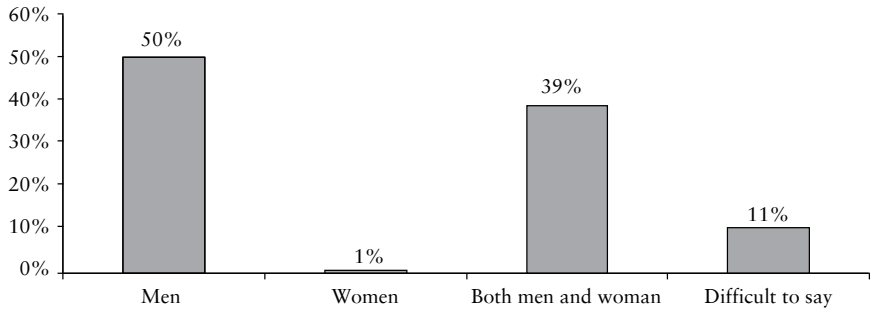
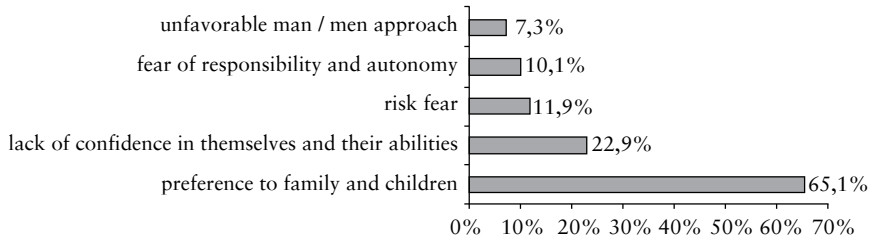


FIGURE 4
Factors Hampering Women to Pursue Professional Career, Distribution of Responses (percentage)



Cauley, 1994). Thus such obstacles prevent women from professional careers, risky positions and prestigious posts. These obstacles force women to undervalue themselves, think that they do not deserve better achievements. However, they tend to resent feeling undervalued and unnoticed by their employers (Hesse-Biber and Carter, 2005). Therefore on one hand women do not want management positions, not because of the family obligations or alike, but due to the fact that management is connected with risk, big responsibility, power of solutions, rationality and their depreciation of themselves.

On the other hand the pursuit of career is a difficult job, requiring physical and psychological efforts among women themselves. According to Shannon Goodson, women careerists who do not support each other have also influenced that. Women who have succeeded in breaking through that 'glass ceiling' usually do not try to help other women having the same aims.

"Women who want to be appreciated in their professional lives must learn to help each other". The existing misogyny in a career world also strongly limits their possibilities. For instance, most women over 40 strike the 'glass ceiling' when they have a well-established career, competence and ability to hold responsible jobs, however are refused such positions because of their gender or age. Usually the career proposal is seen, according to Fraizer and Hunt (1998) as being of 'golden value' or as a 'poison cup'.

Therefore, it is difficult to pursue a career because of artificial obstacles, as well as strongly established and hardly overcome stereotypes in a society. And if women succeed in reaching professional heights, they achieve that not only for having certain abilities, professional knowledge, competence, but also by investing twice as much effort and time, sometimes even postponing starting a family as long as they qualify in their organisation.

Besides, one of the aims of this study was to find out the respondents' assessments of governmental measures promoting gender equality in Lithuania. 97% of respondents think that it important to strive for equal pay for both men and women. 92% of all respondents believe that greater education in gender equality issues is needed. The third distinguished the condition – to enable women to take part in top level management. This category was chosen by 86% of all respondents. Other responses were distributed as follows:

- 84% singled out the encouragement of men participation in family life
- 79% proposed that women and men should share housework equally
- 75% recommended to improve conditions for women using financial resources
- 72% proposed that women should have better possibilities to participate in politics

Due to the fact that most respondents were women, it is possible to say that they are more interested in the implementation of measures promoting gender equality issues. Therefore the last hypothesis can be proven, that if more women could actively participate in politics it could balance gender equality in Lithuania more effectively.

CONCLUSIONS

Different changes in Lithuania are affecting gender related problems and integration. Gender mainstreaming strategy is a very important and relevant document which must be implemented in the economic, social and public levels. It includes planning of political processes, reorganisation, development, expansion, assessment at such a level that would place gender equality in all political spheres in all levels, at all stages by all representatives.

The EU has committed to eliminate reasons for gender inequality, the gender aspect is integrated into all legal documents and policies. The new Social Cohesion Strategy of the Council of Europe is one of the fundamental measures ensuring the priority to gender equality. Sustainable development of the economy depends on a sustainable society which is achieved by having balanced equal rights of both men and women. Although the EU gives clear standards for gender equality balance, in Lithuania gender policy issues are treated superficially. Lithuania was the first in Central and Eastern Europe to adopt the Law on Equal Opportunities for Women and Men, however, gender issues were and still are not the most important question in making macroeconomic policies. Lithuania still needs a lot of effort in order to coordinate gender aspect integration strategies with EU directives and achieve equality in all spheres of life.

In order to solve gender equality problems in a consistent, integrated and systematic way, ensuring integration of gender aspects and showing the specific problems of men and women in Lithuania, the National Program for Equal Opportunities was implemented from 2004. However, the measures planned are more of a onetime nature. This problem should not be solved only on the social level through dealing with ensuring of rights and opportunities for men and women. The formed content of gender roles is connected with cultural and economic factors. Attempts should be made to encompass as many spheres as possible, including macroeconomic, due to the fact that patriarchal attitudes and stereotypical roles of men and women jobs, huge disposition among the economic situation of men and women are still prevailing. The strategy of balanced gender aspect requires absolute involvement of men and women in all spheres of life, including decision-making processes. However, the conducted study shows that the number of women in different levels of authority is still insufficient.

The aforementioned analysis of statistical and questionnaire data has proven that despite different positive changes when, for example, a number

of women with higher education is increased, a significant gap between male and female pay and unequal positions in the Lithuanian labour market can be observed. A range of indicators from the labour market i.e. unemployment, occupation, and pay, vertical and horizontal segregation of the labour market, support this conclusion. Also the situation of women in the labour market is more complicated due to the fact that a woman consciously and unconsciously is forced to choose between the children and her career. One of the main reasons for that is unpopularity of flexible systems, lack of child care and non-stationary social services for individuals nursed in families.

Even in the present day a stereotypical view of a woman's role in a family exists and sometimes it creates obstacles regarding integration into the labour market; besides a low level of public awareness regarding gender equality and possibilities is noticeable. It is often claimed that male and female inequalities in society are natural and normal; also the implementation of efficient gender equality policy lacks effective measures. The conducted study, which aimed at analysing how respondents evaluate equal male and female opportunities in Lithuania, showed that 68% think gender inequality exists in Lithuania. The distribution of answers also revealed that women tend to underestimate themselves and do not believe in their abilities. However, women are more actively concerned with implementation of governmental measures compared to men. Thus to summarise it should be stated that distortion of gender equality still exists in Lithuania.

SUMMARY

Social changes taking place in Lithuania are changing the problem of gender dimension and its integration in society. Strategy of gender mainstreaming integration requires the full participation both of women and men in all fields of life, decision making process included. However the statistical data of the research shows that representation of women in all levels of governmental structures is insufficient. Quite a big gap between possibilities for men and women seeking professional careers, and in gender equality in general is noticeable. In this empirical study the women position in labour market, their participation in decision making process and equal gender opportunities with regard to family policy are analysed. The goal of this research was to clarify the attitude of local self government, NGO and business representatives on women and men equal opportunities in Lithuania.

The study showed quite a significant gap existing in men's and wom-

en's wages, and in general, a different gender positioning in the labour market in Lithuania. Women's situation in the labour market is more complicated because they often are forced to choose between children and a career. The absence of flexible policy systems, the lack of childcare services and ambulatory social security for disabled persons in families are a few of the main reasons causing such a situation. Existing stereotypes of women's role in the family also prevent women's integration into the labour market. The questionnaire revealed that women are more inclined to underestimate themselves and that they do not rely on their own skills. However, they are more interested than men in more active implementation of governmental measures to promote gender equality.

In conclusion we can summarise that a gender equality gap still exists in Lithuania.

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CHAPTER 2

Knowledge to Action

Edited by
Katherine A.T. Eames

Chapter Introduction

Katherine A.T. Eames

Governments, organisations and individuals are giving increasing attention to achieving environmental, social and economic sustainability. Climate change, the widening gap between the rich and poor and the recent global recession indicate how far we still have to go towards these goals. Universities have always played their part in the challenges that face our societies and therefore should try to take a leading role in both research and education on sustainability.

At present universities around the world are already making efforts to be more sustainable in the way their estates are run, how they are constructed and how and what they teach. By their nature universities provide the information that their students will require in their future careers. As such they have a uniquely important role and major responsibility in developing sustainability as they educate the decision makers of tomorrow and research the solutions to some of the biggest challenges global society has ever faced. However, despite their prominent role for the discourse there is still considerable scepticism whether universities have so far taken the challenges that are connected with the subject of sustainability sufficiently seriously.

This chapter explores some of the ways in which the research knowledge that is amassed in universities is being passed on to our students and staff and translated into actions for a sustainable world. Burkšaitienė & Šliogerienė's work (page 39) opens the path for a wider access to a university education by looking at how best to acknowledge learning of a university

level that is not gained within the walls of a university. This wider access could also open the possibility of more innovative teaching methods, as well as broader and freer access to learning while not altering the value of a university qualification. The challenge of including sustainability into a university qualification is investigated in the second paper in this chapter (Eames, Mose & Taylor, page 49) which looks at the different approaches taken by Oldenburg and Kingston Universities to including sustainability in their curricula, and the complications that arise in this endeavour. Sayce & Farren-Bradley (page 59) look at the challenges still to be overcome in removing disciplinary boundaries as sustainability requires multi- and inter-disciplinary collaborations. By not addressing this at an educational level these boundaries can still be found to be quite solid, particularly within the built environment fields. The chapter ends with two practical examples of knowledge to action. Gant & Towers (page 69) show the ultimate benefits of a multidisciplinary approach to sustainability, in this case social sustainability. The project brings together students and staff from different disciplines to interact with the local community to collect information on the perception of safety before passing this knowledge on to local governments to assist their decision making in creating a better society for the students to inhabit. Antoni-Komar, Pfriem & Schattke (page 77) conclude this chapter with a comparison of the communication systems used in sharing sustainability best practice within the meat industry in North-western Germany. The benchmarks used by the companies investigated consider not just the internal processes of the companies but also how their customers behave and make decisions, showing the importance of sharing information and also of considering all the pertinent angles to an issue in order to get the desired result.

The work presented in this chapter looks at a suite of different ways in which knowledge is gained and then informs action. Universities have long been an important part of the development and sharing of our global knowledge. The work presented here covers some of the central ideals of sustainability i.e. equal opportunities, collaboration, education, social cohesion and open communication, demonstrating the breadth of work being done in this field at the Dorich House Universities and the developments towards sustainability that have already been made.

1

Assessment and Recognition of Non-Formal and Informal Learning at University in Lithuania

Nijolė Burkšaitienė - Jolita Šliogerienė

ABSTRACT

Assessment and recognition of non-formal and informal learning at university has become a reality worldwide. The present paper discusses the results of literature and document analysis of the processes of assessment and recognition of non-formal and informal learning in different countries, as well as the research into the need of adults to have their non-formal and informal learning assessed and recognised at university. It was found that the view of adults towards the possibility to have one's non-formal and informal learning outcomes assessed and recognised at university was highly positive. The findings lead to the conclusion that in Lithuania, a need exists of assessing and recognising adults' learning outcomes gained in four areas, mainly in the area of management, social work, psychology, and foreign languages.

Thus, the present research confirms that there is a need to create a system of assessment and recognition of non-formal and informal learning at universities in Lithuania.

Keywords: Assessment and recognition of non-formal and informal learning at university, new role of universities, research on the needs of adults

INTRODUCTION

During the last two decades, assessment and recognition of non-formal and informal learning at university has become a reality in many countries worldwide, including European Union countries where methodologies of assessment of learning outcomes gained through different non-academic

learning environments have been created. Concurrently systems of identification, assessment and recognition have been introduced at all levels of education, and methods of assessment have been established.

In Lithuania, assessment and recognition of non-formal and informal learning at university is making its first steps. This is due to a variety of reasons, among the most important being the lack of legal regulation (until December 2010), lack of information available to the academic community, and the fact that not all university study programmes were learning outcome-based. The *problem the present research* deals with is how to identify, assess and recognise learning that occurred outside the university and which system of assessment and recognition, including the procedure, stages of assessment and methods of assessment, should be adopted at universities. The *research aims* to investigate the processes of assessment and recognition of non-formal and informal learning at university in different countries, and to establish the need for assessment and recognition of this kind of learning in Lithuania. The methods employed in the research include analysis of literature, laws and documents on education policies, and quantitative methods of study (including a survey and statistical data analysis).

Terminology

Analysis of available literature and documents of institutions related to quality assurance for higher education as well as documents of institutions that have already established the procedure of assessment and recognition of non-formal and informal learning revealed that a number of terms exist that are used to describe the process (**Table 1**). Therefore, it is important to note that while describing the process, it is necessary to clarify what is meant by the terms used, or which country's experience is being discussed, because the terms may not hold the same meaning in different countries.

As **Table 1** illustrates, even within the same country (e.g. the UK) different terms are used to describe the process of assessment and recognition of non-formal and informal learning. An overview of available literature and documents revealed that in the UK four of the terms ("Accreditation of prior experiential learning", "Recognition of prior uncertificated learning", "Recognition of informal prior learning", and "Recognition of prior experiential learning") are used for learning for which no certificates are issued (QAA, 2004). The term "Accreditation of prior learning" means learning for which certificates are issued, and can be used in two different contexts. Firstly, it

TABLE 1
Terms Used in Different Countries

Acronym	Term	Country
APL	Accreditation of Prior Learning	UK
APEL	Accreditation of Prior Experiential Learning	UK, USA, Sweden
RUPL	Recognition of Prior Uncertificated Learning	Scotland (UK)
RIPL	Recognition of Informal Prior Learning	Scotland (UK)
RPEL	Recognition of Prior Experiential Learning	Scotland (UK)
PLA/APL	Prior Learning Assessment /Assessment of Prior Learning	USA
PLAR	Prior Learning Assessment and Recognition	Canada
RPL	Recognition of Prior Learning	Australia, Republic of South Africa
VAE	La Validation des Acquis de l'Expérience	France
RPL	Recognition of Prior learning	The Netherlands

may mean transfer of credits from one level of education or institution to another (certificated learning); secondly, it may be used to describe assessment and recognition of learning that occurred in institutions of non-formal education (which also includes certificated learning). What is more, different terms are used to describe the process itself, i.e. "recognition" and "accreditation", therefore, it should be taken into consideration that the term "recognition" has a wider meaning than the term "accreditation", because the accreditation of learning is a form of its recognition.

Table 1 also illustrates that two terms are used in the US. The term "Prior learning assessment / Assessment of prior learning" is meant for the description, documentation, measurement, assessment and credit award of learning that occurred outside academia (Flint *et al.*, 1999). The term "Accreditation of prior experiential learning" specifies the process described in the first term, i.e. it means that experiential learning can be assessed and recognised at university. Thus, it is used for what is described by the term "Accreditation of prior experiential learning" in the UK (Whitaker *et al.*, 2006). In Canada and the Netherlands, the term "prior learning" covers learning that may be acquired through formal, non-formal and informal study (Day, 2000; Danish Ministry of Education, *et al.*, 2004). It is interesting to mention that the term "La Validation des acquis de l'Expérience" defining learning gained through experience is prescribed by the national law in France.

In the present study, the term "non-formal and informal learning" is used to define learning gained through different non-academic learning environments that are outside formal institutions of education and training and

includes both certificated and non-certificated learning. Non-formal learning includes workplace learning and training (both certificated and non-certificated), learning and training in different courses, seminars and workshops provided by institutions of non-formal education, and learning through active participation in various organisations, associations, parties and unions, etc. Informal learning is learning which, unlike non-formal learning, is not organised, not planned, is related to a person's free time activities or hobbies, etc and is never rewarded with a certificate.

ASSESSMENT AND RECOGNITION OF NON-FORMAL AND INFORMAL LEARNING: A CHALLENGE FOR UNIVERSITIES

In many countries, universities are facing radical changes that are due to the challenges of the new millennium: a growing demand to become institutions capable of adapting to the rapid changes of the postmodern world of work where knowledge has become the most important source of competitiveness, and human intellectual resources are considered to be capital equal to land (Field, 2002), a marked shift in the numbers of non-traditional age, i.e. adult students, and the necessity to assess and recognise their prior learning that occurred outside academia (Knapper & Cropley, 2000).

An overview of available literature revealed that since the last decade of the 20th century, universities worldwide have witnessed increasingly growing numbers of adult learners, e.g. in the US, the number of 25-year-old and older learners accounted for 45% of the total number of all college learners (CAEL, 1999) and by now this number may already exceed 50%. In 1999, 53% of applications received by universities in South Australia were from adults who had not been enrolled to higher education institutions until 1998 (Knapper & Cropley, 2000). A similar situation has been observed in countries that do not have long traditions of higher education (e.g. some Scandinavian countries). Recently the number of adult learners in these countries has been rising, too (Parjanen, 1993, cited in Knapper & Cropley, 2000). An exception is Norway, where more than 10 years ago a system of enrollment to a college or university was adopted which was based on assessment and recognition of non-formal and informal learning of adult learners who are 25 and older (VOX, 2002).

Statistical data show that the current situation in Lithuania is similar. It has been estimated that in the academic year 2003/2004 the number of

non-traditional age learners in formal education institutions was 67,900, with 60% of them being university students, which accounted for 34.7% of the total number of university learners in the country (Zuzevičiūtė, 2005).

Unlike students who traditionally enter after finishing secondary school, adult learners applying to a university possess learning outcomes gained through different learning environments. Thus a new role for universities emerges, i.e. to make their shift from one sector of education to another smooth, to bridge the world of work and the university by providing access to higher education, and establish a procedure of assessing and recognising this kind of learning. As it is reported in the available literature, this proves to be a real challenge due to several reasons. First, universities have to make an important decision before adopting a procedure of assessment and recognition of non-formal and informal learning, i.e. to acknowledge that learning is a value that does not depend on the environment in which it occurs and that learning gained through non-traditional study routes may be equivalent to learning acquired at university. Second, members of academia have to discuss a particularly important issue – how does one assess learning that occurred outside the institution without diminishing the quality of university studies, or in other words, how does one ensure that learning which is recognised is in fact equivalent to academic level learning? Thirdly, the decision requires thorough preparation and resources, including human, financial, infrastructural and time resources necessary for the creation and maintenance of an administrative unit that is responsible for the implementation of the procedure, creation of support systems available for adults at university, for establishing what is going to be assessed, setting assessment criteria, training consultants and assessors as well as informing the public about the new possibility that is available to adult learners. The most time-consuming activity is the assessment process, especially if an adult makes a claim for more than 50 credits (Garnett *et al.*, 2004). Fourthly, assessment of non-formal and informal learning at university is a new and specific task, because traditionally learning assessed at university has been provided to university students by university teachers at university, whereas learning that occurred outside the university has never been organised according to university study programmes, and its outcomes are not always easily defined (Boud, 2001, cited by Costley & Armsby, 2007). Finally, it is likely that adults who have never been members of the student community will not have acquired the academic language typical to the study

subject, which may lead to a difficulty in translating learning outcomes into academic discourse (Peters, 2005).

Assessment and recognition of non-formal and informal learning has also been a challenge for universities in Lithuania because at the time of the research, a system of assessment and recognition of such learning covering all levels of education had not been created, therefore, no university in the country had any experience in assessing and recognising learning outcomes gained through non-academic learning environments. However, it is important to stress that for over a decade it was researchers working for universities who not only investigated this area, but also initiated and put forward proposals to the Ministry of Education and Science on closing the gap in the area of legal regulation. It must also be mentioned that at the time of this research, there was no empirical proof that a need existed for assessing and recognising non-formal and informal learning of adults at universities in Lithuania. Under the circumstances, the present research was a timely attempt to contribute to the process of development of the system of assessment and recognition of non-formal and informal learning at university.

Preconditions of Assessment and Recognition of Non-Formal and Informal Learning at University

Literature and documents reveal that there are several factors that exist, the role of which has been crucial for the development of systems of assessment and recognition of non-formal and informal learning at universities worldwide. Higher education policy and political decisions made in this area have undoubtedly been of utmost importance. In the EU, the role of implementing, valuing, assessing and validating learning that occurred outside formal institutions of education and training has been underlined by policy makers on both the European and national levels. As a result, legal acts regulating the process have been adopted and benchmarks and methodologies have been created at the national level. Therefore, during the last decade many countries in Europe have implemented systems of assessment and recognition of non-formal and informal learning at the universities.

An overview of the systems of identification, assessment, recognition and validation of non-formal and informal learning implemented in higher education institutions worldwide shows that although the experience, advancement, aims and methods as well as terminology describing the process vary across the countries, the principles underlying the process are common (Day,

2000, EAEA, 2004, SCQF, 2005; Whitaker *et al.*, 2006; Bjornalvold, 1997; Colardyn, 2002). Based on the analysis of the documents established by the American, Canadian, British and French education policy makers and institutions, the following principles are considered to be fundamental for universities preparing to assess and recognise non-formal and informal learning:

Principle 1: universities can assess and recognise learning that occurred in any non-academic learning environment. This principle is based on the fundamental premise that learning can occur in various learning environments, including the workplace, training courses, seminars and workshops, through active participation in different organisations, institutions and (or) political groups, through voluntary work, self-study, in institutions of non-formal education and training, etc.

Principle 2: at university only **university level learning and its outcomes,** but not experience itself, can be assessed and recognised. It means that academic credit will not be awarded for an adult's life or work experience no matter how long it may be. It also means that learning that occurred outside academia may be assessed and recognised only if it has been established that its outcomes are equivalent to the learning outcomes gained through traditional study routes.

Principle 3: proof of learning outcomes is necessary. A university can recognise an adult's non-formal and informal learning only if s/he can present substantial proof of its outcomes. Certificates (e.g. issued for learning in different training courses), diplomas, results of official tests (e.g. tests carried out at one's workplace), employer's recommendations, samples of work, video and audio materials, etc may be presented as samples of proof. To ensure validity while assessing proof, it is necessary that different experts apply the same assessment criteria. According to O'Grady (1991), all assessors participating in the assessment process must consider five criteria: authenticity, actuality, relevance, adequacy, and variety.

The authenticity criterion is applied to establish if the proof presented by the adult to the university provides enough grounds to

believe that the adult has gained the learning outcomes s/he claims to have. The actuality criterion is used to establish if the learning outcomes are important at present. The criterion of relevance is applied to decide if the proof corresponds to the competence, standard, category or level the recognition of which is claimed. The criterion of variety is used to find out if the adult has used learning outcomes in an adequate number of situations and environments.

Principle 4: clear assessment criteria must be established. According to the British Quality Assurance Agency (QAA) (2004), assessment of learning that occurred outside academia must be based on the same criteria as the assessment of learning that occurred within academia. As the university is held responsible for maintaining the high quality of university studies, it should establish clearly formulated assessment criteria that will be used to assess adults' non-formal and informal learning, ensuring that assessment criteria are comparable against the learning outcomes presented in the study programme. The university should present assessment criteria to adults in a clear form and ensure their consistent application. In other words, assessment criteria must measure the level of proof against the learning outcomes of the study programme expressed in the form of knowledge, skills and competencies.

Principle 5: limitations of the procedure. This principle ensures university autonomy in making decisions and maintaining the quality of university studies. The experience of different universities where non-formal and informal learning is assessed and recognised shows that universities may establish limitations of the procedure, i.e. universities may decide on the maximum number of academic credits an adult can claim, on the study programmes that will not be subject to the assessment process, etc. For instance, in the US, Canada, Australia and the UK, the maximum allowed number of academic credits that adults can be awarded varies from 25% to 60% of the total number of academic credits in the study programme; however, in France, there is no limit in the awarding of credits, which means that adults can make a claim for being awarded with a Bachelor's or Master's degree.

Principle 6: assessment of non-formal and informal learning is open to internal as well as external scrutiny. This principle ensures transparency of the procedure of assessment of non-formal and informal learning at university. In Lithuania, the procedure of assessment and recognition of such learning (beginning from 15 December 2010) is carried out in accordance with the recommendations of the Ministry of Education and Science. All decisions on the assessment and recognition of learning that occurred outside academia made at university are open to scrutiny exercised through the procedure of appeal existing at university which is the same for both students taking the traditional study route as well as adults.

ORGANISATION OF RESEARCH, PARTICIPANTS, AND RESULTS

The present research was carried out in 2006-2008 with a total of 1253 respondents who were representatives from the four major regions of Lithuania – Vilnius, Klaipėda, Kaunas and Šiauliai as well as from some smaller towns. At the time of the research, there were participants who were both employed (in private companies and state enterprises, educational institutions, and voluntary organisations) and unemployed (among the latter there were adults who were registered at the labour exchange, as well as those who were not registered). All adults claimed to have participated in lifelong learning processes and had gained learning outcomes through different non-academic learning environments.

An analysis of the demographic data from the research entitled *The Need of Assessment and Recognition of Non-formal and Informal Learning Outcomes at University in Lithuania* revealed that there was no statistically significant difference in the distribution of respondents according to their place of work in Vilnius, Klaipėda, Kaunas and Šiauliai regions. There were statistically significant differences in the distribution of respondents according to their education among the regions. The findings also showed that more than 50% of respondents did not work according to their qualification, the biggest number of respondents among them being the youngest participants of the research (25 years old and younger). The results of the comparisons of respondents who did not work according to their qualification among the age groups led to the assumption that adults who belong to this age group are po-

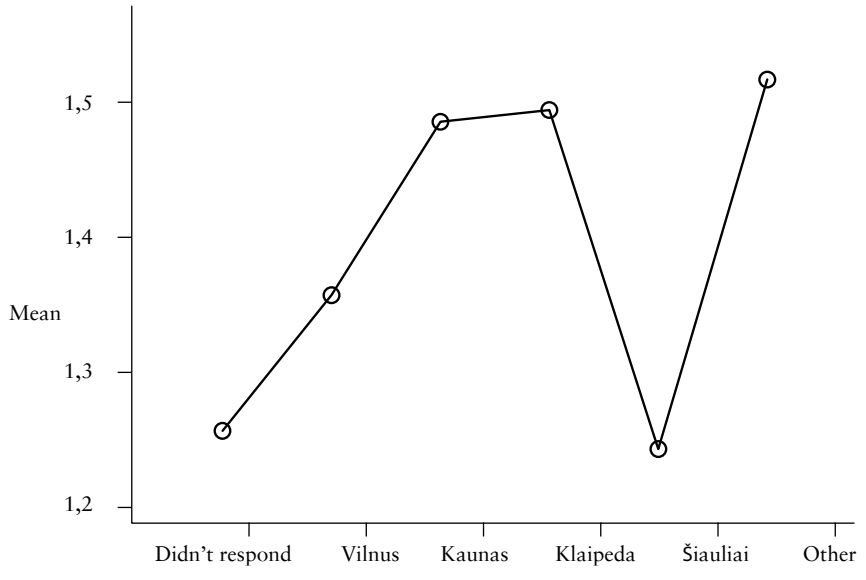
tential candidates for the procedure of assessment and recognition of non-academic learning at university.

Adults' Views Towards the Possibility of Assessment and Recognition of Non-Formal and Informal Learning Outcomes at University

The research findings show that adults' views towards the possibility to have one's non-formal and informal learning outcomes assessed and recognised at university was highly positive. However, adults' desire to go through the procedure of assessment and recognition of non-formal and informal learning at university differed among the regions, with the difference being statistically significant, which means that if universities implemented the system of assessment and recognition of non-formal and informal learning outcomes, the level of adults' participation would differ depending on region (**Figure 1**).

Factors influencing the respondents' view towards the possibility to take part in the procedure of assessment and recognition of non-formal and informal learning were analysed, and the statistical significance was calculat-

FIGURE 1
Respondents' wish to Participate in the Procedure of Assessment and Recognition of Non-Formal and Informal Learning



ed. The research results revealed that the respondents' age had a slight influence on their choice F (5, 1247) = 2.461; p < 0.005. It was also found that the adults' age influenced their view towards their participation in the process of assessment and recognition of non-academic learning at university, i.e. it is probable that 31-35 year-old adults would be more active in seeking recognition of their non-academic learning outcomes at university than 40 year-olds if universities in Lithuania implemented a system of assessment and recognition of such learning. Even though it was established that the respondents' education was different among the regions and that the difference was statistically significant, education did not have a significant impact on the view of adults towards the possibility to participate in the process of assessment and recognition of non-academic learning at university.

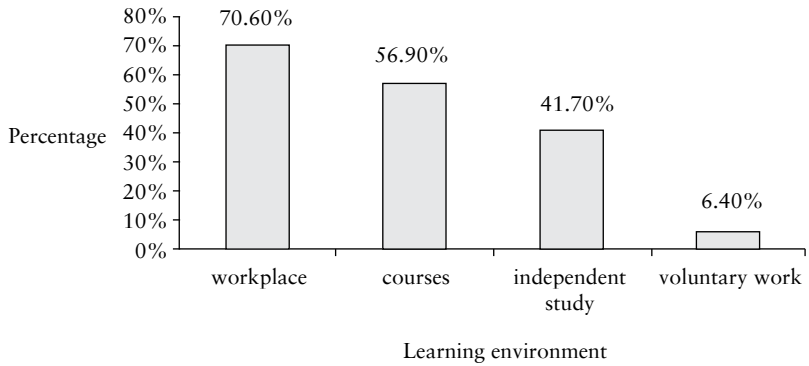
The view of respondents towards the possibility to participate in a training format provided by the university for adults preparing for the assessment procedure at university was positive. It was also established that the adults' wish to participate in such training varies in different regions, and that the revealed difference is statistically significant. F (5, 1247) = 9.843; p < 0.001. The application of the Bonferroni criterion in a post hoc test tabulated the regions in which statistical significance is clearly expressed. The results lead to the conclusion that respondents do not know how to register their non-formal and informal learning outcomes, and that they would like to take part in portfolio training. Male respondents (61.9 %) were more motivated than female respondents, i.e. they expressed a higher degree of willingness to participate in the portfolio training than female respondents even though the number of male respondents dissatisfied with their position and career opportunities offered by their present job was smaller than that of female (56.6%) respondents F (5, 1247) = 22.664; p < 0.001. Respondents with the experience of long-term employment showed dissatisfaction with their position and remuneration; therefore, they expressed a higher level of willingness to participate in the training and acquire new competencies. The conclusion can be drawn that the main motivational factors influencing the need to look for new challenges and development are more clearly expressed by men.

Different Learning Environments
of Non-Formal and Informal Learning

Assessment and recognition of non-formal and informal learning is not the assessment of work or life experience. It is the presentation and assessment of

learning outcomes gained in different learning environments. An analysis of respondents' learning experience revealed (**Figure 2**) that even though at the time of the research 871 adults (69.5%) participated in different learning formats, 85.3% of them did not have any experience of documenting their non-formal and informal learning.

FIGURE 2
Learning Environments in Which Non-Formal and Informal Learning Occurred



Research results revealed that the workplace of adults was the environment in which most of the learning occurred (stated by 70.6% of respondents) followed by learning that occurred in non-formal education institutions (stated by 56.9% of respondents). Only 6.4% of respondents identified non-formal and informal learning outcomes that were gained through working in voluntary organisations.

The statistical significance of non-formal and informal learning outcomes gained in different environments was calculated using the analysis of variance test (ANOVA). It revealed a statistically significant difference between the following groups: at work $F(5, 1247) = 3.574$; $p < 0.005$, studying independently $F(5, 1247) = 5.089$; $p < 0.001$, voluntary work $F(5, 1247) = 14.626$; $p < 0.001$. The Pearson correlation coefficient showed a significant correlation between the two variables "voluntary work" and "independent studies" ($r = 0.76$; $p < 0.01$), as well as "courses" and "independent studies" ($r = 0.61$; $p < 0.01$). It could be assumed that the respondents, who are active participants in different courses or training, pay more attention to autonomous studies.

Study Areas Reflecting Non-Formal and Informal Learning Outcomes

The research revealed that the majority of respondents were young adults (n = 401) or middle-aged people up to 35 years of age (n = 201) having non-formal and informal learning outcomes and willing to participate in the procedure of assessment and recognition of non-formal and informal learning at university. The results of the research showed that the study areas in which the respondents have the most non-formal and informal learning outcomes were management, foreign languages, psychology and social work (Burkšaitienė, Šliogerienė, 2010).

ANOVA revealed that there was a statistically significant difference between the study areas and the learning environment "independent studies" $F(5, 1247) = 2.841$; $p < 0.001$. A significant correlation established between these variables leads to the assumption that through independent studies (informal learning), respondents gained learning outcomes that could be documented as well as assessed and recognised at university. Autonomy plays a significant role in the procedure of assessment and recognition of non-formal and informal learning, where the candidate has to take full responsibility for his or her decisions (Little, 1991, Šliogerienė, 2002). Research results also showed the difference between the age groups and the subject areas in which the respondents have learning outcomes (**Table 2**).

Application of the Bonferroni criterion in a post hoc test tabulated a statistical difference of $F(5, 1247) = 12.631$; $p < 0.001$ between the age group and the area of non-formal and informal learning outcomes. It was revealed that the subject areas in which the respondents have non-formal and informal learning outcomes according to the age group differ between the variables "management" and "foreign languages" as well as "psychology" and "for-

TABLE 2
The Distribution of Age Groups According to Area

	Age groups						
Area of learning	**No answer**	**Up to 25**	**26-30**	**31-35**	**36-40**	**> 40**	**Total**
No answer	1	14	8	9	6	16	54
Foreign languages	7	128	46	19	19	50	269
Management	13	106	79	59	45	115	417
Psychology	9	72	35	30	31	89	266
Social work	8	62	28	26	24	69	217
Other	4	19	5	1	0	1	30
Total	42	401	201	144	125	340	1253

eign languages", the p – value beyond the level $p < 0.001$. Research results show that there is a need for the assessment and recognition of non-formal and informal learning outcomes gained in four areas, mainly in the area of management, social work, psychology, and foreign languages.

CONCLUSIONS

1. Assessment and recognition of non-formal and informal learning at universities worldwide is a reality dictated by the challenges of the new millennium: a growing demand to adapt to the rapid changes of the postmodern world of work, a marked shift in the numbers of adult students, and the necessity to assess and recognise their learning that occurred outside academia.
2. A review of available literature and documents proves that the decision to assess and recognise learning which occurred outside academia is a challenge to universities: specific decisions are required (acknowledgement that learning is a value that does not depend on the environment in which it occurs), human, financial, infrastructural resources must be available, training of consultants and assessors is necessary, presence of mechanisms ensuring the quality of studies, and mechanisms supporting adults are required.
3. The most important preconditions of assessment and recognition of such learning at university include political preconditions (political decisions, educational policy, legal regulation) and practical preconditions (creating benchmarks, implementing the system of assessment and recognition of such learning, preparing for the establishment of the procedure, deciding upon the principles underlying it, etc).
4. Adults' views towards the possibility of having their non-formal and informal learning outcomes assessed and recognised at university is highly positive.
5. Research results lead to the conclusion that a need exists to assess and recognise non-formal and informal learning outcomes (gained in four areas, mainly in the area of management, social work, psychology, and foreign languages) at universities in Lithuania.

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2

At the Crossroads: Teaching Sustainability at University. A Comparison of Experiences from Kingston and Oldenburg Universities

Katherine A.T. Eames - Ingo Mose - Rosalind Taylor

ABSTRACT

This paper forms an initial comparison of the approaches taken by two universities, Kingston University London, UK and Carl von Ossietzky University Oldenburg, Germany to embed sustainability across their curricula. The comparison looks at how each university has approached the issue and what progress has been made. The work is set in the wider Higher Education context of both the UK and Germany and focuses on comparisons of equivalent programmes at each institution. The content of each course programme has been assessed and compared to provide a picture of the level of sustainability coverage. Further analysis of the topics of final year research theses and dissertations gives an indication of the effectiveness of the inclusion of sustainability in the curriculum on student interest in the issues involved. One of the key issues that has become apparent through this scoping investigation is that data availability, particularly on student dissertations is limited. The exception to this problem for this study was for one of the Kingston undergraduate programmes where one of the authors had collected 15 years worth of information on the topics chosen. These data clearly showed that student interest in the topics of sustainability has increased over the last 15 years and demonstrates the value of this type of information being collated and stored by institutions to allow the monitoring of student engagement and effectiveness of pedagogic strategies.

Keywords: Monitoring, measuring, Education for Sustainable Development, ESD

INTRODUCTION

The sustainability agenda has achieved prominence with governments worldwide. Following the 'Rio' summit and successor international meetings there is a growing appreciation of the problems facing society linked with poor understanding of societal interactions with global ecosystems. There has also been an emerging global focus on environmental change and especially the potential for catastrophic climate change, and particularly the potentially huge social and political changes this could engender.

Equally attention has shifted to the failure of current economic and political systems to mitigate poverty and deprivation; and to promote an equitable and sustainable global society in many communities. We have been challenged to rethink our society-environment interactions. Central to this achievement is sustainability understanding permeating all areas of society, especially our political leaders and legislators and global financial institutions. This requires a significant educational programme, available at all levels to ensure appropriate future knowledge while at the same time re-educating mid-career professionals and technicians. The United Nations Decade of Education for Sustainability (UNDESD) runs until 2014. Governmental sustainability education initiatives in Germany (e.g. national programmes targeting schools such as "21 – Bildung für eine nachhaltige Entwicklung" and "Transfer-21", and the extracurricular centres in environmental education) and the UK (e.g. *inter alia* HEFCE; Sustainable Schools; skills and low carbon hubs) also testify to the high level importance attached to this agenda. But what has been achieved?

Fundamental to all this is an agreed understanding of sustainability as a concept. It goes significantly beyond earlier 'greening' educational agendas such as Toyne (1993); Khan (1996) and Khan & Parkin (1992) in embracing economic and social agendas and clearly promoting the message that only joint environmental, economic, and social understanding framed within the context in which it is proposed to seek sustainable progress or solutions, is likely to succeed. The message has moved on from the need for environmental education to this more integrated paradigm; in addition the importance of cultural context has also been acknowledged. Thus it has become more than obvious that only inter- and even trans-disciplinary approaches seem to address the issue of sustainability education appropriately at every level (Godeman and Michelsen, 2011). A key question though is the extent to which curricula and pedagogies have similarly changed. Have we the staff expertise to

deliver sustainability education? Have new modules and programmes been developed to reflect this change in agenda and to what extent are our students embracing these ideas?

Shriberg (2004) proposed that methods of comparison between universities and colleges are essential in the move towards a vision of an ideal future situation. This is made even more relevant as Cullingford (2009) underlines the responsibility of universities to make sustainability more central in the extant curriculum. At an international symposium in Bilbao participants explored how progress with sustainability in curricula of Spanish and Latin American universities could be monitored (Carrera *et al.,* 2007; Macedo, 2007) with case study details exploring sustainability in the curricula at the Universidad Politecnica de Catalonia. This present paper reports an initial examination of ESD in the curricula of two European partner Higher Education Institutions (HEIs), Carl von Ossietzky University, Oldenburg and Kingston University, London.

At both Oldenburg and Kingston staff have sustainability expertise across wide ranging disciplines spanning Economics, all aspects of Engineering, Design, Architecture, Planning, Environmental Science and Management, Geography, Teacher training education and Business and Law, with increasing engagement from wider discipline areas such as Politics, Film, Media Technology, Transport studies, Dance and Drama, History and Healthcare. The informal educational structures of both universities offer sustainability opportunities through staff and student Erasmus exchanges, volunteering opportunities, and town-gown links including a strong programme of *real-world, real-time* learning, a particular focus at Kingston.

Verifying these emerging changes, demonstrating their presence and efficacy presents many challenges. While some changes are evident from new course programme proposals or development of specific sustainability modules; others are less tangible since they reflect the pedagogies adopted to deliver curricula rather than explicit changes to the curriculum content.

The present paper explores the curricula of a spectrum of broadly equivalent programmes at Oldenburg and Kingston to see the extent to which:-

a. They include sustainability at the programme level
b. The extent to which students are responding to this in terms of the independent research dissertations they elect to undertake.

COMPARISON OF EXPERENCES FROM KINGSTON UNIVERSITY LONDON AND CARL VON OSSIETZKY UNIVERSITY OF OLDENBURG

Teaching sustainability has thus been identified as a major challenge for universities with the adjustment of curricula being a core task. According to Walker *et al*. (2004) research into sustainability in higher education has so far remained predominantly theoretical in that few studies have sought to go beyond description. Thus, extended empirical research into the transformation of curricula in the direction of sustainability and responses of the university community (e.g. students; academic staff) seems to be still largely missing. In this respect case studies are regarded a common and appropriate research tool used in studies of sustainability in higher education, especially as it is suggested that others might have something to learn from them (Walker *et al*., 2004). Comparative approaches to case study research are particularly challenging as with regard to additional effort and care that is required to allow for meaningful and reliable findings (Yin, 2009). However, although circumstances vary considerably from university to university, cross-institutional assessment tools can minimise the necessary effort involved in improving sustainability teaching by sharing common experiences and goals (Shriberg, 2004).

Our own approach to comparative analysis is currently an indicative study. Mainly due to limitations in data availability, length of experience with target courses and investigative time we have limited ourselves to two elements. Firstly, we look at how the subject of sustainability has been promoted at both universities. Secondly, we explore a number of selected study programmes which we regard suitable examples for the subject (see **Table**

TABLE 1
Study Programmes from Kingston and Oldenburg Universities Selected for Comparison

	Kingston University, London	Carl von Ossietzky, University of Oldenburg
Bachelor	BSc Environmental Sciences suite of courses BSc Biology BSc Marine and Freshwater Biology	BSc Environmental Sciences BSc Biology
Masters	MSc Sustainable Place Making and Urban Design MSc Sustainable Environmental Development with Management Studies MSc Environmental and Earth Resources Management	MSc/ Dipl. Landscape Ecology MA Sustainability Economics and Management

1). In all these programmes a specific, though limited, examination was conducted focussing on (1) the structure of curriculum (modules and courses), and (2) topics of student theses in these programmes (bachelor and master). Analysis of both modules and theses were based on a list of key words which were used as search tools for issues of sustainability applied to both the British and German data (**Table 2**). Findings of our analysis are presented in the following sections including a brief synthesis of identified similarities and differences.

TABLE 2
List of Keywords used to Identify Sustainability Content in Modules and Theses Throughout this Study Created Through Cross Faculty Discussions with Academics

Behaviour change	Democracy	Food miles	Renewable
Biodiversity	Desertification	Green	Reuse
Biofuels	Diversity	Globalisation	SRI (Socially Responsible Investment)
Carbon emissions	Ecological	Global warming	Social cohesion
Carbon footprint	Ecopsychology	Habitat	Social justice
Carbon neutral	Ecosystem services	Health	Social sustainability
Carbon sequestration	Employment	Human rights	Solar power
Climate change	Energy efficiency	Nature	Sustainability
Conservation	Environment/al	Organic	Sustainable development
Consumption patterns	Environmental economics	Peace	Waste management
CSR (Corporate Social Responsibility)	Equality	Population	Water management
Corruption	Ethical/ethics	Poverty	Wellbeing
Deforestation	Fairtrade	Recycling	

KINGSTON UNIVERSITY LONDON

Institutional Framework

Kingston University, located in south-west London, has roots going back to a Technical Institute established in 1899 though was formally constituted as a university in 1992. With over 25,000 students and 2,900 staff members at present, it is regarded as a medium sized university within the UK university system. The university is structured into 5 faculties and 25 schools and also has 14 centres of research excellence spread across the faculty structure, each one forming a hub for researchers and students, ensuring a dynamic, sustainable research base.

In summer 2011 the Kingston University Sustainability Hub was consolidated as a permanent group based within the Vice Chancellors Office of the university, combining all staff with a full-time, cross institution remit on sustainability into one group. This consolidation was the culmination and recognition of over a decade's worth of grass roots work and campaigning from staff across the University. This Hub has been given the remit to promote the University's contribution towards sustainable development through curriculum, research and consultancy, estates and facilities management, governance and through interaction with the wider community. The increasing engagement of the university staff is shown by the external accolades achieved. Most noteworthy among these are first class rating in the national People and Planet green league in 2010 and 2011; curriculum-related national Green Gown awards in 2007, 2009; and in 2010 a further acknowledgment from the Green Gown awards for continuous long term improvement towards a sustainable university. Since 2010 the university has achieved an EMS (Enviromental Management System) embracing its whole operation including our core educational business; BS8555 phase 3 in 2010; phase 4 in 2011 and expects to achieve ISO14001 status (equivalent to BS8555 phase 6) soon.

Case studies of sustainability in curricula have been identified from all disciplines taught at Kingston University. In conjunction with the Faculties of Art, Design & Architecture, Science, Engineering & Computing, and Business & Law, the Sustainability Hub has assisted in the creation of a suite of sustainability focused taught postgraduate level courses which have been recruiting for the last 2-3 years. These are Sustainability for Built Environment Practice; Sustainability, Environment and Change; and Environmental Law and Sustainability respectively. Further course developments are planned in order to broaden the offerings of Kingston University focused on sustainability, particularly at postgraduate level.

Selected Study Programmes

In order to conduct this initial study into the feasibility of direct comparisons between the approaches of different institutions, taught programmes with a similar focus to ones available at the Carl von Ossietzky University, Oldenburg were chosen (see **Table 1**). Kingston offers a suite of BSc Environmental Sciences programmes, 2 Biology programmes and 2 MSc programmes on sustainable environmental management, all with slightly different focuses. All

these programmes were taken into account in this work to ensure as complete a comparison as possible with the equivalent Oldenburg programmes. Finally the MSc Sustainable Place-Making and Urban Design was chosen for comparison with the Oldenburg programme MSc/ Dipl. Landscape Ecology.

Structure of Curriculum

Analysis of the curriculum content shows very little difference between the four relevant programmes in their relative coverage of sustainability. The only significant outlier is the BSc Biology course where all modules that cover sustainability are optional to the programme and are greatly in the minority of the available choices (only 6 out of 48). The more focussed BSc Marine and Freshwater Ecology course contains 10 out of 22 modules that cover sustainability in some way. This close to 50% proportion is also seen in the BSc Environmental Sciences programme that has 9 out of 15 compulsory sustainability modules. The BSc in Environmental Management has a slightly lower direct focus on sustainability (6 out of 14 compulsory modules) whereas the BSc Sustainable Development programme has the highest number of core sustainability modules (10 out of the 18 compulsory modules) as well as a high proportion of 'sustainability' optional modules. These three BSc programmes form the suite of Environmental Science offerings at Kingston.

A similar picture was seen when the modular content of the MSc Sustainable Environmental Development with Management Studies, and MSc Environmental and Earth Resources Management programmes was examined (5 of 9 and 5 of 8 respectively). However for the MSc Sustainable Place Making and Urban Design only 2 of the 9 modules are flagged by the key word search employed to identify modules (i.e. modules were flagged as covering sustainability if their titles contained at least one of a series of key words shown in **Table 2**)

Topics of Student Theses

Data issues started emerging at this point of the study at Kingston, particularly for the BSc Biology and BSc Marine and Freshwater Biology bachelor level programmes where only 1 year of data was obtainable. Data for previous years had been lost in the handover of responsibility for final year projects between staff. Of the most recent (and only available) year for these two courses combined only 4 of the 25 student dissertations covered a topic related to sustainability (NB projects were flagged as covering sustainability if their ti-

tles contained at least one of a series of key words). This fact is further complicated by the fact that though students on these programmes do select their projects, they select them from a specified list of topics provided by academics within the school. Of the 206 titles available to any student on a Bio-Sciences course that year only 11 covered sustainability, radically reducing the options available to students who may have otherwise chosen to study a sustainability related topic. The poor sustainability visibility in the biology curricula may reflect a need for staff education on sustainability as highlighted by Dawe, *et al.* (2003) in an initial baseline review of sustainability in the curriculum at Kingston University.

A similar issue existed with the MSc Sustainable Place Making and Urban Design course as though the curriculum content could be analysed, due to the very new nature of the course no students have as yet completed a final thesis.

The data available for the other selected programmes was in contrast of much longer duration and the topics were completely freely chosen by the students. Particularly of use is the series of data from the BSc programmes which dates back to 1996 (see figure 1), which was the first year that students graduated from these programmes. The pale grey line in figure 1 is therefore able to show the changes in student decisions on their final year project topics throughout the lifetime of the programmes. Due to the longevity of this data series it has also been possible to add a trendline through this history which suggests that student interest in sustainability related topics has increased during this time. The trend of this data is also statistically significant at the 95% confidence level.

For the MSc Sustainable Environmental Development with Management Studies and MSc Environmental and Earth Resources Management programmes student's selection of sustainability related projects was less easily assessed from the project titles available. The environmental management aspects of these programmes ensure that a significant proportion of the projects look into topics such as potential flood and landslide risks and water pollution issues. These projects may or may not have sustainability connotations depending on the details of the studies which unfortunately were not available for analysis.

CARL VON OSSIETZKY UNIVERSITY OF OLDENBURG

Institutional Framework

The Carl von Ossietzky University of Oldenburg, located in the North West of Germany, was founded in 1973 on the basis of a former teacher-training college with historic roots as far back as 1793. With about 12,000 students and nearly 2,200 staff members at present, it is regarded a medium size university within the German university system.

The university is structured into 6 faculties and 23 institutes. They employ around 1,250 academics of various disciplines at present. Beyond this institutional structure a number of interdisciplinary research centres have been established more recently which specialise in a number of different fields. According to the "leitbild" of the university adopted in 2010 inter- and transdisciplinary orientation as well as regional, national and international cooperation are regarded major trademarks for both research and teaching in the future (Carl von Ossietzky Universität Oldenburg, 2010).

The University of Oldenburg currently offers about 40 courses of study. According to the Bologna Treaty of 1999 since 2005 the university started to transfer the traditional German system of diploma degrees into bachelor and master degrees being one of the first academic institutions in the State of Lower Saxony to do so. At present about 75 percent of students seek a bachelors or masters degree, while 25 percent strive for a teaching certification.

In the course of recent institutional restructuring the University of Oldenburg has also seen increasing attention and orientation towards the challenges of sustainability. Already during the 1970s and 1980s, soon after its formal implementation, the university had earned increasing reputation as a pilot for environmental awareness and orientation among academic institutions in Germany, research in renewable energies (wind and solar power), interdisciplinary marine research as well as ecological orientation in economics being examples for this. However, according to Schneidewind (2009), research in this field had not gained a dominant role for profiling of the university at large before the turn of the century. Rather contrarily, a lack of interdisciplinary cooperation had been noted by the Wissenschaftliche Kommission Niedersachsen (a state advisory commission) in 2003 to the disappointment of the involved institutions.

In response to this criticism, with major support by the university presidency, a university wide centre for environmental and sustainability research

was founded in 2005 named by the acronym COAST associating the new institution with the marine environment which plays a major role in many of the research activities. At present the centre functions as an umbrella for the most important areas involved in this field, comprising (1) marine and coastal research, (2) renewable energy research, (3) research in environmental economics, (4) research in environmental modeling, and (5) research in sustainable spatial development (Carl von Ossietzky Universität Oldenburg, 2007). The formation of the centre is understood as a major contribution to the ongoing process of profiling by providing a consistent concept integrating different points of contact for environment and sustainability oriented research applicable enough for internal and external communication (Schneidewind, 2009).

Additionally the development of new study programmes is of similar importance in the context of the sustainability discourse at Oldenburg University. Influenced both by the transformation of former diploma degrees into bachelor and master degrees and the increasing activities regarding the implementation of COAST several institutes and faculties started to invent new study programmes with a clear focus on the environment and sustainability. This does not mean that such programmes had not existed before. The case of Landscape Ecology, to mention just one example, illustrates a subject that had been a natural focal point of environmental and sustainability issues for a long time. However, only in the course of the Bologna Process and the need for further profiling in competition with other universities did the creation of new study programmes increasingly take shape, giving more explicit sustainability focus. Several bachelor and particularly master programmes have now been introduced which more or less focus on the subjects of environment and sustainability. Out of these, seven master programmes have been identified to form a cluster of study programmes jointly administered under the umbrella of COAST, whereas other programmes are run in separate institutional frameworks.

Selected Study Programmes

As stated above, since 2005 the University of Oldenburg has seen the advent of an increasing number of new study programmes, some of which were developed from the former system of diploma degrees, but also programmes that were totally new to the university. The latter can be regarded a major outcome of the mentioned process of profiling with particular emphasis on the subjects of environment and sustainability. According to the methodolog-

ical design, finally four study programmes have been the subject of investigation (see **Table 1**).

Structure of Curriculum

Analysis of the curricula shows significant differences between the four relevant programmes. At bachelor level generally there is a relatively limited focus on sustainability issues. This applies especially to Biology where only 4 modules out of 14 indirectly touch upon related subjects. The Environmental Sciences, which have a strong foundation in the Sciences, provide a different picture. With 12 related modules out of 21 the subject of sustainability seems to play a considerable role, though it is far from dominating the curriculum. Thus interdisciplinarity is interpreted mainly within the Sciences but not beyond (e.g. Social Sciences).

Contrasting with this the master programmes provide a different picture again. This is particularly true for Sustainability Economics and Management with 12 out of 18 modules focussing issues of sustainability. But even in Landscape Ecology, which is still mostly regarded as a Natural Science, 9 out of 11 modules indicate a significant relation to issues of sustainability.

Topics of Student Theses

Analysis of the two bachelor and two master programmes (from summer term 2008 until present) gives evidence for significant differences regarding the response of students to sustainability related topics. The general outcome of the findings is as follows.

Both bachelor programmes, Environmental Sciences and Biology, have seen an increasing interest of students as reflected by a growing number of enrolments over the years. However, there are significant differences with regard to the chosen topics of student's interest in the subject of sustainability and the topics of their bachelor theses. Whereas in the Environmental Sciences out of 126 theses 38 could be related to sustainability, there were only 2 out of 124 theses in Biology. Although there are at least a few modules that relate to sustainability, Biology students seem to hardly develop any interest in sustainability issues. In contrast there is a much higher proportion of students in the Environmental Sciences who choose sustainability projects, however in relation to the significant number of relevant modules the share still seems rather limited (just below one third).

By contrast both masters programmes indicate a strong interest in issues of sustainability. Not surprisingly all of 28 theses in Sustainability Economics and Management (since winter 2009) relate to the subject of sustainability in one way or another. In Landscape Ecology this link is smaller, as only 40 theses out of 86 have a sustainability focus (just below 50 per cent). However, this figure does reflect well the relatively great importance, as well as the attractiveness, of interdisciplinary sustainability issues in a rather Science based programme.

COMPARATIVE FINDINGS

Due to the preliminary character of our research identification of similarities and differences is provisional. However, some key observations were made that are likely to be of help to other institutions attempting such a comparison. This initial comparative analysis has striven to test methods and availability of data in assessing the inclusion of sustainability in higher education curricula in universities in Germany and the UK.

The first key conclusion of this study is that data availability was found to be very limited, often only available due to records kept by individuals rather than at an institutional level. With the adage that "what cannot be measured cannot be managed" data availability of this type will become more and more important as attempts are made to improve education for sustainable development. Both Kingston and Oldenburg are moving towards centralised, digital records of module titles, descriptions and final project titles and abstracts which will enable future studies of this type to capture a wider range of data more readily. The findings of this project have already been useful in informing the type and breadth of data to be included.

A further complication identified in conducting this comparison was the great differences between equivalent study programmes at these two sample universities. Clearly our experiences indicate the need for intensified methodological reflection, especially with regard to appropriate methods of comparison of programmes on a continental scale which as yet are limited in their ability (Shriberg, 2004).

Both Kingston and Oldenburg are striving to be pilots in the field of teaching sustainability at university. In fact, over the last years both universities have seen the introduction of new study programmes at both bachelor and master level which relate to the subjects of environment and/or sustaina-

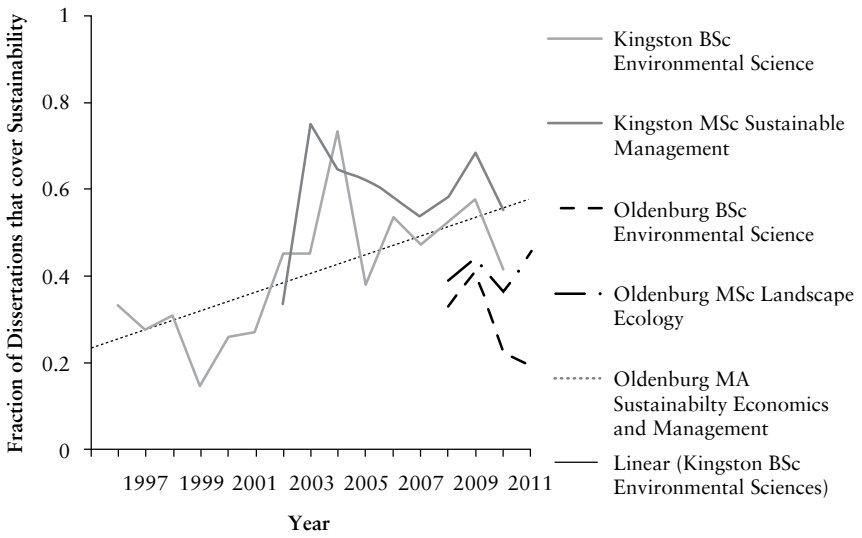
bility. However, looking at the module structure of some of these programmes clearly indicates very different grades of sustainability orientation. For Oldenburg, especially at bachelor level, implementation of appropriate modules seems to be rather limited, with the Environmental Sciences being mainly rooted in the Sciences and therefore missing clear links with other valuable disciplines, e.g. Social Sciences, Economics. These limitations appear to have been addressed slightly more at Kingston through collaborations between teaching Schools. However, even though Biology could be regarded as being a sustainability subject (with competences in the field of biodiversity for instance), our analysis has shown that so far it has not been developed in this way at either of the study institutions. In contrast a number of other bachelor programmes at Kingston show a greater inclusion of sustainability relevant modules particularly within the design, engineering, politics, business and law programmes. This trend is also seen within programmes at masters level which by definition are more specialised to a particular discipline and so may be expected to be less likely to embed sustainability so rapidly. All masters programmes examined (except for the MSc in Sustainable Place Making and Urban Design) show a clear focus on sustainability with hardly any differences between the two universities studied.

One key observation that should be made at this point as it may explain the previously stated anomalous masters programme is one of resolution of the study. Both for modules and student projects studied only the titles were available for the majority of the data. A study at a finer resolution, i.e. including further detail from longer module descriptions and project abstracts, could be reasonably assumed to provide many more insights and data points. However, on institutional scales this would almost exponentially increase the volume of data that would need to be available and analysed.

Finally, focussing on the students' responses to sustainability, these do seem to vary slightly between the universities, with Kingston students on non-sustainability focussed programmes seeming to select sustainability related personal research areas with slightly more frequency than those at Oldenburg (Figure 1). The reverse is, however, true when the data for student selections for programmes where sustainability is explicitly named are examined. For these programmes all Oldenburg students clearly chose a focussed sustainability related topic however at Kingston this did not appear to be the case, though again this quantitative comparison could contain errors caused by lack of access to the details of some studies for the qualitative assessment of

their sustainability/non-sustainability focus. It is encouraging to note that where sustainability is taught and students have the freedom to choose their research topics they do appear to be selecting sustainability related topics for their final research project. This adds credence to the value of adding sustainability to university curricula as being pivotal in "turning society towards sustainability" (Corcoran & Wals, 2004:3).

FIGURE 1
The Proportion of Total Student Projects on Selected Courses that had Sustainability as a Key theme at Kingston University, London, and Carl von Ossietzky University, Oldenburg



Note: For the longest series of data, that for the undergraduate programmes at Kingston, a trendline of these proportions is also shown (solid black straight line).

CONCLUSION

According to Bawden (2004: 23) "universities must accept that they are now as much 'part of the problem' as they were once an almost unrivalled 'source of the solution'" to issues facing our global society. In the UK the Higher Education Funding Council for England updated strategic statement and action plan stated that "The greatest contribution HE can make to sustainable development is by enabling students to acquire the skills and knowledge that allow them to make a lasting difference." (HEFCE, 2009:14). The challenges

for universities and colleges in living up to these two statements require some fundamental changes within their operations.

There is great potential for learning about and improving teaching sustainability in higher education through comparative case study research such as is presented in this paper. Methods of measuring not just the topics that are taught but also the types and methods of teaching sustainability that are employed (Sterling, 2001) such as those presented here need to be developed to facilitate these comparisons (Sterling, 2004). There also need to be measures of the success of this teaching in communicating the issues to students and inspiring them to continue to use this knowledge in their future careers and lifestyles. A lifelong influence would have huge societal benefits but quantifying this will be very difficult. Topics chosen for final research projects could be an important indicator of student engagement with the issues and ideals of sustainability but the research presented here shows the complications in both obtaining and analysing this data.

In summary, the findings of our analysis, though provisional, reflect how much work has been done but also how much remains to be done to ensure that education for sustainable development is included in Higher Education institutions. Both Kingston and Oldenburg have been and still are regarded as leaders in their respective countries for teaching sustainability (HEFCE, 2005; Taylor *et al.*, 2011; Wissenschaftliche Kommission Niedersachsen, 2003) and though both institutions have had success in this venture they also still have a long way to go. By concentrating on a small number of programmes at the two study universities an in-depth comparison of these two institutions has been initiated and will continue. A key next step would be to explicitly look at the pedagogies being employed to impart not just sustainability knowledge but also sustainability skills to our students which this initial testing has not been able to capture. The scope of this study has also remained within the discipline sphere of the authors. The next stages of this research would be to gain a wider ranging view of the situation at each university. This will introduce the complication observed by Schneidewind (2007) who pointed out that interdisciplinary profiling in sustainability remains a politically sensitive undertaking liable to criticism by those disciplines who feel that they have no relation to this field. This is especially true when sustainability is seen as being in competition with other subjects and issues which are high on the agenda of experts from these other disciplines. Against this background it is worth mentioning that since 2011 four academ-

ic institutions in Germany leading in the field of sustainability research and teaching; the University of Kassel, the University of Lüneburg, the Wuppertal Institute for Climate, Environment and Energy, and the Institute for Advanced Sustainability Studies, Potsdam, have established the NaWis network of sustainability sciences (Verbund für Nachhaltige Wissenschaft) emphasising the need for joint efforts in further promoting sustainability in an inter- and transdiciplinary manor (Schneidewind *et al*. 2011). Accordingly there is a constant need for more dialogue between sustainability focused minds and other specialists as well as across different nationality-based preconceptions of subject areas to identify how different scientific themes may overlap. These overlaps will then be likely to adjust the keywords used to identify the inclusion of sustainability in this study, thus adding to the methodologies available for this purpose.

Having noted that the institutions and methodologies still have a way to go, it would however be wrong to overlook the achievements that have already been made. Both institutions are committed at an institution-wide strategic level to include sustainability in curricula and have appointed central offices to champion this. New programmes have been introduced and students on these programmes are not only studying sustainability but appear to be increasingly choosing to investigate it further in their final projects. It can clearly be seen that progress has also been made in thoroughly integrating sustainability into existing programmes though, surprisingly to the researchers, not in the Biology curricula at either institution.

Data availability seems to be a true limiting factor in this type of analysis and often depends on institutional champions, as also noted for Catalonia. The authors suggest that concurrently to efforts to include sustainability into curricula and pedagogies, systems need to be developed to store records of previous course designs and content as well as student projects or a similar indicator of student engagement. This will allow trends to be measured, comparisons to be made and true progress to be observed.

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3

Building Professionals for Sustainable Communities: A Need to Engage

Sarah L. Sayce - Judith V. Farren-Bradley

ABSTRACT

The concept of community engagement is considered central to the delivery of sustainable communities. Nowhere is this more apparent than in the field of spatial planning. The UK's Localism Bill, currently completing its progress through parliament, has decentralisation at its core with spatial planning seen as a key component for local democratisation. Couched within the rhetoric of 'Big Society', and infused with the concept of active *citizenship,* the aim is to increase local freedoms and facilitate greater 'bottom up' determination of where and how development takes place.

This paper looks at the role of built environment professionals within the UK in supporting and delivering the sustainable community agenda and makes the case that the development of sustainable communities requires trans- and inter-professional understanding and collaboration. It argues that, despite a legislative framework that requires community and stakeholder engagement, strong role perceptions, perpetuated by educational models, hinder such collaborations and foster inter-professional rivalries. The paper refers to research undertaken by the authors and examines the potential for future action within professional education and through continuing professional development.

Keywords: Professions, built environment, engagement, skills, stereotypes, education

INTRODUCTION

> "Established ways of working often hold entrenched positions which are difficult to change and are strongly defended. This can impact upon the degree to which innovative and creative methods can become part of mainstream participation strategies."
>
> – Baker, Coaffee & Sherriff, 2006

It is accepted that the built environment has a major contribution to make in meeting the targets set for sustainable development. Much of the emphasis in the past has been on how design, construction and management of the built fabric can respond to the challenges of energy efficiency and carbon reduction and mitigate the impacts of climate change. However, as a more holistic understanding of sustainability and sustainable development has emerged, the role of the built environment in supporting and promoting local and global social aims such as well-being, has been better understood, including its role in the creation and maintenance of sustainable communities and a more inclusive understanding of 'place' and the skills and infrastructure required for 'place-making'. Although still contested, when Jacobs (1961) and Coleman (1985) wrote their seminal works, the relationship between the built environment and social cohesion was regarded as radical. Now, even the nomenclature of 'built environment' is under scrutiny, challenging what has been characterised as an 'object' focussed and 'single project centred' activity.

Community participation has become an integral and obligatory part of the spatial planning and development process in the UK, yet even previously cited exemplar projects have been noted as revealing inadequacies. This was identified by Bishop (2005) as a lack of 'infrastructure for engagement' recognising deficiencies in professional skills and within stakeholder groups as well as a lack of adequate resource allocation for the facilitation of meaningful engagement processes. Recent policy pronouncements represent a commitment to a determined shift in the power dynamic of the planning system, away from 'plan-led delivery to plan-validated empowerment'. This proposes the devolution of decision making on key local issues, including the priorities for local service provision, to the electoral ward or neighbourhood level together with even more radical proposals for the devolution of responsibility for public service delivery through devolved budgets.

However, this power shift should not be seen as the result of a single political ideology. Whilst the nomenclature and rhetoric may have changed, the underlying trend toward greater citizen participation and stakeholder/community engagement across key areas of public service delivery has been the stated intention of successive governments in the UK and elsewhere. This should be understood as part of a wider agenda for public sector reform which has been a key aspect of policy for all UK political parties over the last three decades (Ghobadian, Viney & Redwood, 2009). Research by Pratchett *et al.* (2009a; 2009b), commissioned by the previous administration, evaluated the advantages and disadvantages of local 'empowerment', looking at the evidence base from both UK and overseas studies. This included examples of asset transfer and participatory budgeting and evaluated the means through which enhanced participation might be achieved together with the potential impact of initiatives such as web based participation and alternative forms of citizen governance. However it also identified the risks inherent in such policy initiatives, including potential threats to community cohesion and the need for capacity building both within communities and existing public institutions and practitioner groups. A notable change in the rhetoric is that of an emphasis on 'civic responsibility' as the motivation for, and as an adjunct to, participation. In the guide to the Localism Bill, anticipated to pass into statute in 2012, the stated aim is that, *"Communities should be able to combine different sources of public money to create pooled budgets to tackle difficult cross-cutting issues within an area."* (DCLG, 2010)

By empowering local communities to commission and determine local service delivery, power will be devolved and limited resources targeted. Pilot *local integrated service* (LIS) initiatives, supported by the Cabinet Office, are already working through local authorities to bring together service providers, local business and communities. These are based on the concept of *'place-based'* budgets and have the potential to transform hitherto accepted practises. What remains uncertain is the place of professional practitioners and advisers within the process. Localism will challenge professional *praxis,* reframing the relationship between 'expert' professional and the laity. Professionals will therefore, we argue, be required to re-think inter-disciplinary and client relationships as traditional skills and knowledge boundaries are redrawn and new ways of working and thinking emerge.

FOR AND/OR WITH

The literature on community/public participation is rich and complex but most builds upon the seminal work of Arnstein (1969), whose 'Ladder of Citizen Participation' suggested that participation had potentially eight steps, from manipulation and therapy at the lowest levels, through 'tokenist' strands of consultation and placation, to true participation in the form of empowerment. Later authors, such as Connor (1988), Potachuk (2003), Guaraldo Choguill (1996), Wilcox (1994) and Cummings (2001) have all developed and/or extended the notion of the ladder to include recognition of the complexities of stakeholder engagement. One of the clearest current models of participation and stakeholder engagement is that produced by the International Association for Public Participation whose spectrum of participation sets out five levels of engagement:

1. inform: to provide the public with balanced and objective information, to assist them in understanding the problem, alternatives, opportunities and/or solutions
2. consult: to obtain public feedback on analysis, alternatives and/or decisions
3. involve: to work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered
4. collaborate: to partner with the public in each aspect of the decision making including the evaluation of alternatives and identification of the preferred solution
5. empower: to place final decision-making in the hands of the public

As part of the spectrum each stage also demands a 'promise' to the public for it to be meaningful and offers exemplar techniques for each stage. However, even this approach has been criticised as being over simplistic (Maier, 2001) despite a greater understanding of '*the factors that drive engagement*' (Tritter & McCallum, 2005). An alternative approach to the concept of citizen participation as a ladder is the 'wheel of participation' (Davidson, 1998) in which all types/levels of approach are valid but determined according to appropriateness.Davidson's four segmented wheel of information: consultation: participation: empowerment, although similar in content to the five point plan above, remains useful in that it was devised for 'appropriate

use' and includes a further 12 definitions together with exemplar activities. It is not surprising that the majority of the literature on participation has been developed within the context of social policy. Within the corporate environment, the literature has been less developed but can be seen as an integral part of the development and delivery of corporate social responsibility (CSR) objectives. Within accounting, a stakeholder engagement standard (AA1000) was developed in 2005 in order to secure quality engagement of learning, governance and accountability. SustainAbility, a think-tank and global strategy consultancy recognise three generations of engagement and these can be adapted for applicability to sustainable communities as follows:

- First generation: a re-active process on informing stakeholders
- Second generation: a systematic gaining of feedback from stakeholders in order to gain understanding and inform decision-making.
- Third generation: a deep process in which both those directly impacted by the proposals and those indirectly affected are held to have a legitimate voice and whose opinions could shape better outcomes.

This simple 3 step process equates to only the lower to mid levels of true participation as envisioned by those working in community engagement and in this, it demonstrates a cultural dichotomy between the understanding and development of the notion of engagement as it has been applied within the social context and as applied within the corporate environment in relation to stakeholder engagement. Some of the most notable examples of community engagement in planning and architecture can be traced back to the work undertaken in the 1960s. Davidoff (1965) introduced the concept of advocacy planning in the context of urban renewal in the USA, and much of the initial work in the UK was in the area of housing (e.g. Turner, 1977) continuing through the 70's and 80's with Alexander (1975; 1977) and Habraken (1972). One of the most significant projects, the Byker estate in Newcastle stems from this early period. Identified in the Newcastle City Development Plan of 1963 as an area for redevelopment, the Byker plan was set out in 1964. Ralph Erskin was appointed as architect in 1968 and his Plan of Intent (1970) stated that it would be: "*..a complete and integrated environment for living in the widest sense, at the lowest possible cost to the residents and in intimate contact and collaboration with them.*"

Employing hitherto untested methods, Erskin and his team produced both an innovative design solution and an exemplar process. However, despite these auspicious beginnings, Byker suffered many of the problems associated with high density inner city housing estates, including vandalism, high turnover of residents and deteriorating building fabric. The estate was Listed Grade II in 2006, in recognition of its tangible and intangible heritage value. However, as a testament to its social success following a 45% turnout for a tenant ballot, a majority voted for the estate to be transferred to a Community Trust. This will offer independence, clear accountability and governance arrangements specific to Byker, and is being lauded as, 'the embodiment of the Big Society', (DCLG, 2011) the most recent iteration of the concept of 'people power'. However, the renown of Byker only lends credence to the fact that it remains a relatively rare example of large scale community engagement and empowerment despite being rated by external observers such as Amery (1974) as initially representing only 'middle way' participation.

In later work (Hamdi, 1991; Wates & Knevitt, 1987; Wates, 1996; 2000), broader concepts of participatory planning were developed and the role of the architect and planner was challenged (Till, 1998; 2006). The role of architectural education as a catalyst for change was highlighted by Parnell (2002) and has been further reviewed in publications such as that by Day & Parnell (2003) which illustrated a variety of alternative processes with exemplar projects. Barriers to participation have been usefully assessed (Morris, 2006) and a range of publications (CABE, 2003; English Partnerships, 2007) and more latterly methodologies such as Enquiry by Design (Princes Foundation), The Building Futures Game (RIBA/CABE/AOC) and Imagine (Bell & Morse, 2007) have been developed to support community engagement. However, despite studies and exhortations, a common thread within the literature is that for effective community engagement to take place, the professional 'adviser' must learn to both listen and take cognisance of the individuals and groups who have *personal* rather than professional knowledge and for whom development decisions will have long-term impact.

A CONSPIRACY AGAINST THE LAITY?

From the above it is clear that there has been an increasing recognition that the inter-relationships between people, development processes and the built environment are critical to the development of healthy and sustainable communities. These relationships include not only present use but intangible as-

sociation and future aspiration; understanding and balancing the interactions of social, environmental and economic sustainability. Professional practitioners and educators are being asked to make a paradigm shift, a contemporary example of what Schon (1983) describes as the need for "*unprecedented adaptability*". What, if any, is the role of the professions in relation to community empowerment, personal and corporate social responsibility and the rhetoric of Big Society?

Although contested, the importance of the professions to both society and the economy (Cabinet Office, 2009), has long been acknowledged. A key characteristic of a profession is that the application of its knowledge base is deemed to be important to society (Freidson, 1986; 1994) and that professionals can be defined *as "much by a sense of moral and societal responsibility as by specialised knowledge*" (Solbrekke & Karseth, 2006, p96). But the relationship between the professions and the societies they seek to serve is complex. It can be argued that the development and character of the professions themselves mitigates against their ability to fulfil this societal role (Freidson, 1994) and that professional boundaries reduce efficacy where trans- and inter-disciplinary knowledge and skill is needed (CABE, 2003).

The Egan Review of Skills for Sustainable Communities (2004) identified a series of generic skills as being crucial for the delivery of sustainable communities. In Arup's 'Mind the Skills Gap' (Academy of Sustainable Communities, 2007), the lack of such skills within the core built environment professions was highlighted. In order to address these concerns, an agreed action plan was devised by the Homes and Communities Academy (2009), bringing all the key professional institutions and associated stakeholder organisations together as partners. In October 2010 a memorandum of understanding was agreed providing for mutual recognition of all relevant continuing professional development (CPD) with the aim of promoting cross-professional lifelong learning. However, the longer term aims include embedding "*the full suite of generic and emerging skills*" in initial training and continuing professional development, "*of all practitioners*" (HCA, 2009). These reports re-iterated much of what had been included in the 2001 report of the Planning Network, as skills necessary to deliver what was then termed 'the New Urban Agenda', itself a response to the Planning Green Paper of the same year (McIntosh & Bailey, 2004). This underlines both the speed with which planning policy has been changing and, by inference, raises the issue of how built environment professionals respond to the ever changing context of practice, re-

flect on their performance and recognise when and where knowledge, expertise and modes of practice need to be modified, enhanced or challenged. Theories of professional development and the stages of professional skill acquisition are in themselves the subject of debate (Dreyfus & Dreyfus, 1986; Lave, 1993; Ibarra, 2000; Eraut, 2009). The previously accepted theory that the development of professional knowledge and skill is by a relatively simple and incremental accumulation has been challenged. A more complex and dynamic inter-relationship through critical reflection on practice is being suggested (Dall' Alba & Sandberg, 2006). What emerges from these studies, albeit they were primarily concerned with medical practice, is that professional attitudes and traits are developed through a range of personal and professional interactions, confirming or challenging stereotypical and personal assumptions of professional practice.

Professional experience is therefore key to enculturation. Although perceived as phases of practical knowledge transfer, they play a major part in what Cuff (1991) describes as *"professional socialisation"* further defined by Loosemore & Chin Chin (2000) as being the inculcation of "*unique beliefs, values, attitudes, languages, rituals, codes of conduct, codes of dress, expectations, norms and practices*". Each profession therefore has a tendency to reinforce existing behaviours and consolidate and confirm the stereotypes of their profession in the eyes of others. The Egan Review (2004) identified the need for connections between professions and the *"establishment of integrated cross-cutting team"*', and noted that many professions had not recognised the inter-relatedness of their professional activities. CABE (2003) had been even more explicit in their demand for "*disposing of historic professional silos and developing a common understanding*".

CONTESTED TERRITORIES

Professions define themselves in many ways but one of the dominant modes is through demarcation of a knowledge base and the development and reinforcement of behaviours, attitudes and traits. Recent research (Sayce & Clements, 2010) looked specifically at the nature of stereotypes held by students and graduates, the initial sources of these perceptions and the impact of education on student perceptions. This research aimed to better understand how students formed their attitudes toward inter-disciplinarity and whether there was a perception of hierarchy and/or mutual respect between different professional courses. A survey was therefore undertaken across undergraduate

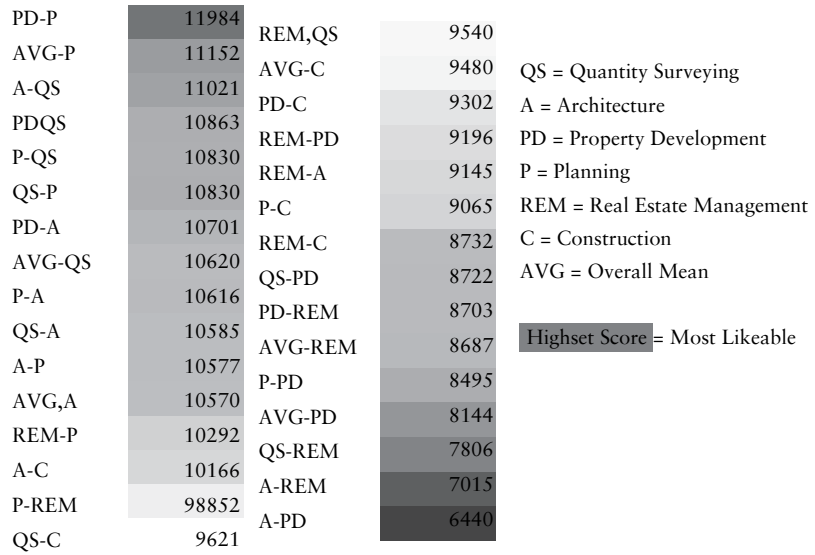
and postgraduate students on architecture, construction management, surveying and planning programmes at Kingston University. The hypothesis being that if mutual respect does not exist, the ability to work collectively for the promotion of society will simply not occur.

Encouragingly this research, albeit as yet only a pilot study, found that students recognised the need for inter-disciplinary working and considered that their educational experiences supported this endeavour; however this had not led in all cases to feelings of mutual respect. Whilst most disciplines recognised and respected the roles and responsibilities of allied professions there was a perception of hierarchy leading to potentially negative assumptions within and between professions. It was noted that only architecture students ranked themselves as the most important, however when the mean of the results in relation to the importance of disciplines was analysed, architecture did emerge as considered the most important across the professions. These findings correlate with earlier studies undertaken in relation to architecture and architectural education (Farren Bradley, 1996, Parnell, 2002; Till, 2009) and have been identified as barriers to better relationships within the construction team and between designers and the communities they seek to serve. Given the key role that architects play within the development process, and their identification as possessing important professional skills within communities (Clark, 2011) further work needs to be undertaken.

The study also asked respondents to associate character traits with each of the professions in order to ascertain 'likeability' scores. This relates to work undertaken by Anderson (1968) and Loosemore & Chin Chin (2000), which suggests that individuals are unlikely to build relationships with those who are outside recognised 'likeability' scores, inevitably impacting on their ability to work effectively in integrated teams. On average planners were identified as being the most likeable, however, not all views were reciprocated. Whilst property development students rated planners highly in terms of likeability, planners placed property development students low in their rating. A similar contrast existed between property development students and architecture students (see figure 1). Another notable finding was that 83% of the respondents had family members from within the construction and built environment professions. However, the two most significant sources of stereotypes cited were work colleagues and electronic media, with over 60% stating that the stereotypes had been reinforced during their course. Few respondents considered that stereotypes had been challenged or modified

whilst within higher education tending to confirm the process of enculturation within the practice environment.

FIGURE 1



Likeability Scores from Sayce, S. & Clements, B. (2010) *Deconstructing the Stereotypes: Building Mutual Respect*, Final report to CEBE/HEA.

Such inter-professional views give an insight into the way professional education might challenge stereotypes. However, the equally intractable problem is that of the external perception of the built environment professions and its impact on potential working relationships between communities and their professional advisers.

Much of the current debate is around the capacity of local neighbourhood groups to bring forward their own plan proposals and to exercise new powers such as a community 'right to build'. If this is legislated, as appears almost certain, the role of the advisor shifts. Professionals within the public sector, whilst responsible for the development of framework documents, will have an obligation to support and advise communities to fulfil their own ambitions and become facilitators and advisers - rather than controllers and managers. Further, consultancy teams may continue to utilise their existing expertise to advise but the power relationship will shift.

As part of a research project undertaken in 2008 (Sayce *et al., 2009*) which sought to understand the emerging skills context for the development of sustainable communities, the team sought to evaluate the extent to which core built environment professionals had developed effective skills for community engagement and the extent to which those skills had been translated into the methods utilised. The research was undertaken through a process of questionnaire, interviews and case studies and revealed that the majority of professionals who engaged with the survey (almost 80%) had some experience of stakeholder/community consultation. However, the extent and notably the type of engagement was varied and for the most part concentrated heavily on lower order engagement (such as the provision of information via formal consultation or exhibition); experience of mechanisms which characterise deeper level engagement, was significantly less common. Whilst, this result did not point to a lack of high order skills, it does suggest that experience in operating within this area is limited.

Further research, via a series of four varied case studies, reinforced these findings but the follow up interviews revealed that the range of mechanisms used for consultation had expanded in recent years. There was greater emphasis on the type of activities that required facilitation and negotiation skills. High level visual communication skills and areas demanding specific technical knowledge were also cited. However, of the case studies conducted, there was only one in which stakeholder engagement was considered to have worked well and where it was noted that the professionals had exercised great skill and sensitivity. For all the others a gap was revealed between the perceptions of the stakeholders and the professionals as to the success of the stakeholder engagement process and the final project outcome. Whilst the professionals had considered the outcome a success in their terms, the community perceived a lack of openness on the part of the professionals. Stakeholders believed that professionals were working to an undisclosed brief and that the consultation was in reality a process of attempting to 'sell a project' rather than to elicit stakeholder views.

The conclusions that were drawn from this research were that professionals have, in most cases, failed to respond adequately to the demands for community engagement. Whilst it is not vital that each and every member of the team - increasingly itself multi-disciplinary – has the full panoply of engagement experiences and skills, basic generic skills and inter-disciplinary respect underpin the ability for the collective team to work effectively with

communities. Unless a genuine dialogue is fostered, aided by a time commitment and local presence, a mistrust of professionals will result and the possibility of conflict will be increased. The notion of 'inclusive visioning', as promoted by Egan (2004) is of increasing importance – without the ability to facilitate those who will own development moving forwards – professionals will no longer have the right to claim that they are important to society. These conclusions provide support and fine grain to the previous work by Egan and Arup and have implications for both the initial education of built environment professionals and their on-going continuing professional development.

BREAKING THE MOULD - SHAPING THE FUTURE

The emerging spatial planning agenda calls for a new realism within built environment professional practice: a realisation that their role in relation to community developments has shifted from powerful expert to supporter of the newly empowered, but not necessarily articulate and informed, local community. Whilst for some communities, the position may be of an engaged conversation between an informed and articulate laity and their professional advisors, communities without a powerful and skilled local voice will require support, encouragement and interactions of a different nature – ones such as implemented experimentally by, for example, Bell & Morse (2007) in their work with communities in Malta.

The role of the professions has never been static. However at the root of their existence should be the promotion of the public interest. Whilst they will continue to work for clients and seek an appropriate reward for the skills and services they offer, they must retain cognisance of this over-arching responsibility. Throughout the industrialisation and commodification of society within the 19th and 20th centuries, they gained technical dominance, and advice has often been given within a paradigm of professional technical supremacy delivered in ways which reinforced their position. As part of the move for more sustainable development and the sustainable communities' agenda, community engagement and inter-professional working is recognised as essential. This has brought into question both the way in which the role of the built environment professional is perceived and the skill base required. Professional advice will not go unchallenged. Further, as the ways in which the development of towns and cities in the UK is increasingly a negotiated process in which the neighbourhood community is viewed as the powerbase

– rather than this resting in state-led planning – so those with technical knowledge must seek to renegotiate their frames of references in relation to their skills. With the rise of civic and corporate responsibility, so new power relationships have already started to emerge, and skills and attitudes will be challenged. Further, as over-lapping and complex technical knowledge is required to deliver complex projects, so it becomes increasingly important that mutual respect and understanding should exist not just between professional and client but between professionals from different disciplines so that they can truly work as a team to support community groups.

As Bishop (2005) states, "*Creating equity in processes, avoiding domination by the powerful and educated middle classes and so forth are all crucial issues, but simply adopting the outdated, win/lose Arnstein model of shifting power from one end of the 'ladder of participation' to the other is no way to make progress*". Whilst this may be so, there is no doubt that power has shifted and professionals must respond. Pratchett, *et al.* (2009) argue that "*Democratic thought has moved on from a time when representative and participative democracy were seen as inherently in conflict with one another*". For the built environment professions to remain relevant they must accommodate the new landscapes of power to help create the new spatial landscapes for sustainable development.

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4

Field-based Learning for Social Sustainability: Fear of Crime in an Urban Context

Robert Gant - Bridget Towers

ABSTRACT

Indicators of social sustainability for urban environments normally include quantitative measures of crime and personal safety. Each year since 2007, first-year Criminology students at Kingston University have conducted 'fear of crime' surveys of visitors to the town centre (c.850 per survey) and University students studying on the four campuses (c.1350). Findings from these cross-disciplinary exercises have been shared with the borough's Crime and Disorder Reduction Partnership and communicated to the Audit Commission and Government Office for London; they have also informed several local police and youth-agency initiatives to reduce crime and anti-social behaviour in areas of the built environment. This paper reviews the aims and learning outcomes set for the exercises; examines fieldwork practices and logistics for (annual) groups averaging 240 students; sets out the headline results and identifies trends in concern and victimisation; analyses student feedback; and discusses partnership working between the University and local authority. Benefits for participants are identified. These focus on personal development through engagement in partnership working towards the goal of social sustainability; for a minority this extends to work placements with borough agencies and departments.

Keywords: Social sustainability, fear of crime, field-based practice and logistics, student evaluation of fieldwork, partnership working.

CONTEXT

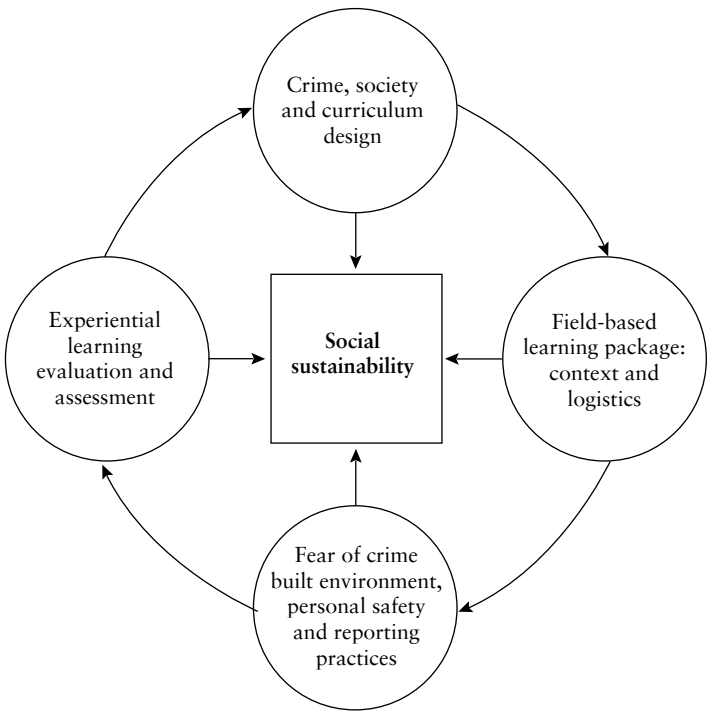
Introduction

In British Universities first year modules in undergraduate courses are often shared by different degree programmes. This situation raises a number of pedagogic issues and has significant logistical concerns for module delivery, student engagement and assessment practice. For instance, at Kingston University the Level 4 module '*Evidence and Issues*' (CM1138) is compulsory for Criminology degree programmes but made available to all students in the School of Social Science. This module is designed to introduce students to contemporary public policy debates within Criminology and to foster a critical approach to the validity and reliability of statistical evidence. The curriculum covers social survey data and forensic science data. It is delivered over a twelve week semester through weekly one-hour lectures, two one-hour classes and fieldwork. Module design and delivery are consistent with the principle of '*learning by doing*' articulated by Takata and Leitling (1987) and the aphorism '*Tell me and I will forget; show me and I may remember; involve me and I will understand*' (Raddon, Nault and Scott, 2007). The Kingston approach embeds the critical pedagogic principle of '*learning through doing and understanding through practice*' derived from the Higher Education Authority Subject Network for Sociology, Anthropology, Politics (C-SAP) project at the University of Aberdeen, an initiative that taught cross-disciplinary social research methods through fieldwork practices focused on academic and community action goals (Ingold, 2000). It also builds on community-engaged teaching and learning that remains central to pedagogies for Education for Sustainable Development (ESD) whilst respecting the long track record of Criminology as a discipline of applied practice rooted in the Chicago School of human ecology. The central challenge for the academic programme at Kingston was to create an effective synergy between community engagement and academic learning experiences that illuminates the dynamic relationships of fear of crime and social sustainability.

Fieldwork training for over 240 students each year connects with that overarching objective and has been directed towards social sustainability (**Figure 1**). For that purpose, the two members of the teaching team (with expertise in Social Geography and Criminology) have extended a cross-disciplinary teaching exercise developed in partnership with *Safer Kingston,* the borough Crime and Disorder Reduction Partnership (CDRP). Since 1998, this

annual survey has monitored personal safety in the Kingston environment. It has two dimensions: a town centre strand that focuses on people using Kingston Town Centre; and, since 2007, a strand built around personal safety issues experienced by University students, a significant cohort in the demographic profile of the borough. This chapter introduces the aims and objectives set for the exercise. Discussion of the survey design follows with consideration of logistical issues and field practices. Survey findings are illustrated with regard to the serial presentation of headline findings from four consecutive surveys 2007-2010. From a pedagogical perspective, student evaluation of the exercise and achievement of learning outcomes is then summarised. This extends to a benefit-cost interpretation of the exercise at a time of increasing pressure on institutions to minimise risk to students in the field whilst offering a range of 'value-for-money' experiences embedded in the curriculum (Herrick, 2010).

FIGURE 1
Fear of Crime: A Pedagogic Approach Towards Social Sustainability



The fieldwork programme in "Evidence and Issues" is designed to achieve four key objectives. These are to:

- teach the principles and practice of survey design, field administration and data analysis, and raise awareness of social sustainability issues
- develop the skills of team working and apply investigative skills to local issues of crime, disorder and anti-social behaviour in the Kingston environment
- contribute, from local experience, to the debate on 'British Crime Survey versus police statistics' for crime pattern analysis and interpretation
- engage with the Crime Reduction and Disorder Partnership (*Safer Kingston*) in monitoring trends in student perceptions of crime and levels of victimisation, and contributing to on-going review of the Borough Strategic Assessment and Partnership Plan

These aims are consistent with the stated learning outcomes for the module. On completion of the exercise, in the wider context of the curriculum, students are expected to have:

- gained personal experience in the conduct of face-to-face interviews
- experienced the essence of teamwork and time-management in meeting stated targets for data collection and collation
- developed skills in task negotiation, critical reflection, and oral presentation
- added, through fieldwork and seminar discussion, to the time-series data-base on personal safety in the Kingston environment

THE FIELD-BASED LEARNING PACKAGE

Managing Crime and Disorder in the Urban Environment

Kingston upon Thames, a relatively affluent borough in South West London with a population of 160,000, has one of the lowest number of recorded crimes in the capital (www.met.police.uk/crimefigures/data; Local Futures Group, 2007). The town centre supports one of the largest retail centres in

the South East, extensively re-modelled around a compact and well-serviced pedestrianised core in 1989/90. It provides employment to 17,500 workers in the retail and commercial sectors. Furthermore, it supports a vibrant and well-managed night-time economy that qualified for the Civic Trust 'Purple Flag' in 2009 (Civic Trust, 2009). Licensed establishments, including several well-known night-clubs, have an approved capacity of 15000. Metropolitan Police statistics show that in the five years since September 2004 the borough total for notifiable offences has reduced from 15,297 to 11,284. Typically, in each year, one third of these offences are concentrated in Grove ward which covers the town centre (www.met.police.uk/crimefigures/data). The *Crime and Disorder Act 1998* and *The Police Reform Act 2002* placed the responsibility on police forces and local authorities to work in partnership with a range of associated agencies to develop three-year strategies for community safety (Walker, *et al.,* 2009).

This legislation has had important implications for urban design, policing, the commercial and social vitality of town centres and growth of the night-time economy (Chatterton and Hollands, 2002; Talbot, 2004). The introduction of the Licensing Act 2003, Anti Social Behaviour Act 2004 and Government Strategy for Reduction of Alcohol Harm 2004, however, has further highlighted the need for a careful monitoring of public concern regarding personal safety in an ever-changing urban environment (Gant, 2010; Gant and Towers, 2010). More recently, *The Police and Justice Act 2006* has amended the *Crime and Disorder Act 1998*. The newly-instituted Strategy Group has been charged with undertaking a Strategic Assessment (at least annually) and preparing a three-year Partnership Plan (reviewed annually) to reflect new and emerging priorities. Included in the first Kingston Partnership Plan are six priorities: alcohol misuse; violence against the person; drug misuse; anti-social behaviour; crime by and against young people; and domestic violence and hate crime (Royal Borough of Kingston upon Thames, 2008). In this context, serial surveys of personal safety, including town centre visitors and University students, can play an important role in monitoring local performance and sustainability practices.

Field Practice, Fear of Crime and Survey Logistics

Personal safety is a real concern for many people (Gray, *et al.*, 2008; Walker, *et al*. 2009). Where there are large concentrations of young people with distinctive life-styles, as in University towns, this issue becomes very important to

life-style and social wellbeing. However, it is important to note that in British cities fear of crime far exceeds the actual levels of recorded offences (Killias and Clerici, 2000; Farrell *et al*., 1997). Moreover, for some social groups, fear and anxiety can become as great a problem as crime itself. Furthermore, media attention can fuel public concerns over race/hate crime, homophobic crime and various strands of anti-social behaviour, such as vandalism and noise, in local environments. Even if the statistical risk is low, people may still justifiably worry because of the potentially distressing consequences *if* they were to be victimised. There is evidence, too, that fear of sustaining personal injury or of becoming the victim of a less serious crime or incivility can influence people's behaviour, movements and levels of activity in major shopping centres. The fieldwork exercise addressed these issues and focused on Kingston University students' perceptions of Kingston town centre as a secure place for shopping, recreation and part-time employment, at different times in the day.

An introductory lecture briefed students on the concept and semantics of 'fear of crime'. A background survey document was then issued and discussed. Issues covered included: the aims of the survey, learning outcomes, administrative procedures, timetable for activities, team membership and assessment topic. Students were introduced to the pilot-tested questionnaire designed for on-site interviewing and (possibly) inclement weather. Well-spaced, it covers two sides of an A4 page and can be read by Optical Mark Reader (OMR). It uses scales to measure personal levels of concern regarding: a graded set of offences and types of anti-social behaviour; the use of the town centre in daylight and darkness at different times of the week; and perceptions of safety related to public and private transport services. Provision is made to record experiences of victimisation and respondent characteristics. In addition, since 2009, the survey has collected evidence on the police response to reported crime and incivility.

Each year over 240 students were registered on the module. For logistical reasons, the group was divided into two and the exercise repeated in timetabled hours on consecutive weeks in mid-February. Guidelines for completing the questionnaire were issued. To build confidence, each student in the lecture theatre was tasked with interviewing a neighbour. Questions were invited to ensure standardisation in field practice and recording technique. Completed questionnaires were examined and issues identified to improve the quality of data entry. At this time, students were forcibly reminded to use an HB pencil (not a blotchy felt-tip pen) for 'filling-in' boxes on the question-

naire, to avoid folding or stapling the sheet, spilling beverages on the paper or getting it wet. For personal comfort, the importance of warm and weather-proofed clothing was stressed and students urged to buy a clip-board. These precautions were vital to ensure that the OMR could read, correctly, the data entered on the completed proforma.

As directed, students reported to supervisors in the base-room. Field teams of six members were established. Each had a nominated leader charged with: coordinating the team's work and time-management; securing the team target of 60 'on-site' interviews with a representative sample of students; ensuring that approved University health and safety safety regulations were observed; and overseeing the recording process. Teams were dispatched to the four University campuses (Penrhyn Road, Knight's Park, Roehampton Vale and Kingston Hill) for fieldwork sessions set within 2-hour class slots. Interviewing was staged between 1000hrs and 1800hrs. The teams working at Kingston Hill and Roehampton Vale used the University's inter-site bus service from Penrhyn Road. At the end of each session, teams returned to the base room and the completed survey proforma were checked by academic staff before processing by OMR. Then, in preparation for the timed assessment, students were urged to share working experiences and make brief notes. Subsequently, the end-of-survey report written by academic staff was communicated to students on *Studyspace*, a University-wide Virtual Learning Environment (VLE). Three weeks later, the final report was submitted to the Kingston Crime Reduction Partnership as part of the University's commitment to partnership working.

In-Course Assessment and Achievement

Prior to each fieldwork session, participants were reminded to read again the printed title for the written assessment. The mark for fieldwork was set at 40% in the end-of-module assessment. It comprised two elements. Firstly, academic staff overviewed the questionnaires returned from each team. A group mark (maximum 10%) was awarded based on adherence to instructions regarding data entry; overall quality of the data record; and satisfactory attainment of the targeted workload. Secondly, one week following the fieldwork, students completed a timed assessment entitled: "*Critically review the methods used for the study of personal safety in the urban environment. How might the survey have been improved? What techniques did you use to secure a good and unbiased response rate?*" This (pre-circulated) in-class as-

sessment (maximum 30%) was designed to consolidate learning around the fieldwork experience.

Consistent with module results in previous years, in 2010 the overall pass rate for the 233 students was 85%. Completion and progression rates were higher than for other Level 4 modules in the Criminology programme. Overall, 89% of students passed both the fieldwork and in-class test whilst 25% secured full marks for the fieldwork element. An alternative assessment to test learning outcomes was designed for the 3 students with disability-related support needs, all of whom passed.

HEADLINE SURVEY FINDINGS 2007-2010

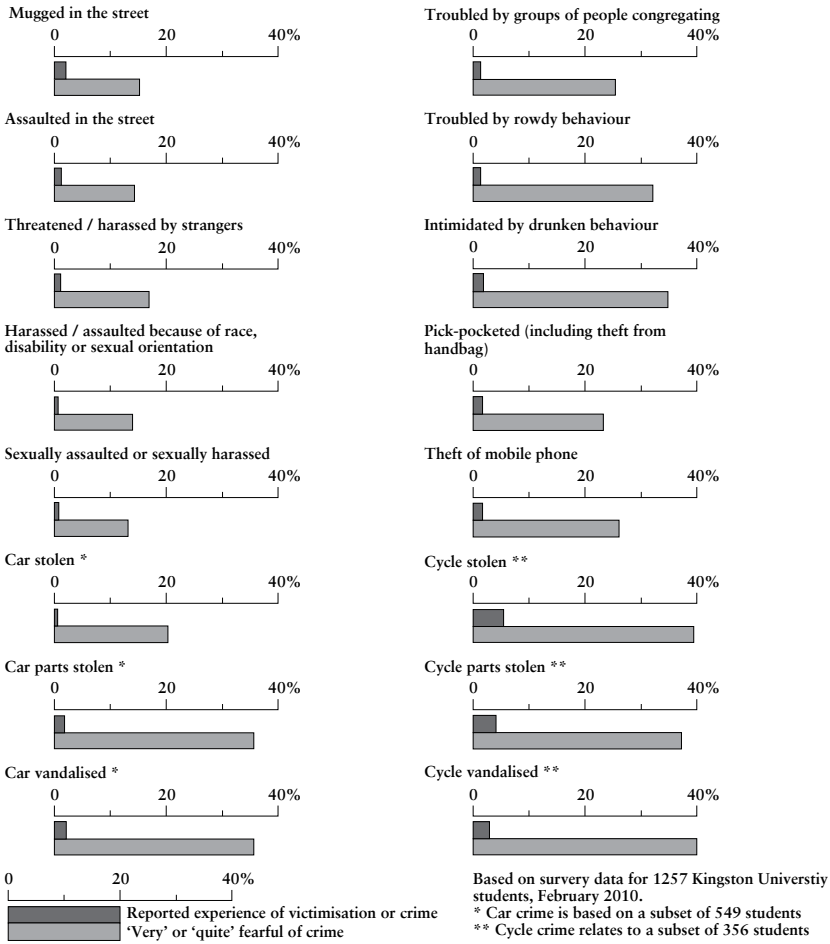
Fear of Crime, Victimisation and Reporting Rates

Although this report focuses on findings from 2010, for illustrative purposes with regard to trends in social sustainability, and to flavour the core theme of pedagogic practice, it overviews *headline results* from comparable surveys since 2007 (see, for reference and a further discussion of the statistical base, Gant, 2010; Gant and Towers, 2010). Each year, field teams interviewed in excess of 1150 University students, representing around 5% of the total enrolled at the University. Only minor inter-campus differences were detected in the social, demographic and journey-to-study profiles of respondents. **Figure 2** highlights the situation in 2010. It effectively demonstrates the extent to which fear of crime exceeds the reported level of victimisation across 16 categories of crime and incivility.

Over the longer period 2007-2010, the comparative surveys confirm that:

- with the exceptions of threats or harassment from strangers, intimidation from drunken behaviour, and theft of a mobile phone, the proportion of students victimised rarely exceeds 2%; and that sexual assault and harassment and assault in the street are normally below this level.
- the proportions claiming to have been intimidated by drunken behaviour, threatened/harassed by strangers, registering concern over rowdy behaviour and having had a mobile phone stolen have decreased consistently in the time period; in contrast, reported levels of street mugging and criminal assault have increased marginally.

FIGURE 2
Victimisation and Fear of Crime, 2010



- autocrime levels have generally fallen; in contrast, cycle crime has increased
- around one quarter of those reporting an incident in 2009 and 2010 judged the police response as 'very interested'; in contrast, under 15% claimed that the police were 'not interested'.
- each year at least 30% claimed to be either *'very' or 'quite'* worried about: being intimidated by drunken behaviour; being troubled by

rowdy behaviour; groups of people congregating; and theft of a mobile phone.
- cyclists and motorists registered consistent concern over theft from, and damage to, property
- in general, however, University students were, consistently, *less* concerned about: sexual assault and harassment; harassment/assault on grounds of race, disability or sexual orientation; and physical assault in the street.

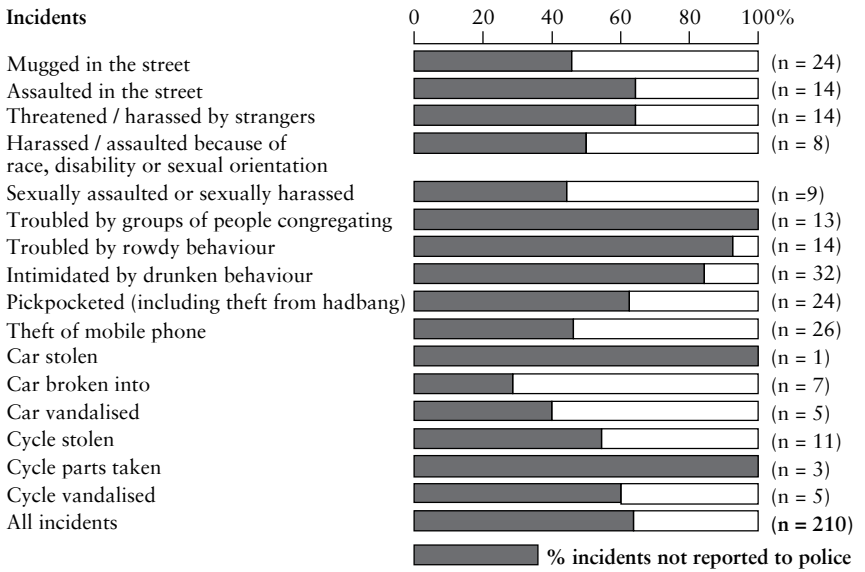
Under-reporting of crime persists. In 2009 (the first occasion on which these local data were collected) 71% of all incidents had *not* been reported to the police; this total included over 85% of incidents involving drunkenness, harassment, groups loitering in public places and causing annoyance to members of the public and instances of rowdy behaviour. In contrast, reporting rates for mugging and pick-pocketing were higher. Likewise, for reasons of claiming against an insurance policy, higher reporting rates characterised the theft of bicycles and cars. Notwithstanding a lower volume of crime reporting, the pattern for 2010 captured in **Figure 3** is similar.

Transport and Personal Mobility

Kingston functions as a major transportation hub in south west London. Notwithstanding relatively low rates of victimisation, students attach importance to personal intimidation, drunkenness and threatening and rowdy behaviour perpetrated by groups of people who (periodically) congregate on the streets and in public open spaces. Consequently, personal access to town centre facilities at different times of the day, and day-of-the-week, become an issue in promoting a sustainable life-style. In addition to continued investment in CCTV, the local authority has developed a range of initiatives, including Safety Mark Awards for car parks and mobile CCTV systems. These have direct bearing on student perceptions of personal safety. Survey findings indicate that:

- relatively few students avoided Kingston town centre in the hours of daylight; in contrast, during the hours of darkness at weekends, around one third of students admitted to avoiding the town centre at least '*sometimes*'
- Since 2007, the proportion feeling '*very safe*' has increased, marginally, for most transportation facilities: train station (+3%); car

FIGURE 3
Incidents of Crime and Incivility Not Reported to the Police, 2010



parks (+3%); and bus stops (+1%). In concert, those feeling '*very safe*' when walking in the town centre have increased from 84% to 88%

- a stable 62% of students were aware of CCTV coverage in the town centre

EVALUATION

An evaluation questionnaire was completed by all students. Written questions covered students' experience of conducting the survey, personal preparation and recommendations for improvements on the exercise. Illustrative findings in 2010 show that:

- students had engaged positively with the survey practice; over 90% felt that participation in partnership research had deepened their understanding of research methods
- most respondents acknowledged the importance of the pedagogic principle of 'learning by doing', witnessed by qualitative comments

such as *"experiencing it at first hand rather than reading about it"; "gaining firsthand experience of how a survey is done"; "experiencing the difficulties of selecting a sample first hand"; "learning about research methods by actively taking part"*

- one quarter claimed that participation in criminological research had enriched their learning experience; one student wrote "*it gave me an insight into victimhood*" whilst another claimed that it had provided an opportunity to "*make people realise that this is serious research that we are doing*"
- 10% of students claimed that measured interaction with elderly people had provided a new and positive life experience
- the time-constrained exercise had developed personal confidence; moreover, approaching people in the street, securing participation and coping with rejection were identified as the most challenging aspects of the exercise
- even the small minority who had not enjoyed the (weather dependent) fieldwork exercise admitted that it had reinforced an understanding of survey methodology
- three quarters of those without previous experience of street interviewing confessed to personal difficulty in coping with the 'messy reality' of on-street fieldwork

From a staff perspective, informed by student feedback and operational practice, the design, management and delivery of future surveys will embrace: the prior training of students with new video materials on techniques for conducting on-street interviews; actions to secure full attendance of students at briefing sessions, and the development of strategies for dealing with the potential falsification of fieldwork data; and measures to monitor more closely students' field performance and background preparatory work through the assessment process.

CONCLUSIONS: THE WAY FORWARD

University students are major consumers of town centre services and contribute significantly to the local economy. They adopt a life-style that is different, in many respects, from that of the wider population. This often involves personal movements to travel destinations on foot, by cycle and public transport during the hours of darkness. Personal safety is a significant and enabling

concern. This investigation has identified a number of issues that relate, comparatively, to student safety in the town centre environment. It identifies differentiated patterns of reporting for crime and incivility. These concerns will be monitored to identify trends and as a contribution to the development of sustainable life-styles for students at Kingston University.

The survey is an important pedagogic initiative designed for a large student cohort. It makes a significant and incremental contribution towards the understanding of social sustainability issues in an urban context. Moreover, it sits firmly within the ethos of the Criminology degree programme and provides students with a socially-grounded approach towards crime and justice through community-based fieldwork. By fostering this genre of community-University partnership, the School of Social Sciences aims to encourage both academics and students to develop a sense of civic contribution and participation. In the wider context of partnership, such engagement has already produced tangible benefits including independent assessment towards the successful case for 'Green Flag' status (Audit Commission recognition of exceptional achievement in town centre transformation and safe development of the night-time economy); post-graduate internships with the borough, University staff secondments, knowledge transfer projects and major collaborative research bids.

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5

Comparing the Communication of Sustainable Business Practices – An Empirical Approach to Develop Cultural Competences in the Meat Economy of North-west Germany Towards Sustainable Concepts

Irene Antoni-Komar - Reinhard Pfriem
Hedda Schattke

ABSTRACT

Benchmarking as a useful method for companies to learn from competitive best practices has increased in importance in recent years. The aim of this paper is to highlight potential improvements in sustainable communication practices for the meat sector in north-west Germany by developing cultural competences in the process of benchmarking. Besides the deduced empirical results of a benchmarking and a consumer study, two main challenges for a successful development towards sustainable concepts are presented. In developing transferable strategic recommendations for companies, it is important to reflect best practices against the background of the underlying structural and cultural context of strategic business practices. Additionally, consumer behaviour, especially consumers' potential and willingness to modify their actual food routines towards sustainability, will be considered. To this end, the results of benchmarking are correlated to the recursiveness of consumer demand and integrated into a cultural approach in economics which frames the empirical results in the meat sector. By transforming resultant strategic recommendations into sustainable entrepreneurial practice, the paper shows the significance of cultural competences in strategic management.

Keywords: benchmarking, sustainable communication, meat economy, recursive strategic management, cultural competences

INTRODUCTION

Benchmarking has increased in importance in recent years because it is a useful tool for companies to ensure the flow of ideas, to identify competitive gaps and to improve the company's performance. It consists of four main steps: planning, collecting, analysing and adapting data with the aim of learning from other companies' best practices (cf. Jarrar/Zairi, 2001, 74f.). While many recommendations have been made concerning the planning steps of benchmarking, for example the benchmarking partner selection phase, whose successful conclusion is one of the most crucial factors (cf. Razmi/Zairi/Jarrar, 2000), not many studies and results have been published which describe the process itself and its empirical bases, the challenges and useful outcomes. Therefore this paper aims to give brief recommendations about the method and its implementation in the context of the research field as well as to elaborate on a potential for developing sustainable communication strategies.

In a time of a multi-option society, brand profiles and management concepts as well as an integrated and consistent communication of companies lead to more customer orientation. Now and in the future, orientation towards relations in marketing and communicational approaches (pull communication) as well as interactive web-based communication, such as social media activities, will grow in importance (cf. Bruhn 2009, 550f.), not least for the meat sector. In the meat economy in north-west Germany, competition is intensifying. The meat sector is currently confronted with many different laws and economic, ecological and societal challenges (vegetarianism, veganism), meaning that the sector is facing a time of crisis (cf. Ilea, 2008). Increasing requirements for environmental protection, food safety, animal welfare and animal rights are becoming more important (cf. Steinfeld, 2006, cf. Adams, 2008; Foer, 2010) and are, at the same time, delegated in part to companies by national and European regulators. Consumer attitudes towards industrial livestock farming as practised, for example, in north-west Germany, especially in Lower Saxony, are also changing. Companies have already conceded that sustainable development, and communication concerning it, is an issue they must address and have moved in different ways to include it in their strategies. The motivation of companies to implement sustainable strategies can be explained, for example, by a lower societal and political resistance of pressure groups against their production methods or products, and is underlined by their complying with environmental regulations or improving their

environmental management as soon as they gain a competitive advantage (cf. Jansen/Vellema, 2004, 2), for example by profiling the meat supply.

Benchmarking is thus a helpful tool to highlight potential improvements in sustainable communication and marketing strategies of companies in the meat sector in other regions (south Germany) and countries (Austria, Switzerland). These findings are useful in promoting a sustainable communication strategy for the meat sector of north-west Germany. To be successful in the future, "organisations need to rethink their structures, products, processes and market. They must re-establish themselves to be quicker to market, customer focused, innovative, nimble, flexible, and be able to handle rapid change" (Jarrar/Zairi, 2001:75).

To analyse the potential for transforming strategic recommendations into successful entrepreneurial action, the following steps towards sustainability (in communication) are discussed: comparing the communication of sustainable business practices in the meat economy (Section 2), correlating them to the recursiveness of consumer demand (Section 3), and integrating them into a cultural approach in economics, which frames the empirical results in the meat sector (Section 4). In the last section (5), our paper outlines the significance of cultural competences for an authentic sustainable communication strategy.

BENCHMARKING THE COMMUNICATION OF SUSTAINABLE BUSINESS PRACTICES

The debate on sustainable business practices implies a variety of different interpretations and concepts. In the context of this paper, this means that the performance of sustainable business practices in 'sustainable communication' is guided by two different points of view: first, the communication concerning the comprehension of sustainability in the meat sector and, second, the concept of sustainable communication. The comprehension of sustainability in the meat economy and its communication strategies should, apart from its economic, ecological and social aspects (cf. Brundtland 1987), also include the underlying cultural context. Important criteria should embrace both supply and demand and generally deal with issues such as conditions and transparency of livestock farming and production, animal welfare, sustainable quality aspects (product *and* process quality) and locality, as well as changing consumer demand. With benchmarking as a concept orientated towards learning from the best and focused on a continued process-based comparison (cf.

Mertins/Siebert 1997, 78) and not on "its ancient practice of *ad hoc* imitation" (Zairi/Ahmed 1999: 815), it is possible to integrate different aspects of sustainable meat production and communication and to improve the performance of the company. Benchmarking generates a sense of cooperativeness to exchange and compare ideas and strategies and time to reflect on these.

The focus of this paper is on a qualitative benchmarking done from a researcher's perspective because of the strategically sensitive issues of 'communication and marketing strategies'. It is based on empirical studies conducted in a research project[1] between 2007 and 2009. Our paper presents the results as a triangulation of methods (cf. Flick, 2004), which includes qualitative and quantitative data from companies, combined with a literature analysis.

Benchmarking Design, Methodology and Scoring Rubrics

In building a prospective sustainable communication strategy by way of benchmarking, current communication strategies and activities of companies should be analysed first. A qualitative (n=7) and a subsequent representative quantitative study (n=45) of companies in Lower Saxony identified weaknesses of communication and marketing strategies (cf. Pfriem/Schattke/Uphoff, 2009). The data were analysed with the help of an audio guideline on the theoretical basis of the integrated marketing concept of Meffert (cf. 2000). The benchmarking objects (scoring rubrics) are deduced out of communication strategies involving intermediates, customers, the public/society and internal communication and their impact on sustainability. The quantitative study was carried out with the help of a fully standardised questionnaire in the form of a Computer Assisted Telephone Interview (CATI) to support the developed hypotheses. These data provide a basis of comparison for the benchmarking. Subjects of these studies were companies in the meat processing industry (fresh meat and sausage production) and meat supply chain (producing groups, fabricators, slaughterhouses, retailers) from north-west Germany.

The benchmarking subjects (n=11) were best practice companies in the meat supply chain in south Germany, Switzerland and Austria. The benchmark interviews were conducted with the same audio guideline and subjects similar to those in the previous qualitative study and should give answers to the question of *how to build a successful concept of sustainable communica-*

1 www.verbundprojekt2-faen.de

tion away from price orientation. Therefore qualitative benchmark data was collected from companies which have already implemented sustainable brands, sustainable quality aspects or new marketing and communication concepts based on sustainability.

Comparing the Communication of Sustainable Business Practices in the Meat Economy

The empirical study in the meat economy of north-west Germany (Lower Saxony) shows that 83% of the companies interviewed know about sustainability and that various comprehensions of sustainability exist. The aim of sustainability is less clearly defined by companies and only referred to by using synonyms such as 'quality' (9%) or 'traceability' (7%) without a corresponding and representative comprehension in the relevant sector. Cuts of meat are seen as specialties and reflecting quality differentiation, while sustainable processes and product quality are considered less important for a quality differentiation strategy. This leads to a more technical definition and differentiation of meat quality and likewise explains companies' communication weaknesses in their consumer relations' (unknown, internal and professional certificates and quality standards are used in b2c communication). A good price, not quality communication, is seen as the most successful content in merchandising (72%). As a result, most of the companies are focused on cost leadership strategies rather than differentiation and profiling strategies. Only 50% of them (including sausage production companies) are brand orientated and therefore interested, and even actively engage, in marketing and communication strategies. The high investment needed for communicational activities and the low potential, seen due to structural constraints (retailers and retail brands), excludes an active and proactive marketing and merchandising strategy by manufacturers. Concerning companies' public relations, press and media are viewed critically and not as a helpful medium for communication with the public. Companies allow themselves only marginal space for scanning societal and cultural issues and deal with these in day-to-day business, even though they have understood the increasing importance of topics such as climate protection, genetic food, animal welfare and overall social acceptance (Albersmeier *et al*. 2009) of the sector. The need to make consumer information more effective, improve name recognition and company image (65%) has already been acknowledged by companies but has not yet been incorporated into their business practices.

The following points outline the main differences in sustainable communication practices between companies in Lower Saxony and best practice companies in south Germany, Switzerland and Austria. A comparison of these practices shows that one of these differences lies in the structural components of the meat sectors themselves. The best practice cases under review (in the other countries or regions) have mostly different and specific structures and organisations of their meat supply chains, which impact differently on the strategy and performances of the company, for example vis-à-vis retailers and customers. In addition, the regions are characterised by their geographical, local, cultural and historical distinctions, affecting the business practices that have evolved there. The meat economy of north-west Germany has an intensive, highly efficient mass-production orientated system while the production in Switzerland is rather based on a national profiling of supply and demand. Especially in Switzerland, companies (mostly with the help of retailers) have developed and supported the concepts of sustainability and organic farming from very early on.

Despite these transfer problems and even though the benchmarking is not a representative study allowing for a high degree of generalisation, the following entrepreneurial results can be reported.

In best practice companies, sustainability is clearly outlined and effectively implemented in corporate strategies, guidelines, corporate culture or reflected in established criteria for marketing and brand management. Sustainable guiding principles and a strong corporate culture regarding sustainability serve to legitimate and explain sustainability orientated topics and activities such as reduction of CO_2, support of local food culture, protection of biodiversity or support of varieties in breeding. These criteria, aimed at sustainability, also contribute to a corporate communication strategy, giving the company an authentic, trustworthy and reliable profile.

1) In best practice companies, the comprehension of sustainability is based on economic, ecological and social dimensions, supplemented with a more differentiated, deeper understanding of quality in terms of sustainability, on an awareness of the financial situation of the farming sector and the limited capacity of rural farming based on regional culture. In addition the responsibility towards animals kept for meat (animal welfare and ethics), including the disclaimer regarding genetically modified organisms is mentioned. Companies

use these criteria for their corporate strategic differentiation, market positioning and for the development of more effective customer relations with their focused target groups.

2) Sustainability criteria also serve to convey the communicative contents of labels and brands, marketing strategies and local quality programmes, which can be differentiated as follows:
   a) traditional, cultural and geographically based breeds,
   b) alternative feeding systems,
   c) husbandry systems (e.g. mother cow husbandry),
   d) animal welfare concepts (e.g. developed in cooperation with animal protection activists) and through institutional control and quality seals (e.g. organic farming).
3) In contrast to most companies in north-west Germany, the best practice cases are more concerned with societal issues (genetic foods, climate change) and demands of stakeholders (e.g. animal rights activists, environmentalists, NGOs). They introduce these issues into public relations initiatives or into business cooperations, or have integrated these stakeholder demands from the beginning when developing sustainable brands and quality programs.
4) Best practice companies reflect critically on issues such as feeding systems (grass-feeding, feeding of whey), biodiversity of breeds and species or alternative livestock farming systems such as pasture management, mother cow husbandry or free-range breeding instead of indoor breeding, and integrate these issues into quality programmes and brands (see above). The communication of these differences may also improve consumers' understanding and the traceableness of animal husbandry and meat production as a whole. This is important because alienation from, and lack of competence in, food practices and sometimes insufficient knowledge on the part of consumers, as revealed by the study conducted in Lower Saxony, reduce the potential for communicative contents regarding sustainability, e.g. in market communication.

Ultimately, the analysis of best practice companies shows that they critically reflect on their products and processing systems and try to find a more sustainable way of producing, selling and communicating "meat", especially when taking into account the global problems of sustainability in

their everyday business practices. *"We feed our cattle with roughage. I think it's not acceptable that now when corn is becoming scarce and the price of basic food is increasing, competition for food arises between cattle and humans. Thus our pasture husbandry with ruminants such as cattle has become even more sustainable" (expert from a producing group).*[2]

Furthermore, the results of this analysis show the variety of sustainable contents in meat production and of sustainable elements used in companies' communication. Understanding sustainable development as a regulative idea for strategic management is further fostered by a process of interaction between companies and society in specific contexts (cf. Pfriem, 2006) and ensured by relevant communication strategies. These entrepreneurial results show that in the meat economy sustainable business management orientated towards the public and society at large can be accomplished. According to the market situation, the type of company and the stage in the supply chain, successful concepts can be seen to emerge in branding, upgrading quality differentiation, focusing on niche strategies and cooperation with mostly critical stakeholders and business partners. In sum, best practice companies demonstrate the possibilities and necessities of quality differentiation and communication by developing sustainable strategies and concepts.

CONSUMER DEMAND AND CULTURAL CONTEXT

Besides these entrepreneurial steps, one of the main problems of developing a successful sustainable communication strategy is consumers' potential and willingness to modify their present food routines towards sustainability. Additionally, the results of another research project (Wenke^2)[3] help to understand consumer practices. As suppliers, companies have to be aware of barriers to, as well as opportunities for, sustainable consumption, asking: *What are the main orientations of consumers today in buying sustainable food products, especially meat? Which effects increase the willingness to pay premium prices for sustainable food products?*

In this section, we present results based on qualitative and quantitative empirical research in the field of sustainable food consumption, conducted in north-west Germany between January 2008 and January 2009. The basic research question asked why sustainable consumption patterns had only partly diffused. In order to structure the field of sustainable food consumption, we

2 For better understanding German quotations have been translated.

3 www.wenke2.de

built three case studies, that is, of organic, local, and fair trade food. We conducted 16 semi-structured interviews with *experts* in the field of food supply and 3 group discussions with intensive *consumers* in the fields of organic, local, and fair trade food. Participants (n=26) were relatively heterogeneous with 18 women and 7 men; their age distribution was between 17 and 60 (for further details, see Antoni-Komar/Pfriem, 2010).

In the quantitative sample, 402 people were interviewed with a standardised questionnaire. The focus of the research was on consumers who had experience in buying food. Consequently, they could be assumed to have the knowledge to answer questions about food consumption. The people we asked lived in the area of Oldenburg (Germany), and we approached them in the street and in shopping centres. The questions were based on hypotheses deduced from theory. We mainly used a five-point Likert scaling. The sample is balanced and heterogeneous with 56% women and 44% men. The age distribution was between 20 and 50 (79%). The level of education also showed no significance and is in line with a representative sample. Incomes amounted to between 1000 and 5000 euros; the distribution of income groups was balanced.

Below, we present some empirical results on the recursiveness between supply and demand, especially the relevance of conflicts and scandals for changing food practices and the potential of interaction between supply and demand.

The Impact of Conflicts and Scandals

While shopping routines were identified as high constraints for the change in food practices by consumers and experts, the qualitative data on the supply and intermediate sector confirmed an ambivalent quality of the impact of environmental scandals on the change of food practices towards sustainability. Due to only short-term mobilisation, a discourse on *"Alzheimer's disease of consumers"* is conducted by experts. However, the data confirms that a scandal-laden conflict situation leads to a (re-)interpretation and change in food practices. Following the loss of confidence in meat products after the disclosure of scandals, there have been shifts in the inquired products and qualities (e.g. conventional → organic) or shopping venues (e.g. discounters specialty shop). Meat products in particular are more affected by such fluctuations than other food product categories. Apart from the shifts affecting quality and purchase venues, scandals can lead to a reduction in meat consumption: *"People*

... of certain social classes ... simply eat more consciously. They eat less meat and when they do, it is high-quality meat"; expert). In personal crises caused by radical changes in life and necessary health orientations, stronger reasons for long-term changes in social practices are observed *("...perhaps, if there is one point in life, then it is, I believe, the first child*"; expert; or *"... [if] people get the red card from their physicians, you must change your life";* expert).

More clearly than statements made by experts, discussions in consumer groups provide important impulses for a change in food practices, dealing with food scandals and major biographical changes (life cycles, health, taste, ethics). In the long run, these processes of (re-)interpretation lead to a transformation of biographically motivated changes in consumer practice into ethical orientation: "*Now, I take a greater interest in the topic of food. What does food mean for the environment? And I recognise also social aspects and such things. I wish that the food I eat does not damage my environment too much"* (consumer).

In the quantitative sample, we explored the function of scandals or radical life changes by asking: *"Did your food practices change in recent years?"* We used a five-point Likert scaling with ten different answering options. A surprising answer given by 173 of 402 interviewees (44%) was that their food behaviour had actually changed in the last few years. Asked for the reasons, 71% answered that their health consciousness had increased. Other important reasons given were an increase in financial possibilities (59%), environmental consciousness (53%) and food scandals (43%). Apparently, a value change regarding health and environment can be assumed for changes in food consumption. These are not the only factors, however. Often several factors forming a cluster of reasons cause an accelerated change in food practices. These factors are observed in addition to health consciousness (71%), scandals (43%) and illness/allergy (31%) or in the context of radical life changes, importance of changed living conditions (53%), a new partner (18%) or a baby (21%).

We also explored the reasons for buying organic products by asking an open question: *"What are the reasons for you buying organic products today?"* As outlined above, health considerations were the most important reason (56%), but the second most important reason was "taste" (33%), followed by "environmental protection" (29%), "ethical motives" (18%) and "fewer pollutants in food" (17%). We can thus conclude that health orientation as a higher ranking motivation of food consumption is connected with taste, environmental protection and ethical motives.

These qualitative and quantitative results are in line with Cicia *et al.* (2009), who, in a qualitative consumer research (n=45), constructed a hierarchical value map with "Health" (n= 39) and "Environment" (n=10) as two main purchase motivations for consumers buying organic products. In a quantitative step, it is shown that health and environment proved to be the main motivations explaining consumer willingness to pay a premium price for organic products. These results may explain the second rating of financial possibilities (59%) among the answers of our interviewees. Health orientation as the most important reason for changing food consumption is connected to the willingness to pay a premium price for organic products. Wier *et al.* (2008) argue that in most studies health considerations play a major role in consumer demands for organic food, but in a Danish survey, they identified improved animal welfare and environmental protection as valued attributes of organic food to which most respondents accorded importance. In contrast to our results, health attributes were rated as third most important (Wier *et al.* 2008:412). This difference can be explained as follows: In our empirical research, we asked about reasons for changing food practices in the past. In so far, no real preferences are described, but social practices of food consumption are evaluated against the background of a specific biographical context. More significant is the highlighting of a threefold value of organic products, orientation to health, taste and to the environment, because health components can be adopted or substituted by non-organic competitors.

The Relevance of Social Interaction Between Supply and Demand

On the side of demand (in the discussion groups), especially the lack of transparency concerning the indications of origin and the anonymity of the product "meat" is deplored – a trend which has been advanced particularly by the discounting process and permanent availability of global products: *"I believe that I do not check many things, if I do not experience it coincidentally"* (consumer). As a consequence there is a reduced availability of local products. Non-transparent structures can be weakened by building communication strategies and personal relations. In the interaction between suppliers and customers, the sales personnel plays an important advisory role. With growing differentiation of product quality, there is a greater requirement for comprehensive communication and consultation. In contrast to the sales personnel in supermarkets and discounters, whose low consulting competence is underlined by experts and discussion groups *("they do not know, what they*

sell", expert), a high consulting competence in the specialised trade creates proximity and confidence and provides for strong customer loyalty.

Furthermore, a high affinity for the term 'region' can be deduced from the data. Experts even define "*regionality*" as a "*key term for customers*" (expert), which has to be specified and communicated. An unawareness of region due to global production processes, in which local products threaten to disappear, constitutes a central obstacle in their criticism. A consequence of the loss of contextualisation of products and processes is consumers' focusing on the price. Proposals for solutions refer in particular to a synchronisation of supply and demand so that *"everyone who buys food has to be conscious of the fact that he is actually a co-producer. The political act which is behind this is one that more and more people become aware of"* (expert). This result is in line with Hansen and Henning (1995). The cultural context of food products, for example the "Buntes Bentheimer Schwein" *("we can tell a story about it"*, expert), also carries a high potential for sustainability. Protected Designation of Origin (PDO) guaranteeing authentic local purchase could support the recontextualisation and synchronisation of supply and demand. One hypothesis of the quantitative sample examines the impact of products with local provenance on consumption practices. The result clearly shows that the factor 'local provenance' is important for organic food consumers (46%) but even more for non-organic food consumers (49%). A similar result is presented by Wier *et al.*, where it is outlined that of all respondents, 72% would prefer to buy conventional domestic fruit and vegetables rather than organic foreign fruit and vegetables: "Thus, the origin attribute commonly overrules organic attributes, although this order of priority is found to a greater extent among non-buyers." (Wier *et al.* 2008:417). But if we consider the influence of fair trade labeling on consumer decisions, the picture is quite different because 37% of organic food consumers answer that this is an important criterion in their consumer decision. Only 4% of the non-organic food consumers answer in the same way. For 82% a TransFair label is not important. These results clearly point out that for non-organic food consumers the production conditions of food are not important. They decouple these criteria from their consumer decision. Only the context of the local provenance plays a role as a largely unspecified category. Finally, another important factor for the support of sustainable food development is the recontextualisation of production conditions.

STRATEGIC RECOMMENDATIONS FOR ENTEPRENEURIAL ACTION

Summarising the results of the two empirical studies, the following main outcomes should be considered for sustainable communication strategies:

1) As a very important impulse for the change in food practices, we can identify food scandals and radical biographical changes in the wake of which a threefold value is placed on organic products: orientation to health, taste and the environment are the main criteria on the consumer side.
2) The empirical data on food consumption show a high affinity for interactional strategies between supply and demand. Especially the lack of transparency concerning the indications of origin and the anonymity of the product "meat" are deplored – a trend which has been advanced particularly by the discounting process and permanent availability of global products.
3) Protected Designation of Origin (PDO) (with) guaranteeing authentic local purchase can support the re-contextualisation and synchronisation of supply and demand. The re-contextualisation of food culture is discussed as an urgent necessity in order to promote biodiversity and cultural diversity in the face of ubiquitous and omnitemporal standardisation tendencies. These conditions of sustainable development are also summarised by an expert from a producing group: "I think that the products have to be in conformity with our national and regional culture (...) we don't have a hamburger or junk food mindset, we have our own culture." The synchronisation of both sides is also pointed out in an expert's quote highlighting "the consumer as a co-producer". Consumers' preference of local provenance has to be coupled with fair production conditions to foster the process of sustainable development. Highest transparency of production conditions and authenticity of personnel and production facilities are a condition for regaining the strength of local supply chains, on the one hand, and promoting the variety in food culture, on the other.
4) In terms of building a successful sustainable communication strategy for companies in north-west Germany, the benchmark results indicate the need for developing a content-based corporate communication strategy with the main focus on sustainable produc-

tion. "We always say you can't do just a little bit of sustainability. Production has also to be changed. It must fit as a whole" (retailer from Austria). Thus, the importance of an integrated communication concept (cf. Bruhn, 2006) as a basis for a corporate communication strategy has to be stressed. This comprises three functions: market communication, organisational or internal communication and public relations (cf. Zerfaß, 2007).

a) Companies' market communication can be optimised concerning the communication of sustainable production and processing aspects, for example, as regards locality, with the help of a more intensive *(1)* brand and relationship management, *(2)* communication of quality dimensions (e.g. breeding) or sustainable processes and *(3)* a more context-based communication of quality beyond technical descriptions. *"The question was how is it possible to get meat out of the no-name range? You have to fill it with content and use the true story to build up a brand or a brand communication (...) with a brand you have a profile and you are not replaceable by others" (producing group about their locally and geographically based brand).*
b) The advancement of knowledge exchange and transparency within companies is the main challenge for internal communication. Especially interdivisional cooperation concerning product characteristics can be difficult. Developing a successful interface management, for example between the three functions, product research, quality management and marketing, could ensure *(1)* an effective exchange between these functions and *(2)* create a potential for communication concerning differentiation in breeding and feeding or in the production process.
c) The lack of stakeholder orientation and reflection on consumer demand is harming the public image (cf. Albersmeier *et al.* 2009). Thus, companies need to invest in dialogue with society on relevant issues to achieve confidence and proximity. Ultimately, to improve authenticity, sustainability has to be implemented in the corporate culture of companies as a whole.

The empirical results of the benchmarking and the consumption study show that in addition to the importance of corporate foresight in strategic

management processes, the present role of companies in modern society needs to be reflected upon. This role is therefore characterised not only by supply of organisations and purchase of consumers but also by interactional and recursive processes involving economic, ecological, societal and cultural relations and challenges (Antoni-Komar/Beermann /Schattke, 2010). The theoretical concept of a cultural approach in economics implies that social and cultural phenomena are not objectively given – but should be interactively produced (cf. Antoni-Komar/Lautermann/Pfriem, 2010). If interactional relations between society and entrepreneurial development are to be understood as a form of responsibility, it is necessary for companies to build strategies taking societal and cultural processes and contexts into account. This concept of interactional and recursive strategic management identifies companies as creative and proactive agents with cultural competences and a capacity to contribute to the future quality of society in sustainable ways.

For the meat economy in north-west Germany, in particular, it is necessary to build cultural competences. In analysing the meat sector, it becomes clear that the former holds a special role as a societal agent in view of the fact that the corporate, economic, societal and cultural developments in that economy have an impact on society. The implementing of such cultural competences (cf. Joutsenvirta/Uusitalo, 2009; Antoni-Komar/Lautermann/Pfriem, 2010) as an essential element of strategic management, for example in societal and cultural dialogue, is necessary in view of increasing discourses within the sector on climate protection, proposed food safety, animal welfare and the strengthening of local, culturally embedded food (in contrast to globalised food systems). The technical production methods of industrial livestock farming (technification), the acceleration in breeding and the extensive use of automation in slaughterhouses (acceleration) have led to the meat sector's alienation from society and to growing social movements which reject industrialised meat production processes (e.g. Veggiedays, Meatless Monday, etc.). This rejection is supported by a rapid increase in public relations, emotional communication and new social media (mediatisation). The improvement in cultural competences by recognising, and reflecting on, these societal issues and cultural processes (e.g. technification, acceleration, mediatisation) and implementing them into the strategic planning of communication is one of the main future challenges (Schattke, 2010) for companies in developing sustainable communication concepts.

CONCLUSION: TOWARDS SUSTAINABLE DEVELOPMENT

The aim of this paper was to highlight potential improvements in sustainable communication practices for the meat sector in north-west Germany by developing cultural competences in the process of benchmarking. As it is shown, benchmarking is important as a successful method (1) for screening and analysing the market and own used strategies and (2) for comparing business communication practices of competitors. The third, even more important potential of the benchmarking process and the transfer of results to companies in other regions lie in the (3) self-placement and self-analysis of these "new" generated practices or strategies. In this context, benchmarking with best practices directed towards sustainable strategies is a helpful interactional tool to link supply and demand and to rethink previously used strategies.

With regard to the meat economy, the paper outlines the increasing importance of cultural competences in the field of sustainability and demonstrates the utility of a cultural approach in economics. This means to consider the underlying structural and cultural context of strategic business practices. Especially consumers' potential and willingness to modify their actual food routines towards sustainability has been considered. As a very important impulse for the change in food practices, we identified food scandals and radical biographical changes in the wake of which a threefold value is placed on organic products: orientation to health, taste and the environment. In addition, transparency of product and process quality, synchronisation of supply and demand, and re-contextualisation of food culture are the main criteria on consumer side.

To advance sustainable development, the benchmarking tool has to be enhanced by cultural competences. Therefore, and in order to improve sustainable communication strategies, companies face the following challenges:

1) reflecting on societal discourses and cultural processes as well as on the development and change of consumer practices,
2) practising communication
   a) in awareness of the embeddedness of the product "meat" in natural and cultural processes, which can change the effect of communication and its characteristics,
   b) by integrating sustainability into corporate culture and corporate communication in order to be authentic and to combine it with transparency and quality differentiation.

In summary, the main impact for companies and their business practices aimed at sustainable concepts lies in the cultural competence to change.

The steps of self-placement and self-reflection will be dealt with at the conclusion of this research project (end of 2011) jointly with companies from the meat supply chain in north-west Germany (case studies). In workshops, the experiences gained from the project will be discussed and used to initiate processes designed to put skills (e.g. the "learned" sustainable communication practices and sustainable contents) into practice. This project approach agrees with the challenges for organisations as analysed by Zairi/Ahmed, who pointed out the "difference between 'doing' and 'learning' (...) and that the biggest problems associated with the transfer of best practices are of a behavioural nature rather than one related to mechanics and systems" (1999: 813). Consequently, the more important question is "how to transfer aspects of best practice" (1999:816) and not just to search for strategies and best practice companies. The action orientated research presented here could help to advance sustainable development in practice and should be given greater emphasis in future research.

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CHAPTER 3

Material Manufacturing and Design

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Jorge Marx Gómez

Chapter Introduction

Jorge Marx Gómez

For the development of true holistic sustainability, the topic of material manufacturing and design offers many opportunities. Especially during and after the economic crisis 2008 and 2009 all actions aiming to improve sustainability in the context of companies need to be justified additionally in terms of financial risks. The classical approach to improve the efficient usage of resources during the production processes is one of the most prominent examples how environmental issues and financial profits are strongly coupled and directly benefit from each other.

Any company taking part in a supply or value chain has the potential to optimise the overall performance and furthermore to spread the acceptance and knowledge of acting sustainably. The problems mentioned before require that any change or action that is planned in order to improve sustainability performance needs to be appropriately captured, monitored, managed and incorporated in other information systems. Additionally any sustainability information should be communicable in terms of environmental or sustainability reporting as this still is one of the main goals alongside the need to fulfil legal regulations. This is where Information Technology comes into play and special Corporate Environmental Management Information Systems (CEMIS) have been developed to address the needed requirements.

At first glance, the goal to improve the sustainability a material, product or service obviously is driven by the resource and energy reduction potentials found in the production or usage phase of its life cycle. Those classic ap-

proaches are complemented by more complex issues like recycling, remanufacturing, sustainable product design or waste management. These topics become even more complex when the borders of sustainability do not end at the company's gates but are extended to a huger network of companies or suppliers of a value chain.

The contents of this chapter starts with the contribution "Problems of Practical CEMIS usage" that provides valuable information about the usage of CEMIS in different sized companies covering several industrial areas. It is followed by "Ecological Intelligence through Life Cycle Assessment" which gives an overview of the historic developments of Life Cycle Assessment and how it is used during manufacturing processes. The contribution "Secondary Resources: Former Waste now Valuable Resource" outlines the importance of material flow management methodologies for recycled materials and secondary resources in order to improve the usability of these in production processes and to describe the materials' quality. One of the emerging research areas "Green IT" is covered by "Creating a Green IT Cockpit" in which a promising framework and prototypical implementation for the capturing and monitoring of indicators of a computer centre is described. As already mentioned sustainability reporting is a major topic for many companies, which are involved in actions regarding sustainability, so a theoretical description of conditions for the rationality of sustainability reporting is covered in the contribution "Sustainability Reporting out of a Prisoner's Dilemma". The exploration of links between supply chains and sustainable development using lean and agility paradigms is done thoroughly in "Lean Production and Agile Organisation: The Link between Supply Chain and Sustainable Development". Raising sustainability from a company to a citywide level and approaching the task of the development of an appropriate indicator set is done in the contribution "Methodology and Practice of Sustainable Development Indicator System Construction for Eco-City". Finally, one way of communicating and training the importance of sustainability using a simple card game for the area of sustainable building materials is demonstrated in "The Development of a Game-Based Teaching and Learning Tool to aid the Selection of Sustainable Building Materials" and shows a very innovative way to raise the overall awareness of sustainability.

1

Creating a Green IT Cockpit

Jürgen Sauer - Philipp Gringel

ABSTRACT

Operators of computer centres often have multiple software tools at hand to access the data that they need on a regular basis for their daily business. These data conventionally include for example network statistics, servers' load, and the temperature of the server rooms. Nowadays, green aspects of running computer centres, like the power consumption of single devices as well as of the whole computer centre, become an increasing focus of interest. A cockpit can provide the current status of key performance indicators and present it visually for to the cockpit's user. This paper presents a sample of the most important performance indicators of Green IT and how they can be collected, stored and presented. For the prototypical implementation a framework for creating cockpits is used that allows the easy implementation of cockpits for different themes and stakeholder groups, i.e. with different views on the area under control.

Keywords: Green IT, IT Cockpit, Performance Measurement, Visualisations

INTRODUCTION

How 'green' is the IT? This is a question often asked not only by vendors of low power solutions. The management too has to answer this question quite often. Therefore it should be possible to have a quick overview on the main parameters that are used to make statements about how green the IT is. This is what a so called cockpit can provide: latest information visualised to show the key performance indicators for a specific area. This idea is

used to provide a cockpit for the most important indicators of the Green IT area. Thus the management can be provided with the information they need at a glance. The information consists e.g. of data from the actual power consumption of the computer centre as well as information on usage of printer toner or other materials. Also a carbon footprint of several resources as well as of the whole computer centre may be computed and presented. To keep track of the variety of relevant performance indicators that are vital for the managers and operators of a computer centre, a software tool is required. This tool should be able to incorporate aspects of Green IT, as well as conventional monitoring data. It has to be customisable in the way which indicators are presented, so it can be used by various persons who carry out different roles within an organisation.

After a short introduction to the topic of Green IT, we focus on some Green IT indicators and particularly on the requirements that a cockpit has to fulfill in general. For the criteria it is investigated which information is needed and how and where it can be collected. We present our approach of creating a cockpit based on our proposed process and framework, and evaluate this method by creating a cockpit for Green IT in a real world scenario. This prototypical result is described before the paper closes with an outlook on future activities.

GREEN IT

The idea of Green IT is not as new as perceived by many people. In the late 1970s the 'Blue Angel' was one of the first environmental seals, which has been awarded to environmental friendly products and to computers since 1994. The term 'Green IT' itself arose with the labels 'Energy Star', 'TCO', and 'European Eco Label' in the early 1990s (Jobelius, 2008). In literature (Dahme, 2010; Schaefer 2008; The Green Grid, 2007) Green IT often focuses on computer centres and their consumption of electrical energy in particular. We take a broader view on Green IT and for this article we adopt the definition given in (Murugesan, 2008):

> "Green IT refers to environmentally sound IT. It's the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems – such as monitors, printers, storage devices, and networking and communications systems – efficiently and effectively with minimal or no impact on the environment. Green IT also strives to achieve economic viability and improved system performance and use, while abid-

> ing by our social and ethical responsibilities. Thus, Green IT includes the dimensions of environmental sustainability, the economics of energy efficiency, and the total cost of ownership, which includes the cost of disposal and recycling."

During the whole life cycle of an optimal Green IT system, electrical energy and raw materials should be spent as environmentally friendlily and as resource efficiently as possible. Furthermore, the user of such systems should be capable of reducing his energy costs and contributing to the relief of the environment.

Drivers of Green IT

The results of a survey analysis presented in (The Green Grid, 2009) highlight the main driving forces behind measuring a computer centre's electrical energy consumption. Running IT systems on a large scale is a costly business, especially when the costs related to energy and power supply are considered. We differentiate between power and energy in the sense that power is an instantaneous measurement, while energy is an integral over time (The Green Grid, 2010). Identifying potentials for saving energy or reducing the demand for electricity is the first step towards reducing costs, which is the main reason for measuring a computer centre's energy usage. Second and third place go to the desire to get more capacity out of the current computer centre and to a cooperative initiative to be 'green'.

There are several aspects of IT that are relevant to the managers and operators of a computer centre, Green IT is just one of them. In this work we will not focus on the conventionally monitored performance indicators like network statistics or servers' load in general. On the green side, saving energy and thus reducing costs is the main concern a manager would have. In future, auditors that are reviewing a company that runs a computer centre might be also interested in the company's greenness. Nowadays, there is a growing number of governmental regulations regarding the environmental friendliness of companies, like for example the emission of CO_2, an organisation has to comply with. Furthermore, performing green can be used as a marketing tool and as a means of acquiring new customers. These examples of drivers for Green IT constitute an exemplary, non-exhaustive list that might differ from the actual reasons to go green, which a specific company might have. No matter which are the decisive factors, there should be an eas-

ily accessible overview of those, which leads to the idea of creating a cockpit for green IT.

GREEN IT INDICATORS

Besides the key figures and metrics that are already available for the assessment of IT systems run in computer centres, there are more factors that have to be considered when the 'greenness' of IT should be measured. First we will present some general thoughts on indicators of green IT. Secondly, we mainly reference the work of the Green Grid organisation by presenting some specific key figures for computer centres. Thirdly, we will briefly discuss issues of assessing the greenness of peripheral computer devices.

General

Considering the greenness of IT systems in general, not only the amount of electrical energy they consume during their operating time should be considered, but their whole lifecycle. The first step of a system's lifecycle is its production, or the production of its components. How green is the production of the single products used? It can be a challenging task to answer this complex question extensively, because one is dependent on information only the manufacturers of the IT systems / components / products can provide. The work of Jobelius (Jobelius, 2008) names several harmful substances, as for example lead, mercury, bromine, and other acids and chemicals, which can be found in IT systems. Without valuable information of the manufacturers, it can be difficult to make a statement for a specific system. Furthermore, many manufacturers purchase components from suppliers and install those within the systems they build. The consequence is that not every manufacturer can answer the question how green the production cycle of his product actually is, on a detailed level. Nevertheless, there are guidelines that manufacturers have to conform to like RoHS (Restriction of (the use of certain) Hazardous Substances) and REACH (Registration, Evaluation and Authorisation of Chemicals), or voluntarily can conform to like the EnergyStar and the TCO certificate.

Metrics for Computer Centres

There are already some metrics available regarding the effectiveness and efficiency of computer centres in using electrical energy, for example published by the Green Grid organisation. In (The Green Grid, 2007) two short-term

metrics called PUE (Power Usage Effectiveness) and DCE (Datacenter Efficiency) are proposed. These metrics allow for a quick estimation of the computer centre's energy efficiency. A computer centre's PUE is calculated by a fraction, whereas the nominator is the *total facility power* and the denominator is the *IT equipment power* only. The former includes everything that supports the IT equipment such as chillers, air conditioning, power delivery components, and lighting. The latter summarises amongst other things, computing, network, storage, and telecommunication devices. The DCE is the PUE's reciprocal. In addition, the white paper (The Green Grid, 2007) also proposes a long-term metric called DCPE (Datacenter Performance Efficiency) and a modified version of the PUE, suitable for analysis of all major power-consuming subsystems in a computer centre. As an evolutionary step of the PUE, the more mature DCPE uses the amount of power spent for *useful work* as the nominator.

The white paper (The Green Grid, 2010c), also issued by the Green Grid, proposes an indicator that considers useful work as the work performed by a server to deliver primary services. A server is usually acquired to deliver a primary service i.e. to serve a special purpose, e.g. e-mail. Supplementary services like anti-virus, screensavers, and software firewalls are regarded as secondary or tertiary services for that server, because they are not necessary to provide the e-mail service, i.e. the primary one. The indicator *server compute efficiency* (ScE) is computed for every server of a computer centre. According to (The Green Grid, 2010c), the ScE is a percentage over a time interval calculated by a fraction, whereas the sum of samples where the server provides primary services constitutes the nominator and the denominator is the total number of samples taken during the interval. To have the actual percentage the fraction has to be multiplied by 100. The aggregated average of all servers' ScE is called *data centre compute efficiency* (DCcE).

Another performance indicator, called *carbon usage effectiveness* (CUE), is introduced by (The Green Grid, 2010b). By dividing the *total emissions of CO_2 caused by the total facility power*(c.f. PUE, see above) by the *energy needed by the IT equipment*, a computer centre's relative sustainability can be quickly assessed. The CUE can be used as a metric for the long run, to document the development of a computer centre's greenness.

This kind of metrics allows for a general overview of a computer centre's greenness, but should be accompanied by metrics, which enable a more sophisticated analysis of single power consumers. However, this still might be

a problem due to an insufficient measurement infrastructure (The Green Grid, 2009).

Peripheral Devices

In addition to the merely operating (computing) IT systems there is a variety of peripheral devices that significantly can influence the greenness of IT as a whole. For example, laser printers that are commonly used, consume toner, which implies the emission of ozone. Older printers that do not conform to RoHS-guidelines may even emit cadmium and lead.

It can be hard to estimate the waste of some consumables such as toner or paper. How many percent of the paper thrown away is wasted? Is a sheet of paper wasted, if an employee doesn't read an article on the screen, but prints it and disposes it after reading once? One may argue that this paper is wasted. But, what if the employee has to review an article in detail, and prints it to take notes next to the text directly on the sheet? Then the sheet of paper might be disposed after the text was read, too. But was it wasted? How to decide?

A paper by Ananthanarayanan & Katz, (2008) indicates the power usage of the USA's network infrastructure with 24TWh. Taking 0.20ğ / 1kWh as a basis this is ğ4.8 billion. Computer centres in Germany have to spend up to 5% of the used electric energy for their network (Stobbe, 2009). The energy consumption of Ethernet networks is currently investigated by the IEEE group *IEEE 802.3 Energy Efficient Ethernet Study Group*.

REQUIREMENTS FOR A GREEN IT COCKPIT

The variety of aspects that have been mentioned above requires a substantial amount of data and some analysis on this data. There are some key questions characterising the requirements that are mentioned in the following list and that will be refined in the subsequent sections. Which role is interested in which information? Which data have to be gathered to get this information? Where are these data stored, and how can they be accessed? How can the information be presented to the respective role in an adequate (role-specific) way?

Stakeholders, Views and Viewpoints

A stakeholder in our case is a person or role, which can affect or is affected by or interested in the activities of an organisation regarding it's IT's greenness. The list of potential stakeholders of Green IT can include the employees

(e.g. managers or the operating personnel as well as others), consumers, suppliers, government, regulatory authorities, environmental associations, shareholder, and society (Raghu Raman, 1998). A stakeholder can have various roles, for example an employee can have the roles *chief executive officer* (CEO) and *employees' portal user* at the same time. In each of his roles the respective employee might have different concerns. The *CEO* is interested in the overall performance of the company, but the *user of the employee's portal* is interested in the availability and the correct functioning of the portal application. However, we propose identifying the relevant roles and the specific demands of information these roles have. For each role there should at least be one *view* that addresses the role's concerns. A view consist of one or many models (cf. [IEEE, 2000]), which can include key figures or performance indicators that allow for an objective assessment of the criteria that is necessary to answer some of the concerns addressed by the view. A view conforms to a viewpoint, which specifies the conventions for constructing and using a view ([IEEE, 2000]).

Identifying Performance Indicators and Metrics for Their Calculation

A view can contain several key figures. According to (Kütz, 2009) a key Şgure captures facts quantitatively and in an aggregated manner, which means they are often used to map a large amount of data to few signiŞcant values. A key Şgure is the result of measuring a deŞned property using a concrete metric. A metric is a measuring speciŞcation (often a mathematical formula), that belongs to a property (e.g. the availability of an application). The metric deŞnes in which way a resulting key Şgure has to be determined. For each view the set of relevant key figures has to be specified. Every key figure is based on concrete data, which has to be known before the calculation can be initiated. This is quite an important aspect, since information gathering usually is time-consuming and thus expensive. Organisations in general do not have all required information at their disposal. It may either not have been collected at all or may be outdated. Thus, the objective to use a key Şgure might be connected with some effort (Addicks & Gringel, 2009).

Finding Data Storages and Accessing Them

Crucial questions in the process of calculating key figures arise when it comes to finding the required data and to collecting them. Some questions might

arise in this order: What key figure should be measured or calculated? Which data is necessary for that purpose? Where can the data be collected from? Is the data already available in machine-readable form, if it's not; is it available digitally at all? Which types of data have to be aggregated to calculate the results? Is the result measurable on a metric scale or with linguistic terms like good, average, or poor (cf. [Addicks, 2009])?

If the required data is stored in a data base or another system, which was designed to store and retrieve data in a convenient way, we assume that those data are technically accessible. If some of the required data is even not available digitally or even not in written form (e.g. expert knowledge) it has to be evaluated whether or not the key figure promises benefits that justify the effort to raise it.

Adequate Visual Presentation of Key Figures

For many key figures there is a variety of presentation possibilities. The availability of an application for example, can be depicted as a pie chart, a bar chart, a percentage, a raw number, and if time is considered as a graph or a table, etc. But not every presentation possibility is adequate for any key figure. On the other hand, it might be impossible to present the key figure in the designated way. Furthermore, the subjective perception of key figures may vary from person to person. Different stakeholders may prefer a different presentation of key figures. Those who are interested in highly aggregated key figures may favour a table of percentages over several graphical representations of the same material. The same applies the other way round. To support as many stakeholders and roles as possible, there should be the possibility to take these individual preferences into account.

To summarise, these requirements demand specific support of a software tool. To be mentioned first are dashboards or *cockpits*. These systems are equipped with a graphical user interface that is designed to be an easy way to present aggregated data.

IMPLEMENTING A GREEN IT COCKPIT

As it has been argued that the use of the cockpit metaphor for monitoring and control issues seems to be adequate, in a next step the implementation of a Green IT cockpit system will be described. This is based on a framework for building cockpit systems. This framework design started in 2009 and is actually under improvement. In previous work (K nnemann, 2009 and Siemers,

2009) we investigated how an IT cockpit supports different stakeholders, and some flexibility in the way the measured or calculated indicators are visualised. The work elaborates on creating an IT cockpit based on system monitoring data, but the actual cockpit implementation allows for assessing aspects of Green IT as well. The following sections introduce the general approach of creating cockpits and show how it can be used to create a cockpit for Green IT.

Process for Creating Cockpits

Creating a Green IT cockpit involves similar tasks as when creating several other kinds of cockpits. The process is sketched by the following steps:

1. Identify the relevant stakeholders of the cockpit that should be created (e.g. future users).
2. Identify the stakeholders' main concerns, these have to be considered first or at least as soon as possible during the process of creating a cockpit.
3. Identify ways to answer the stakeholders' questions using specific key figures that are ideally supported by metrics.
4. Identify the data, which are necessary to raise the key figures or to calculate the metrics, respectively.
5. Define data and presentation in Cockpit DB for Cockpit Builder
6. Define Interface and thus wrapper for connecting delivering system to Cockpit DB
7. Define users and their roles together with allowed performance indicators in Cockpit DB
8. Deploy and use the cockpit.

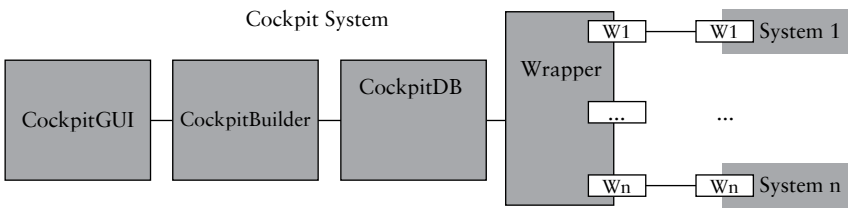
The steps are iteratively performed. Steps 1 to 4 have been investigated in the previous sections. To implement the cockpit (steps 5-7) a framework is needed, which allows for the easy incorporation of data sources as well as the modular description of the indicators to be presented on the cockpit. For this task we are developing a framework that allows the easy configuration of different cockpits. Here it will be used to create the Green IT cockpit.

Figure 1 shows the architecture with the most important components of the framework. The Cockpit System itself consists of the components Cockpit Graphical User Interface (GUI), Cockpit Builder, Cockpit DB, and a Wrapper component.

In the Cockpit GUI the chosen representation of the performance indicators is presented. This component allows for the actual configuration of the GUI. The indicators are linked to a visual representation, e.g. the electric power consumption of a server shall be depicted by a graph. The Cockpit Builder combines the representation with the data from the Cockpit DB and compares the user's rights and roles (part of the users' management, which is not illustrated in

Figure 1 to present only the information the user is allowed access to, but in the designated way. For example, for a list of the top ten users in printer usage several possibilities for an appropriate presentation are feasible: a pie chart, a bar chart, or a simple list. The Cockpit Builder also determines, whether there are preferences to present the indicators to a user and respects these.

FIGURE 1
Cockpit System Framework



The Cockpit DB is the database with the loaded and sometimes preprocessed data from the systems that deliver the basic information. Those systems are connected via wrapper functions that realise the interface between the Cockpit DB and the systems delivering basic data.

The case study presented in the next section shows how the framework and the process can be used to create a Green IT cockpit. Where necessary, we added the referenced steps of our process (process step, PS) sketched above to the sections of the case study.

CASE STUDY

We applied our approach of generic cockpits to a computer centre with about 100 physical servers, including additional 50 servers realised as virtual machines. To keep the temperature and the humidity in the server rooms at an

even level an air conditioner is installed. Several activities have been done for autonomous power production and for power savings, e.g. a photovoltaic system was installed that covers a hundred square meters. Additionally there are energy storage devices that are filled up during the night when electrical energy can be purchased cheaper than during the day. At daytime the energy is taken from these storage devices to reduce the demand of electricity.

According to the process steps described in the last section we worked out the case study.

Steps 1-2

To find out about which key figures a cockpit for Green IT should inform, we interviewed the technical administration manager (TAM), who is responsible for the computer centre and represents one user group of the cockpit. The TAM stated that he uses various different tools to access the data that he needs on a regular basis for his daily business. In addition there are several relevant green key figures that are raised by different tools, too. Some of those are vendor specific like the visual display of the energy storage devices' filling level or like the display of the photovoltaic system's power production. Therefore he would appreciate an integrating software solution.

Steps 3-4

The following paragraphs contain the **eight** key figures that are most important for the TAM. Unfortunately, not all of them relate to aspects of Green IT because the failure-free operation of a computer centre is more important for a service provider than saving some electrical energy.

A key figure is desired that indicates the overall performance of the computer centre. This key figure should incorporate other key figures, which can be individually weighted. The weights reflect the individual criticality of the key figure considering the operation of the computer centre. For example, the temperature of the servers might have a bigger influence on the overall performance indicator than the average usage of RAM, because the former can become a serious thread for the computer centre's infrastructure. Besides the overall performance the **PUE** should be calculated once a month based on the monthly electricity bill.

Commonly used tools are able to log and/or monitor the load a server has to deal with, for example the load of the CPU, RAM, hard disk, and of the whole system. The computer centre of our case study has additionally installed

measurement devices that capture the actual power usage per server. These measurements are archived, because the devices are installed on the power cord, which connects an individual server with the respective electrical socket. The TAM has to use proprietary software that gives him access to the data of the servers' power consumption. The preferred way of displaying the key figure is a graph that shows the average power consumption per hour during the past three days. When this key figure was integrated into the cockpit for Green IT, the TAM could renounce the use of the proprietary software.

There are two key figures that are related to the power supply of the computer centre. The first one represents the production of electricity by the photovoltaic system on the computer centre's roof. It is displayed how many kWh the system produced during the past five days. The other key figures depict the filling level of the energy storage devices. In sum the computer centre has four of those devices, some relying on different technologies.

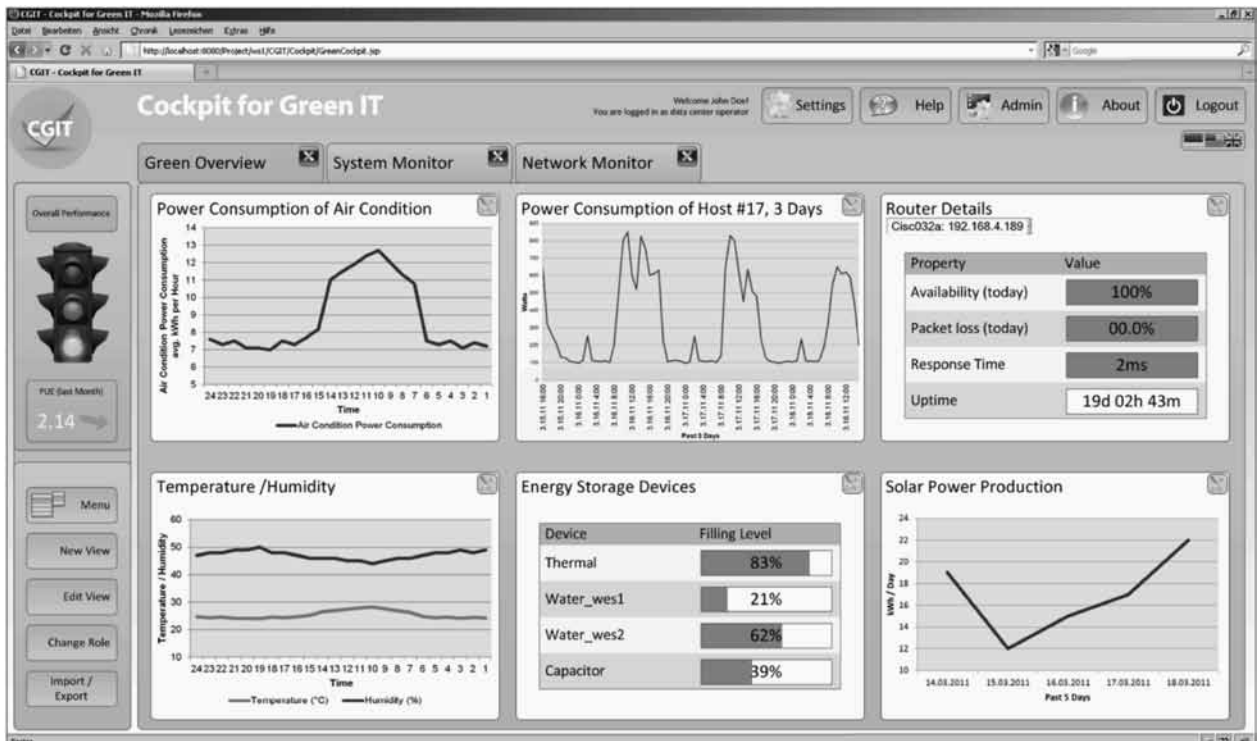
As stated above not all of the key figures are directly related to Green IT. There is a router that connects some particularly important subnets to each other, which are vital for the computer centre. Information (e.g. availability, response time, and packet loss) about this specific router is considered as important to the TAM. Thus, we also included these key figures into the cockpit.

Step 5

Figure 2 shows our prototypical design of the cockpit for Green IT. According to the statements of the TAM, we designed a graphical overview of the eight key figures that were called most interesting regarding aspects of Green IT. The overall performance indicator is represented by a traffic light showing the accumulated state of all parameters. A decimal below the traffic light hints at the monthly calculated PUE. We added a colored arrow to indicate a trend respecting the month before the last month. A grid of six diagrams holds the information about the other key figures, which were identified in our case study. Two other grids, or so called *views*, are dedicated to key figures and graphs that cover the areas of system monitoring and network monitoring, respectively. For the prototype, initially just the role of a computer centre operator was realised.

The upper part of the cockpit contains menus a user can consult if he wants to change general settings of the tool, or to perform administrative tasks. Entries offering helpful information about the cockpit's functionality

FIGURE 2
Prototypical Implementation of a Cockpit for Green IT Indicators



and information about the cockpit itself, as well as the possibility to switch between the supported languages, so far German and English, are also present.

Steps 6-8

Most of the systems that had to be integrated into the cockpit were equipped with an interface, which allowed for an easy access to their data. Thus, the system-specific implementation of the wrappers could be accomplished.

CONCLUSION

Creating a Cockpit for Green IT is not as easy as it may seem at first sight. Many required data cannot be accessed to the extent as it is necessary. The usage of electricity is only one aspect. In some cases the measurement infrastructure that is a mandatory prerequisite for raising real-time key figures related to the power consumption may not be available. There are indirect costs that cannot be measured, which can have a negative influence on the greenness of IT. Actually we are further exploring important performance indicators of Green IT (see also the work of the Green Grid organisation) as well as on the extension of our cockpit system framework.

Last but not least, we wish to thank the staff of the computer centre for their patience and the information, which they provided us with during the interviews. Their input played a substantial role in the implementation process of our prototype.

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2

Ecological Intelligence through Life Cycle Assessment

PERE FULLANA I PALMER - MARCO RAUGEI

ABSTRACT

Life cycle assessment is increasingly being recognised as a pivotal tool to evaluate the impact that human-dominated processes and activities have on the environment; it is characterised by a rigorous and comprehensive approach which aims at avoiding the potential shift of impacts between different processes or impact categories when an environmental decision needs to be made. This chapter draws an outline of its historical development and the main institutions that fostered it; a concise operational description of the method is also provided, as well as a discussion of its possible applications, with two real-life examples, respectively dealing with ecodesign and policy development.

Key words: Life Cycle Assessment, Ecological Intelligence, Sustainability Assessment, Technology Assessment

INTRODUCTION

Developed in the early 1960s, Technology Assessment (TA) has evolved and, thanks to the Rio Conference in 1993, the often referred to 'triple bottom line of sustainability', which includes social, environmental and economic impacts, has become a standard framework. This is the same evolution that Life Cycle Assessment (LCA) is going thorough nowadays, thanks to the work within the UNEP/SETAC Life Cycle Initiative.

A new challenge of TA is to assess the basic system changes and unwanted system changes due to rebound effects. The challenge can be met by coupling TA with Life Cycle Assessment (LCA) applied to the so-called 'three pillars of Sustainability'. A long way has been travelled to develop environ-

mental LCA; however, economic (Life Cycle Costing) and social LCA are not so developed yet, and are still the object of debate and controversy in the wider scientific community.

LCA has been established as an important methodology to assess the environmental sustainability of products and services. LCA is mainly product- (service-) oriented. However, its application has broadened to strategic planning by companies and governments, to environmental labelling for marketing, for waste management options decision making, for strategic energy mix design, for green public purchasing, etc.

It is interesting to see that LCA has gone from being a methodology used by scientists a decade ago to having been introduced to the media. Time magazine, in a recent special issue on the '10 Ideas Changing the World Right Now', cited trend number 10 as 'Ecological Intelligence'. Time is advocating for LCAs to be 'ecologically intelligent' [Walsh, 2009]. In addition, a media guru like Daniel Goleman, author of best seller Emotional Intelligence (Goleman, 2006), has recently published Ecological Intelligence (Goleman, 2009), in which, through LCA and Industrial Ecology, he guides the reader on how to make the best choices on purchases, when one wants to be green.

In addition (we, scientists, would say: 'much more importantly'), there was the remarkable May 2009 editorial of the top-of-the-list journal in Environmental Science and Environmental Engineering of the Science Citation Index, Environmental Science & Technology (Schnoor, 2009). The editor, Jerald L. Schnoor, stated that over 8% of all papers were LCA papers and that they welcomed "*the increase in LCA papers in ES&T as a modern accounting tool allowing us to consider our decisions more carefully and to tread a bit more lightly on the earth*". He says: "*[...] Which (technology, product) is best environmentally? [...] It (LCA) opens our environmental books in a transparent fashion... Whatever the real benefit of LCA, it's here to stay and is changing our way(s) of life*". Moreover, in only six years in the SCI, the International Journal of Life Cycle Assessment has got into the first quartile in both Environmental Science and Environmental Engineering.

LCA: ORIGINS, INSTITUTIONS, STANDARDS AND GUIDES

Origins

Life Cycle Assessment (LCA) is a comparatively recent tool that has rapidly grown to become standard procedure for environmental scientists and engi-

neers alike to investigate and assess the environmental performance of a wide range of human-dominated processes.

The origins of LCA can be traced back to studies conducted in the 1960's and 70's aimed at optimising energy consumption in a context where the latter represented a restraint for the industry. These were soon followed by broader studies also taking into account raw material consumption, and eventually emissions as well. Probably the first modern multi-criteria study taking into account a wide range of environmental issues, including raw material extraction and alternative waste disposal options, was performed by H.E. Teastley for the Coca Cola Company in 1969; against all expectations his study identified plastic bottles as environmentally preferable to glass ones.

In the following years, LCA gradually became more complex and sophisticated, and was eventually made into a standardised procedure for the first time by the Society of Environmental Toxicology and Chemistry (SETAC) in 1993 (Consoli *et al.*, 1993). Specially remarkable have been the scientific contributions of its European branch and its working groups. According to the original SETAC definition, later modified by LCA-Nordic (Lindfors *et al.*, 1995), Life Cycle Assessment is:

> A process to evaluate the environmental burdens associated with a product system, or activity by identifying and quantitatively describing the energy and materials used, and wastes released to the environment, and to assess the impacts of those energy and material uses and releases to the environment. The assessment includes the entire life cycle of the product or activity, encompassing extracting and processing raw materials; manufacturing; distribution; use; re-use; maintenance; recycling and final disposal; and all transportation involved. LCA addresses environmental impacts of the system under study in the areas of ecological systems, human health and resource depletion. It does not address economic or social effects.

This early definition makes it clear that LCA is based on the basic principle that in order for its environmental impact to be assessed, a system or product must be 'followed' through all its life stages, 'from the cradle to the grave' so to speak, because in each life stage new environmental support is required, both in the forms of supply of primary resources and of absorption of pollutants. A further extension of this concept leads to the phrase 'from the cradle to the cradle', in which even more importance is put to the recycling phase of the system's components as the first and foremost way to limit its load on the environment.

In the late 1990's the International Standardisation Office (ISO) started a large effort towards the comprehensive standardisation of Life Cycle Assessment, issuing a set of four norms: ISO 14040 (1997), 14041 (1998), 14042 and 14043 (2000). These have since eventually been superseded by the new ISO 14040 and 14044 (2006), and integrated by ISO 14047 (2003), 14048 (2002) and 14049 (2000).

One of the environmental impacts studied within LCA is global warming, which at a given time gained widespread methodological acceptance through the Intergovernmental Panel for Climate Change (IPCC). However, a similar political consensus was not attained for other impact categories at the same time. Hence was born the UNEP/SETAC Life Cycle Initiative, in order to provide a kind of international governmental umbrella to all LCA developments. In addition, and going further than the definition by the Nordic Council, the UNEP/SETAC Initiative is strongly working in including economic and social aspects within the life cycle perspective: Life Cycle Costing and Social Life Cycle Assessment. Meanwhile, the European Commission in 2005 started its project 'European Platform on LCA', which may be the most important effort to standardise LCA data and methodology worldwide. More recently UNESCO has launched, together with Pompeu Fabra University in Barcelona, the UNESCO Chair in Life Cycle and Climate Change.

Over the last ten years there has been a rapid expansion in the demand for, and use of, LCAs fuelled by both industry and governments. For the industry, an important use is in characterising current operating practices with a view towards how the industry itself stands in relation to current and proposed legislative measures. A series of LCAs performed by a given company over consecutive years will help analyse the environmental soundness of its operating practices as well as help to establish manufacturing trends. For governments, awareness of the implications of proposed legislation, especially when the effects may counter those originally intended, can help in usefully amending legislation before it is adopted. A suitable example of this is the setting of realistic recycling targets.

For enterprises in rapidly emerging economies, ready access to up-to-date technologies and know-how is vital. Joint ventures with companies in the West to provide such access is now an established approach. For the interested companies, particularly in large and populous countries such as India and China, an ideal selling point would be the demonstration of their full awareness of the environmental aspects of their operations and adherence to

regulations. This is where LCA, as an internationally accepted methodology for establishing full environmental credentials, would be invaluable. Equally, the application of LCA as a management tool can help to identify optimum strategies for interested companies in becoming resource- and energy-efficient to international standards.

During the last years, two of the indicators commonly addressed by LCA have developed their own communities, tools and standards: Global Warming Potential, which is now called Product Carbon Footprint, and Water Depletion, which is now called Product Water Footprint. It is important to mention that, although the impetus of these two environmental indicators may make the world aware of the rest of the environmental challenges that we are facing, there is an inherent risk, too. Putting too much focus on these two categories may result in the unnoticed shifting of large environmental impact to other impact categories, in the absence of fully fledged LCAs, assessing the complete set of indicators.

Institutions

A short description of the three most important institutions/initiatives working internationally on LCA (SETAC, the UNEP/SETAC Life Cycle Initiative, and the European Commission's Platform on LCA) is presented below.

As already mentioned, Life Cycle Assessment had its cradle in SETAC (Society for Environmental Toxicology and Chemistry)[1], which contributed impressively to the development of an established and accredited methodology as we know it today, and continues to provide a valuable support to improve the science behind the LCA methods. An advisory group on LCA was created, which is aimed at advancing the science, practice, and application of LCAs to reduce the resource consumption and environmental burdens associated with products, packaging, processes, or activities.

This Advisory Group in Europe serves as the focal point of a broad-based forum for the identification, resolution, and communication of issues regarding LCAs. Moreover, it facilitates, coordinates, and provides guidance for the development and implementation of LCAs, in collaboration with LCA North America and, more recently, also with other societies that address the life cycle concepts in an interdisciplinary way. This is achieved by means of a series of initiatives that include, among others, the planning and organisation

1 Description of SETAC LCA activities received from Alessandra Zamagni, currently Vicechair of the SETAC Europe LCA Steering Committee.

of LCA-related sessions at the annual SETAC scientific conferences and application-oriented LCA Case Study Symposia. Recognising that LCA is an evolving tool, new and less addressed issues were recently promoted and opened to the debate during the meetings, like sustainable consumption, social and economic aspects and newly emerging methods for addressing water and carbon, just to mention a few. In relation to these latter topics, the LCA community is contributing to the ISO standardisation process by providing consistent, science-based commentary. This activity is the fruit of the strong and closed relationship between SETAC and the ISO standardisation body (Technical Committee 207), which culminated with a liaison between the two organisations.

Among the other activities promoted by the LCA Advisory group in Europe, Working Groups (WGs) deserve a special place, as they continue to play a major role in the development of the methodology. A new one on Chemical Footprint was recently set up and, even in its initial phase of development, it has distinguished itself for providing a platform for interdisciplinary and global debate, in which the life cycle approach is at the core.

Other WGs are active within the UNEP/SETAC Life Cycle Initiative[2], a partnership between SETAC and the United Nations Environment Programme that was launched in 2002 in order to enable users around the world to put life cycle thinking into effective practice. The Initiative responds to the call by Governments around the world for a Life Cycle economy in the Malmo Declaration (2000). It contributes to the 10-Year Framework of Programmes to promote sustainable consumption and production patterns, as requested at the World Summit on Sustainable Development in Johannesburg (2002).

The added value of the Initiative includes:

- The ability to access and mobilise an established and growing global network of over 2000 interested members who have been and continue to be interested in understanding and advancing Life Cycle approaches worldwide. These experts represent industry, governments, academics and the service sectors and are the leaders in developing and applying Life Cycle Assessment (LCA) and Life Cycle Management (LCM) worldwide.

2 Information about the UNEP/SETAC Life Cycle Initiative has been extracted from <http://lcinitiative.unep.fr/default.asp?site=lcinit&page_id=9FDF7FDF-261F-4F0E-A8E3-5FF4E16B33C2> [Accessed 17 July 2011].

- The ability to gather and manage examples of best practices and Life Cycle achievements across the world.
- The status of being considered as a 'one stop shop' for Life Cycle approaches.
- The opportunity to connect science and decision making in policy and business with the supply and demand side of Life Cycle approaches. Therefore, an opportunity exists to become the global authority for consensus building and peer review on methodological questions and environmental assessments of natural resources, materials and products in the field of science.

The objectives of the Life Cycle Initiative are to:

- Enhance the global consensus and relevance of existing and emerging Life Cycle methodological approaches.
- Facilitate the use of Life Cycle approaches worldwide by encouraging Life Cycle thinking in decision-making in business, governments and the general public about natural resources, materials and products targeted at consumption clusters.
- Expand capability worldwide to apply and improve Life Cycle Approaches.

In this regard, the LCA component of SETAC contributes by providing scientific knowledge in addressing the main challenges that the methodology entails both from the methodological and practical points of view.

Now a new challenge is at the core of the LCA community, a challenge on which activities in the future will be devoted: sustainability, in the broadest sense. Recognising that SETAC's founding principles are multidisciplinary approaches to solving environmental problems, a 'Sustainability within SETAC' group has been established, aimed at addressing sustainability in both its broad and deep meanings, which will entail finding ways to bring together the breadth of life cycle approaches with the depth of more traditional SETAC science. Bringing together the different system perspectives, levels of detail and disciplines covered within SETAC, this group promotes the collaborations among the different geographical chapters of SETAC, as a global initiative.

In its Communication on Integrated Product Policy, the European Commission (2003) concluded that Life Cycle Assessments provide the best framework for assessing the potential environmental impacts of products

currently available. In the document, the need for more consistent data and consensus in LCA methodologies was underlined. It was therefore announced that the Commission would provide a platform to facilitate communication and exchanges on life-cycle data and launch a coordination initiative involving both ongoing data collection efforts in the EU and existing harmonisation initiatives. The debate is ongoing about good practices in LCA and interpretation. The Commission intends to further this debate through a series of studies and workshops with the aim of producing a handbook on best practices, based on the widest possible consensus attainable among stakeholders.

The European Commission's project 'The European Platform of Life Cycle Assessment' intends to address all of the above. The aim of the European Platform on LCA is thus to support businesses and public authorities in the implementation of Sustainable Consumption and Production. The support is provided with guidance on consistent and quality-assured life cycle data, methods and assessments. The European Platform on LCA also hosts a selection of tools, reference data and recommended methods for LCA studies.[3]

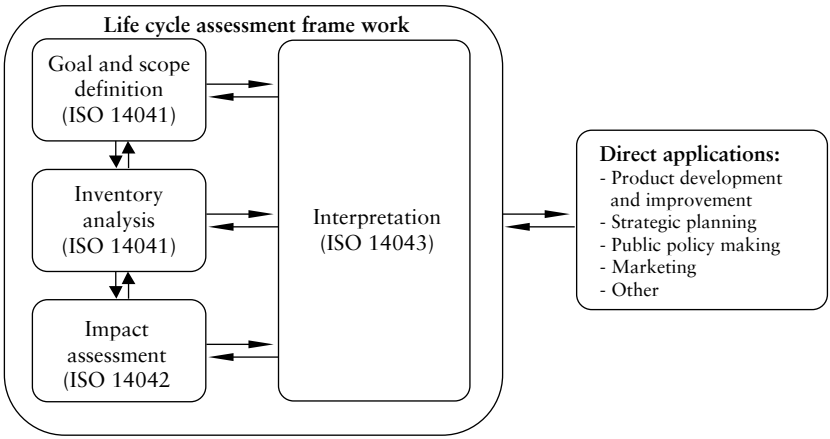
Standards and Guides

According to the original ISO 14041-14043, a LCA must be conducted in four stages: Goal definition and scoping; Life Cycle Inventory; Impact Assessment and Interpretation. A schematic representation of the whole LCA procedure is illustrated in **Figure 1**.

The two new standards introduced in 2006, "ISO 14040:2006 Environmental Management -- Life Cycle Assessment -- Principles and Framework" and "ISO 14044:2006 Environmental Management -- Life Cycle Assessment -- Requirements and Guidelines", consist of a revision and integration of the original ISO 14040-14043, and fully replace the latter, essentially leaving the core part of the technical contents unchanged. In particular, they deal with the LCA methodology, including: definition of the goal and scope of the LCA, the life cycle inventory analysis (LCI) phase, the life cycle impact assessment (LCIA) phase, the life cycle interpretation phase, reporting and critical review of the LCA, limitations of the LCA, the relationship between the LCA phases, and conditions for use of value choices and optional elements. They do not describe the LCA technique in detail, nor do they specify

3 Information about the LCA Platform has been extracted from <http://ec.europa.eu/environment/ipp/lca.htm> and <http://lct.jrc.ec.europa.eu/> [Accessed 17 July 2011].

FIGURE 1
Diagram Describing LCA Steps According to the Original ISO Standards



methodologies for the individual phases of the LCA. The intended application of LCA or LCI results is considered during definition of the goal and scope, but the application itself is outside the scope of these international standards.

There are also some additional ISO documents complementing the two mentioned standards: "ISO/TR 14047:2003 Environmental Management -- Life Cycle Impact Assessment -- Examples of application of ISO 14042"; "ISO/TS 14048:2002 Environmental Management -- Life Cycle Assessment -- Data documentation format" and "ISO/TR 14049:2000 Environmental management -- Life cycle assessment -- Examples of application of ISO 14041 to goal and scope definition and inventory analysis".

After the first series of standards, some guides were produced to further develop different methodological aspects that the standards only mentioned within their framework, among which "The Hitch Hiker's Guide to LCA" (Baumann and Tillman, 2004) is recommended. After the second series, the most important methodology guidance work has been done by the European Commission, through the European Platform on LCA, launching a set of documents known as the ILCD Handbook,[4] which are in line with the international standards on LCA (ISO 14040/44):

4 International Reference Life Cycle Data System <http://lct.jrc.ec.europa.eu/assessment/projects#d>

- The General guide for Life Cycle Assessment consists of both a comprehensive, detailed guide as well as a 'cook-book'-style guide for experienced LCA practitioners. It covers all aspects of conducting an LCA: defining the objective and target audience, gathering data on resource consumption and emissions that can be attributed to a specific product, calculating the contribution to impacts on the environment, checking the robustness and significance of results and conclusions, and reporting and reviewing to ensure transparency and quality.
- The Specific guide for Life Cycle Inventory (LCI) data sets builds on the general guide. It provides more detail for the generation of specific types of data. For example, it describes how to create LCI data sets that best reflect the average situation regarding emissions and resource consumption.
- The Life Cycle Impact Assessment (LCIA) guide provides requirements for assessing the emissions and resource consumption associated with a product in terms of impacts on the environment, human health, and resources depletion. It outlines criteria against which models and indicators for use in LCIA should be evaluated, covering both scientific aspects and stakeholder acceptability.
- The guide on Review schemes for Life Cycle Assessment presents the minimum requirements for the review of life cycle data or assessments for different applications. The guide on Reviewer qualification specifies the requirements on the experiences and expertise of reviewers.

Since those documents are very comprehensive and exhaustive, the European Commission is formally supporting the adaptation of the ILCD Handbook to specific sectors and activities by third parties; in some cases such specific guides are also commissioned by other EC services such as e.g. on Hydrogen Production and Fuel Cells or Building and Construction.

The ILCD Handbook is complemented by a web-based LCA data infrastructure: the ILCD Data Network, which is currently being established. It is designed to provide access to quality-assured, consistent life cycle data and it is open to all providers on a global basis.

LCA: METHODOLOGICAL OUTLINE

In this chapter, a very brief methodological description is introduced and for more in-depth information, any of the guides mentioned above are highly recommendable.

> LCA is the compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its entire life cycle (ISO 14040:2006).

This sentence is the very foundation of LCA: a) the impacts are assessed thanks to a quantitative compilation of (material and energy) inputs and outputs; b) the impacts are potential (and not actual) ones; c) a complete set of impacts is assessed; d) the object of the assessment is a product system, including all the processes needed to deliver the value of the product (or any activity) to society. This combination of methodological conditions allows avoiding a potential shift of impacts between processes or impact categories when an environmental decision needs to be made.

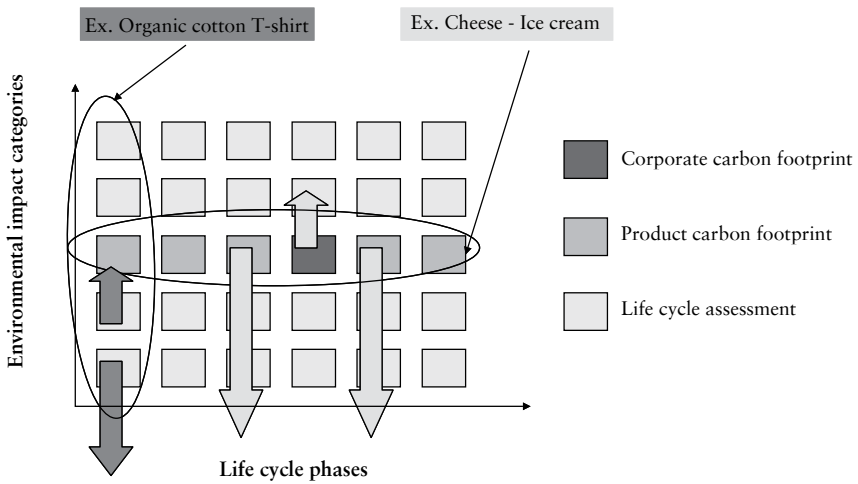
Within the article mentioned in the introduction (Walsh, 2009) a clear example was described of possible problem shifting. The authors say that we would all probably accept an organic cotton T-shirt as environmentally friendly but some of us would change their minds if somebody told them that 10,000 litres of water are needed for the cotton of that one T-shirt. There is more than one environmental impact category, such as acidification, toxicity, eutrophication, global warming etc. (rows in **Figure 2**).

One cheese producer may claim that his cheese is a CO_2-neutral one because their corporation is producing all the electricity needed in the cheese factory out of renewables. Meanwhile, an ice-cream producer may be claiming that only 2% of the CO_2 emissions of their dairy product are actually emitted by the ice-cream factory, while the large majority is emitted by the milk producer, the retailer or the packaging manufacturer. Is it fair to claim zero emissions by compensating only 2% of the total emissions? There is more than one process in the product chain (columns in **Figure 2**).

According to the ISO 14040-14044 standards (**Figure 1**), an LCA must be conducted in four stages: goal and scope definition; life cycle inventory; impact assessment; and interpretation.

The ISO 14040 main requirements for the *goal and scope definition stage* are:

FIGURE 2
LCA Scope Encompassing a Set of Impact Categories and the Complete Value Chain



- A functional unit of the analysed system or product should be defined (e.g. 1 kWh of electricity delivered, 1 kg transported by 1 km, 100 square metres of wall painted during 20 years, etc.).
- The system boundary should be set (to what extend the processes within the product system are being studied).
- A list of the necessary data should be made.
- The basic assumptions should be stated.
- The intended verification procedures should be defined.

This stage is a critical one, since all the subsequent stages are dependent on it; sometimes a slight difference in the initially set system boundaries (e.g. not including in the system that supermarket plastic bags are used as rubbish bags after primary use), an incomplete allocation procedure (using market prices to allocate burdens among different metals mined together while not recognising that metal prices change every year) or a bad functional definition (forgetting that some paints last longer than others, and that the surface painted is therefore not enough to define a proper functional unit), for instance, can make a substantial difference in the final life cycle impact assessment (LCIA) results and mislead their interpretation.

In the *inventory stage* (LCI) all the input and output flows of the various process steps within the analysed system are investigated, and the list is extended from the local scale to the life cycle scale in order to keep track of all the indirect material and energy requirements and emissions that are associated to each direct system input. The quality and reliability of the employed data is of paramount importance, since the results of the analysis cannot obviously be of any better quality than the input data themselves.

Then, probably the most uncertain stage of an LCA is the *impact assessment* one (LCIA). This is carried out in three consecutive steps: classification, characterisation and normalisation/weighting. ISO standards dictate that all the input materials and emissions from the LCI be classified into different impact categories, according to the type of impact that they may have on the environment. Generally speaking, environmental impact categories can be divided in two broad sets: those that are focused on the amount of resources used per unit of product ('upstream' categories, such as Abiotic Resource Depletion, Biotic Resource Depletion, Water Resource Depletion, Commercial Primary Energy Resource Requirement or Land Use), and those that deal with the consequences of the system's emissions ('downstream' categories, such as Global Warming, Acidification, Stratospheric Ozone Layer Depletion, Water Body Eutrophication, Photochemical Oxidation and Tropospheric Ozone Formation, Human Toxicity or Eco-toxicity).

The classification of the inputs and outputs is followed by the so called characterisation. Impact in the upstream categories is usually assessed by multiplying each input item by the total amount or primary resources (which can be water, non-renewable primary energy, etc.) that is necessary for the production and delivery of one unit of that particular input. The resulting total is a cumulative indicator of the system's impact on the considered category. For downstream categories, however, the impact indicators are calculated by summing together the category-relevant system's outputs (emissions and wastes), prior multiplication by appropriate characterisation factors. The latter are numerical multipliers which represent the amount of a given reference compound (e.g. CO_2 for the Global Warming category) which, if emitted, would have a quantitatively comparable effect on the environment to one unit of the actual system emission being considered.

A third, optional, phase of LCIA is normalisation, in which multiplicative factors are assigned to all the considered impact indicators, in an attempt to facilitate the interpretation of the results; this is achieved by providing the

end user with an indication of the comparative relevance of the environmental impact caused by the system under study in the different impact categories. To attain this, the calculated life cycle impact of the system within each category is divided by the total impact score calculated for the same category for a reference situation, based, for instance, on the total yearly emissions for a reference year in a reference region or a reference industrial sector. Lastly, normalised indicators can be multiplied by additional weight factors and then summed together, to produce one or more 'super-indicators' of overall environmental impact. Such weighting phase is of course the most arbitrary step of the whole LCA procedure, since many of the different impact categories are really irreducible, and the choice of the weighting factors is to a large extent a political one, which bears (according to ISO 14044) no scientific relevance. This optional phase of LCA is therefore not recommended.

LCA: APPLICATIONS

As introduced in Figure 2, LCA has many applications. LCA is a systematic methodology for gathering and assessing environmental information, and this information may be used to make different types of decisions. According to the ILCD Handbook [European Commission – Joint Research Centre 2010], the applications can be divided in three categories: A) Micro-level decision support applications, such as weak point analysis, identification of key performance environmental indicators, ecodesign, green public procurement, development of product category rules, development of an environmental product declaration or a carbon footprint, etc: B) Meso/macro-level decision support applications, such as policy development in, for instance, waste management, policy information about, for example, identifying product groups with the largest environmental impact, development of generic life cycle data sets, etc.; and C) Descriptive accounting, such as monitoring the environmental impact of a nation, corporate environmental reporting for an environmental management system, etc. Situation C) implies no decision context with consequences on other systems, for it is purely descriptive. Examples of situation A), 'ecodesign', and of situation B), 'waste management policy', are introduced below.

Product Development – Ecodesign

LCA may be used for product development and improvement (Ecodesign). Ecodesign considers that the effect that a product or a service has on the en-

vironment may come from any stage along its life cycle and, therefore, environmental improvements may (and should) be sought in all stages. Following the same reasoning, it is clear that, since decisions made during the design phase of a product will influence its entire life cycle (from both physical and economic standpoints), those same decisions will also influence the product's environmental impact over its life cycle. In fact, environmentally speaking, the design phase is arguably the most important phase of the whole life-cycle of a product, and often largely determines its potential impact on the environment. Design factors such as employed materials, weight, volume, possible providers, durability, components assembly, etc. are fundamental aspects for determining the environmental impacts of a product.

Ecodesign adopts an integrated approach to address the relationship between products and services and the environment, structured on three levels:

1. The whole Life Cycle of the product or service is considered. The environmental impacts of a product do not only arise during its manufacturing, use or disposal phases, but throughout its entire life cycle. The product life cycle includes the extraction and transport of the resources needed to manufacture it, the manufacturing processes, distribution, use and maintenance, reuse and treatment of wastes.
2. The product is considered as a system. All the elements that a product needs to develop its function (consumables, packaging, energy networks etc.) must also be taken into account.
3. A multi-category approach is considered. All different environmental impacts that can be generated by a product system along its life cycle are assessed in order to avoid as much as possible trade-offs between different impact categories (e.g. resource depletion, greenhouse effect, toxicity etc). This integrated structure facilitates the use of ecodesign in combination with other IPP tools.

Example: Ecodesign of an Electronic Toy (Muñoz et al., 2009).
A cradle-to-grave Life Cycle Assessment (LCA) of a toy incorporating electric and electronic components was carried out following the ISO 14044 standard, with the purpose of identifying the environmental hotspots and suggesting ecodesign measures to the manufacturer.

FIGURE 3
"Winnie the Pooh tells Stories" by IMC Toys

The use phase is identified as potentially the most important life cycle stage, due to the impact of batteries production. It is responsible for 50% to 64% of the overall life cycle impact, depending on the impact category. Toy production is also an important stage, with 28% to 34% of the total contribution. Maritime distribution also involves relevant contributions in some impact categories. Based on the results of the study a set of ecodesign measures were suggested to the manufacturer, being most of them judged as feasible and applied in a new product. The LCA study was found as a very helpful tool to define ecodesign measures for this product. Several measures suggested have been actually implemented by the manufacturer in a similar product. This case study, together with others, has helped in the long run to define general ecodesign measures for the toy sector in Catalonia (Fullana i Palmer et al, 2008).

Policy Development – Waste Management

LCA is frequently used for policy making when comparing alternatives. According to legislation in the European Union (EU), movement of waste is to be reduced and, if unavoidable, the environmental gain from a specific waste treatment option requiring transport must be larger than the losses arising from transport. The European Commission recently recommended that the enlargement countries take an integrated approach based on LCA when making decisions on their waste management systems. Life cycle thinking and LCA are explicitly mentioned in a Thematic Strategy on the prevention and recycling of waste and related immediate implementing measures (European Commission, 2004):

> "A first necessary step is to develop a new type of knowledge base taking into account life-cycle information. This knowledge should be used to design environmentally and cost-effective waste prevention and recycling policies. It should help to define what information on waste is relevant to policymaking and to ensure that such information is taken into consideration as an integrated part of policy-making.
>
> The main options available are:
> – Maximum use of life-cycle assessment (LCA): Undertake a full life-cycle assessment at EU level in accordance with ISO standards on waste generation and management and introduce mandatory LCA for waste management planning;
> – Move to life-cycle thinking (LCT): LCT is a mindset for policymakers to make every effort to take into account relevant life-cycle aspects. In many cases this means using common sense to look at the wider picture while in others it could mean using assessment tools such as LCAs. To spread LCT in waste policy it is necessary to formulate an environmental objective for EU waste policy and legislation and set a framework for the assessment of waste policies at EU and national levels. This would be supplemented by a knowledge-gathering function at EU level that would inform further developments in EU waste policy."

More information on these issues can be found in work by Bala and Raugei (2009); a recent survey on the use of LCT in European waste management was published by Del Borghi *et al.* (2009).

Box 1. Example: PROGRIC 2007-2012 (Fullana i Palmer et al, 2011)

In the last two revisions of the Industrial Waste Management Programme of Catalonia (PROGRIC 2007-2012), the use of a life cycle thinking approach to waste policy was mandated. Four life-cycle based models of options for the management of, for instance, waste solvent to be addressed under Catalan industrial waste management legislation were proposed. All involved actors concluded that the models were sufficiently robust, easy to apply and accomplish the aim of limiting the transport of waste outside Catalonia, following the principles of proximity and sufficiency.

The problem was quite complex, with several different waste types, combination of treatment scenarios, transport systems, models with multiple variables, etc. Starting with a complex model and simplifying it until it was deemed applicable by all stakeholders proved to be a good way to proceed. Even with a very intensive goal and scope definition, it was acknowledged that this kind of project must be flexible enough to adapt to new alternatives and scenarios as they develop and interim results are presented.

Response to interim results for this study changed from somewhat sceptical at first, to enthusiastic in the end. During the start-up phase there was fear that applicability would be scarce but, seeing that different degrees of simplification were possible and that companies could always go further and perform a more complete LCA at will, this fear was overcome. Concerns from the Legal Department of the Catalan Waste Agency that no limitation to the transport of waste would be possible were overcome too. Finally, in a meeting with the General Manager of the Agency and Board of Directors where the final proposed solution was presented, all politicians were able to understand it, accepted it and acknowledged its application within the framework of EU waste legislation. The decision was also made to use the results of this study, and the LCA methodology in general, in the Catalan Government's waste management decision making process, although the operational way in which this will be done is not clear yet. Clear statements were also made about continuing to commission this kind of study for other types of waste. In the end, the final conclusion by all actors was that the intended goal had been accomplished: models were produced with satisfactory scientific robustness, ease of applicability, and which complied with the aim of limiting the transport of waste outside Catalonia following the principles of proximity and sufficiency.

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3

The Methodology and Practice of Sustainable Development Indicator System Construction for an Eco-City

Juan Wen - Wentao Chang - Zhenzhen Feng - Xueqiang Lu - Tao Sun - Xuefeng Lin - Meizhu Jin - Jingling Bao - Xiaochun Zhang - Lei Qi

ABSTRACT

A style of sustainable city, or Eco-city, has been developed rapidly in China due to promotion by Chinese central and local governments. An eco-city master plan is needed to integrate the concepts of sustainable development, especially ecological philosophy (e.g. industrial ecology, circular economy). Thus, a set of sustainable development indicators (SDI) is of substantial importance to quantify and guide city development. This paper aims to: a) analyse and establish a methodology for an eco-city sustainable development indicator system and b) apply the methodology in the study of Sino-Singapore Tianjin Eco-city. Due to the lack of a mature approach to constructing an eco-city sustainable development indicator system, a five-step methodology is proposed herein. Sino-Singapore Tianjin Eco-city catches the eye as a showcase of a sustainable, resource saving, socially harmonious and economic growth development pattern for a city. In addition, it is the first eco-city to set a carbon emission indicator in China. The SDI system for Sino-Singapore Tianjin Eco-city is proposed as a case to illustrate the method.

Keywords: Sustainable development indicator, eco-city, Tianjin

INTRODUCTION

Eco-cities, also known as sustainable cities, are cities designed with consideration of minimisation of required inputs of energy, water and food, and waste outputs of heat, air emissions and water pollutants. The study of eco-cities can be traced back to the MAB (man and biosphere) programme of

UNESCO in the 1970s (Register, 1987; Roseland, 1997; Yanitsky, 1982). In China eco-city research began from the 1990s (Huang and Chen, 1997; Huang and Yang, 2001; Wang, 2007). To make the concept of an eco-city a reality, city leaders should know how to build and manage the city correctly and keep the coordination of economic growth, social development and ecological preservation. However, the city is a complex system affected by social, economic, ecological and cultural factors. A set of sustainable development indicators (SDI) is critically important because SDI can be used to evaluate, monitor, and guide the planning and construction of an eco-city (Wang, 1991; Murphy, 2001; Yang, 2007; Potts, 2010).

Since the concept of sustainable development was first proposed by the World Commission on Environment and Development in 1987, the research on SDI has progressed (Song, *et al.*, 1999; Joachim, *et al.*, 2002; Li, *et al.*, 2010). The United Nations Development Programme (UNDP) proposed the Human Development Index (HDI) in the Human Development Report in May 1992. In the 1990s, both CSD and the Organisation of Economic Cooperation and Development (OECD) proposed their SDI systems. The International Institute for Management Development, Lausanne Switzerland (IMD) has also published international competition indicators. The World Conservation Union (IUCN) published it's "sustainable barometer". The United Nations Statistical Office (UNSD) also proposed its indicators on nation sustainable development. The traditional development indicators for national economy, *e.g.* Gross National Product (GNP) and Gross Domestic Product (GDP), have proven incapable of measuring sustainability for a city. Therefore SDI themselfs are changing with people's understanding of sustainable cities.

SDI systems take the city as an integrated system with three features: (a) high logistics efficiency, (b) coordination of economy-society-nature, and (c) high efficiency of information management networks. However, those indicators are unable to meet the requirements of sustainable development in developing countries.

Currently, with the rate of urbanisation in China, establishment of a complete SDI system is the main task of today's sustainable city research due to the lack of a mature approach to constructing an eco-city SDI system. In practice, the eco-city construction in China is a top-down process directed by government. Therefore the traditional SDI system construction method is no longer appropriate. A five-step methodology is proposed herein, based on the

consideration of sustainability theory and sustainable city practice in developing countries.

The present paper displays the method step by step and Sino-Singapore Tianjin Eco-city is proposed as a case study. The role of the research is to establish a pattern for SDI construction of an eco-city.

METHODOLOGY

There are four principles that should be followed in SDI establishment for an eco-city.

(1) Reasonability - The SDI must illustrate the vision of the eco-city from conception to practice, and reveal the connections between different factors precisely. Therefore, establishment of the indicator system must be reasonable and comply with sustainable development theory.
(2) Systematisation - Sustainable development in eco-cities is a systematic work. The coverage of the SDI must be wide enough to measure sustainability in different dimensions, e.g. reasonable use of natural resources, economic efficiency, healthy development of the social system, and so on. Besides, to facilitate efficient management of eco-city construction as a management tool for local government, SDI must have a systematic structure with different hierarchies and levels.
(3) Relevance - Relevance between the indicators and the sustainability target must be ensured. The relevance of the indicators should be considered, so that all the indicators point to the same aim. It is inevitable that the indicators in SDI system have interactions between each other. But the contradictory indicators must be eliminated as well as complementary ones.
(4) Flexibility and feasibility - The SDI system should be easy to apply. The establishment of SDI must be based on the local environment and culture, as well as considering government performance and management capacity and also development potential.

Five-Step Method

In the planning and practice of eco-cities in China, a five-step method to build SDI system has been developed by the Tianjin Academy of Environmental

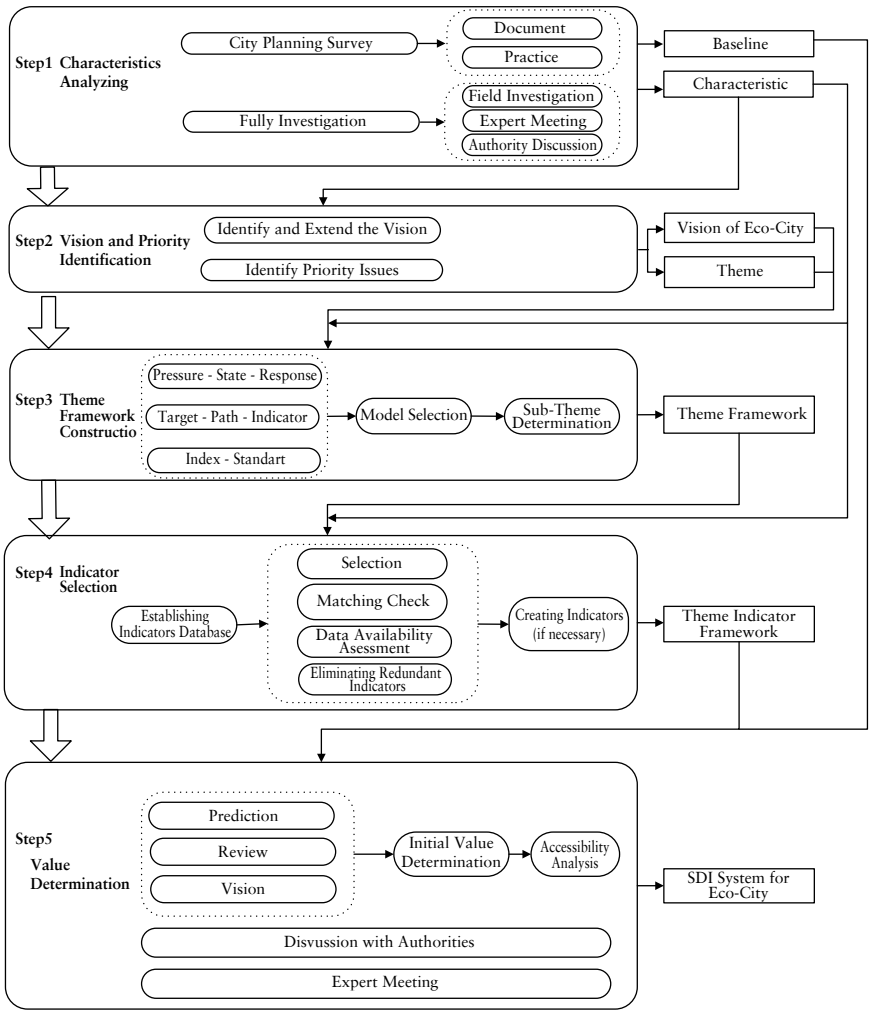
Sciences. This method follows the pathway of characteristics analysing – vision and priority identification – theme frame construction – indicator selection – value determination. A diagram of the five-step method is shown in **Figure 1**. The SDI system is composed of themes, sub-themes, indicators and values (**Table 1**).

(1) Characteristics analysis - A successful and efficient SDI system must comply with local characteristics. Thus, it is necessary to conduct a full-scale investigation and city plan survey through field investigation, expert meetings and authority discussions. Generally, the investigated factors can be classified into social, environmental and economic factors, such as people's living conditions, cultural background, location, climate and weather, biodiversity and so on. Based on this investigation, researchers can find the key characteristics of the eco-city, which is the baseline of the SDI system.

(2) Vision and priority identification - Combined with local characteristics, the vision and priority are identified. The vision is the expectations of authorities and stakeholders of the eco-city. The priority issues are the construction field which need to be considered first.

(3) Theme framework construction - The theme framework could generally be determined using the models of target – path – indicator (TPI), pressure – state – response (PSR) or index – standard (IS). The proper model represents a 'best-fit' to guide the assignment of the sub-themes. The TPI framework provides the objectives of the eco-city and a methodology of how to achieve the objectives. It can be used to establish the structure of environmental, social and economic themes and sub-themes. The TPI framework is suitable when a SDI system is set to guide the planning and construction of an eco-city or compare sustainability between the actual operation and targets set. It helps to establish a context and draw a boundary around a problem before deciding what the pressures, states, and responses are. The PSR framework could answer what the state of environment and of natural resources are, why this state has happened, and what can be done to improve it. The PSR framework was originally applicable for environmental themes, and it is hard to adjust to social and economic themes. The IS framework does not classify the indicators into different themes, it only provides in-

FIGURE 1
Flowchart Diagram of the Five-Step Method



dicators and values. Therefore, the IS framework could be used when the themes (or indicators) lack logical links or when the number of indicators is small.

(4) Indicator selection - The individual indicators could be quantitative or qualitative to describe the themes in the framework. An indica-

tor database is established firstly through the literature review. From the database, the priority indicators are selected to fill up the framework based on the local characteristics and the city vision. Certainly, new indicators are often created according to local characteristics.

(5) Value determination - Based on the baseline of the eco-city, a prediction for individual indicators is calculable according to the city vision and plan. The initial values of the indicators can be determined by consideration of the prediction and comparison to the performance of other cities. The initial values can be modified by accessibility analysis to each indicator. During this process, expert meetings and authority discussion always plays an important role.

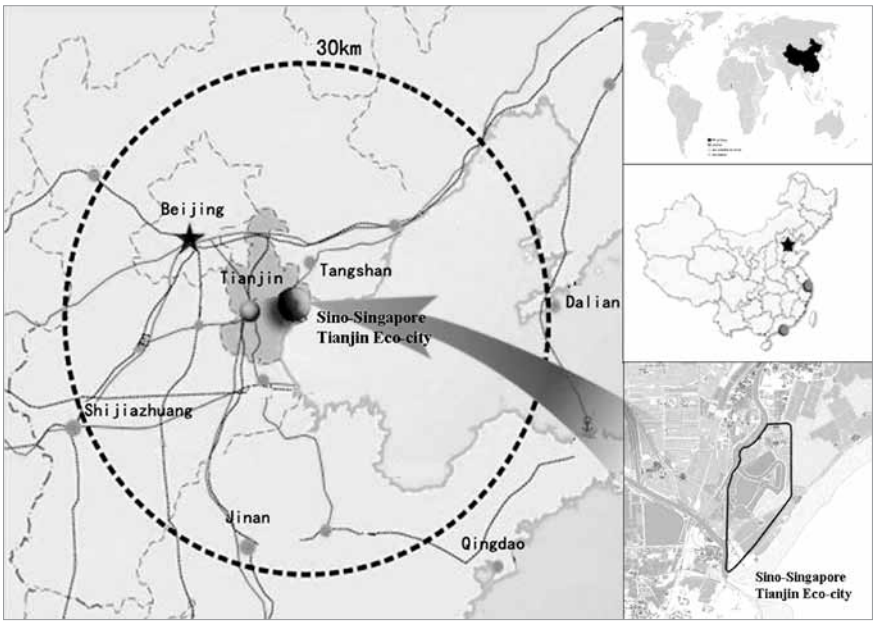
APPLICATION

In 2007, China and Singapore governments agreed to jointly develop an eco-city in Tianjin with harmony between man and man, harmony between man and the environment, and harmony between man and economy. This eco-city project can be replicable, practicable and scalable.

Sino-Singapore Tianjin Eco-city is located in the Haihe River estuary, which is north of the Tianjin Binhai New Area, a national level development area like Shenzhen of Guangdong and Pudong of Shanghai (**Figure 2**). Deserted salt pans, saline-alkaline wasteland and aged contaminated water bodies currently take up one-third each of the city area. Due to lack of water, the natural conditions and ecology are unfavourable and fragile. According to investigation and discussion with the city authority, there are also crucial requirements to construct an eco-city with green buildings, green transportation, green consumption, green economy and a green environment. The SDI system for the eco-city is designed in four themes: healthy ecological environment, social harmony & progress, vibrant & efficient economy, and regional coordination. Therefore, the eco-city can be a paradigm for other eco-city projects in China with land and water shortage.

As the Sino-Singapore Tianjin Eco-city is a new city in the construction stage with clear targets set, the SDI system including social, environmental and economic aspects emphasises the guiding function to the city construction and planning. Both the PSR and IS frameworks are not suitable in this case. According to the pattern of “target-path”, the themes are disassembled to sub-themes using the TPI framework. For example, the theme of healthy

FIGURE 2
Location of Sino-Singapore Tianjin Eco-City



ecological environment is divided into two sub-themes: good natural environment and coordination of man-made environment. The theme of social harmony & progress is divided into healthy living pattern, comprehensive infrastructure, and sound management mechanism.

According to a literature review of existing indicators, an indicator database is established. Indicators for each sub-theme are selected. Some new indicators are created, such as net loss of natural wetlands, a local/native plants index, prominence to the river estuarine cultural character, advocating green consumption, proportion of green trips, and proportion of green buildings. Carbon emission per unit GDP is also added, as carbon emission intensity is an important checking indicator for local government.

With baseline data and predictions for the eco-city, cross comparison to other cities, and requirements of the eco-city, the value for each indicator is given along with the accessibility analysis. The values will be upgraded according to the stage of eco-city (planning, construction and operation) and timeframe (short-term, mid-term and long-term).

Overall, as listed in **Tables 1** and **2**, the constructed SDI system covers four themes with 22 control indicators and 4 guiding indicators. The SDI system has been used for two years since the construction of the Sino-Singapore Tianjin Eco-city started in 2008. The requirements of the eco-city and the sustainable theory have both turned into measurable indicators. The practice indicates that the SDI system has performed well.

CONCLUSION

Eco-cities are an important progression in the practice of sustainable development theory. Recently, eco-cities have drawn more attention and continue to grow rapidly in China. Due to the lack of a mature approach on SDI construction in developing countries, a five-step method is developed and has been applied in the case of establishment of an SDI system for Sino-Singapore Tianjin Eco-city. The method emphasises consideration of local characteristics and vision of the eco-city in the procedure of SDI system establishment. The two-year practice of the SDI system for the Sino-Singapore Tianjin Eco-city indicates the five-step method is reasonable and feasible.

TABLE 1
Quantitative Indicators of the SDI System

Themes (Target)	Sub-themes (Path)	Number	Indicators	Unit	Values	Timeframe
Healthy ecological environment	Good natural environment	1	Ambient air quality	Days	fl310 days per year in which ambient air quality meets or exceeds Chinese National Ambient Air Quality Standard (GB 3095-1996) Grade II (i.e. 85% of 365 days)	Immediate
				Days	fl155 days per year in which SO_2 and NOx content in the ambient air quality meets or exceeds Chinese National Ambient Air Quality Standard Grade I (i.e. 50% of 310 days)	Immediate
					Air quality meets Chinese National Ambient Air Quality Standard	By 2013
		2	Quality of water bodies within the Eco-city		Surface water quality meets Chinese National surface water quality Standard (GB 3838-2002) Grade IV	By 2020
		3	Water from taps attaining drinking water (potable) standards	%	100	Immediate
		4	Noise pollution levels must satisfy the stipulated standards for different functional zones	%	100	Immediate
		5	Carbon emission per unit GDP	tones of carbon equivalent per million US dollars	fi150	Immediate
		6	Net loss of natural wetlands	%	0	Immediate
	Balance of man-made environment	7	Proportion of green buildings	%	100	Immediate
		8	Local/Native plants index		fl0.7	Immediate
		9	Public green space per capita	m^2/person	fl12	By 2013

TABLE 1
Quantitative Indicators of the SDI System

Themes (Target)	Sub-themes (Path)	Number	Indicators	Unit	Values	Timeframe
Social harmony & progress	Healthy living pattern	10	Per capita domestic water consumption	l/person/day	fi120	By 2013
		11	Per capita domestic waste generation	kg/person/day	fi0.8	By 2013
		12	Proportion of green trips	%	fl30	Before 2013
					fl90	By 2020
	Comprehensive infrastructure	13	Overall recycling rate	%	fl60	By 2013
		14	Provision of free recreational and sports facilities within walking distance of 500m	%	100	By 2013
		15	Treatment to render solid waste non-hazardous	%	100	Immediate
		16	Barrier-free accessibility	%	100	Immediate
		17	Services network coverage	%	100	By 2013
	Sound management mechanism	18	Proportion of public housing	%	fl20	By 2013
Vibrant & efficient economy	Sustainable economic development	19	Renweable energy usage	%	fl15	By 2020
		20	Water supply from non-traditional sources	%	fl50	By 2020
	Vibrant technological innovation	21	Number of R&D scientists and engineers per 10,000 labor forces	man-year	fl50	By 2020
	Overall balanced employment	22	Employment-housing equilibrium index	%	fl50	By 2013

TABLE 2
Qualitative Indicators of the SDI System

Theme (Target)	Sub-themes (Path)	Number	Indicators	Description
Integrated regional coordination	Coordinated natural ecology	1	Healthy ecological safety, advocating green consumption, low carbon operations	To maintain an integrated regional ecology, strengthen ecological safety and establish a sound regional ecological security system within the Eco-city, from the perspective of the optimum usage of regional resource and energy, and the capacity of the environment.
	Coordinated regional policies	2	Advance innovative policies, united anti-pollution policies in place	Actively participate in and promote regional cooperation, and implement the principle of uniformity of public services. Regional policies should ensure regional policy coherence. Establish a sound regional policy system to ensure the improvement of the surrounding areas.
	Social and cultural coordination	3	(Give) prominence to the river estuarine cultural character	Urban planning and architectural designs should preserve history and cultural heritage; manifest the uniqueness, while protecting ethnic, cultural and scenic resources. Also, to ensure safe production and social order.
	Regional coordinated economy	4	Supplementing the recycling economy	Sound market mechanism to overcome the limitations of administrative divisions, drive the orderly development of the surrounding region, promote a reasonable division of functions at the regional level, as well as an orderly market, and relatively balanced economic development and living standards.

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4

Secondary Resources: Former Waste now Valuable Resource

Alexandra Pehlken - Jorge Marx Gómez

ABSTRACT

Most input materials into the manufacturing processes of products are mainly primary resources and can be clearly described in their properties since nearly all suppliers of resources participate in a quality management system and provide all their details on material streams. In most cases material streams generated from recycling processes (secondary resources) cannot compete with virgin materials because secondary resources are often a mixture of various components. There is a huge potential for secondary resources to able to substitute primary resources if the information on their properties is complete and provided. This paper will give an overview on Material Flow Assessment in recycling processes and how providing information on the recycling potential of a product may be essential to meet environmental constraints. This is only possible through describing material properties.

Keywords: Recycling, material flow, waste, uncertainty, modelling

INTRODUCTION

Raw materials are essential to satisfy our needs in energy and products. Many raw materials are restricted and far from being endlessly available, therefore, there is a strong imperative for developing raw material- and energy-efficient production processes. Recycling processes provide a substantial contribution to sustainable resource management due to the supply of valuable secondary raw materials for new applications.

Secondary resources are not derived from mining or chemical process-

es comparable to primary resources. They are resources that had been already in use and are processed afterwards. Some secondary resources may be waste material in their original application because they don't provide the required properties any more but they might be useful in other applications. An example represents printed paper: Once paper is printed it may be useless as resource for new printing activities, but they provide properties to be used as resource for new envelopes for example.

Processing solid waste materials generates new secondary resources from residues as resources for new products. This saves primary resources and keeps up a long material life cycle. It has to be noted that no processing technique can guarantee solely material flows with properties close to primary resources. There are always material flows of minor quality. This makes it difficult to assess the future potential of secondary raw materials to substitute primary resources.

Recycling can be found in various ways:

a) direct recycling - material is used "as is" in further applications (no recycling process involved)
b) down-cycling - material is used for products that are of lowerquality than the source (for example passenger tires into construction materials)
c) up-cycling - material is used for products that are of better or equal quality as the source (for example aluminium or glass recycling)

The goal of each recycling process should be to generate material streams with a quality that ensures up-cycling in any way. Since it is not possible to achieve this goal for all life cycles the goal has to be to maintain processing of materials as long as possible to guarantee specific material properties. This cycle can be maintained longer if the design of new products take into account the recyclability or further use of materials and product components. The material properties and consistency including regulation of impurities are important. Excellent material properties cannot be achieved if extreme variations in quality are seen making materials unreliable and irreproducible. Substance values are reproducible if – when repeating the sampling procedure – the new set of one or more substance values is statistically indistinguishable from the original one (i.e. the statistics of interest (e.g. means) do not differ significantly). The reproducibility must be guaranteed over the

whole processing time to obtain a material stream with constant properties and therefore ensures the process capability.

ASSESSMENT METHODS

To assess a sustainable resource management the following conditions for a reasonable recycling process have to be achieved (Pehlken, 2011):

- Adequate material mass for the recycling process
- Adequate material mass for further product manufacturing
- Defined material properties
- Very little variation of material properties

It is desirable to forecast the above mentioned conditions for choosing the processes with the best performance. A rough prediction on material flows, costs and environmental impacts can be assessed through combining the methods Material Flow Assessment (MFA) and Life Cycle Assessment (LCA). But these methods lack of the description of material properties and their variations and uncertainties respectively. Material flows should rather reflect a fundamental basis than being reduced to the assessment of mass and volume. Future prospects of the quality of secondary resources, including their input and output properties may be helpful to assess their potential to substitute primary resource for example. Information on material properties generated with LCA and MFA can contribute to the product design, the production phase and the recycling performance of a product.

The management of product life cycle includes the best knowledge of processes, their materials and their system boundaries. Attention has to be paid to uncertainties in performing LCAs in recycling processes. Life cycles of secondary resources are often identified as open loop processes (conversion of material from one product into a new application) compare to closed loop processes (conversion of material into the same application). While characterising the output material stream of the first life cycle the input material stream of the following life cycle is characterised as well. This lowers the uncertainty and makes it more likely to substitute primary resources as well.

Although there will be always some waste, the best way to conserve resources and reduce the impacts of resource use is to address the entire life cycle of materials, looking to improve material choices, and anticipating resource conservation and recovery at every step. This implies that during the

product design the designer has to consider the whole life cycle of the product and the materials used for the product to follow sustainable resource management.

Life Cycle Assessment (LCA), which is used to assess the environmental impacts of products from cradle to grave, is increasingly being applied to the evaluation of waste management strategies. It should be noted however that there is a fundamental difference between the life cycle boundaries of products and wastes. The life cycle of a product starts with the extraction of raw materials (through activities such as mining, logging, etc.) and ends with the final disposal of a product. The life cycle of waste on the other hand, starts when a material is discarded into the waste stream and ends when the waste material has either been converted into a resource (such as recycled material or recovered energy) or, when it has been finally disposed (EPIC, 2000).

Since 1992 the Society of Environmental Toxicology and Chemistry (SETAC) is organising workshops focused exclusively on uncertainties in Life Cycle Assessments (LCA) (Fava *et al*., 1994). Modelling recycling processes and the assessment of uncertainty are firmly connected; otherwise the model provides a lack of reliability due to parameter uncertainties. An interest on the credibility of process modelling due to the performed decisions based on the LCA is evident (Pennington *et al*., 2004).

Modelling solid waste recycling processes is a challenge because there are few specific data available. Various materials are firmly connected to each other that make an ideal separation success nearly impossible. Useful information can be accumulated with data received from particle size distribution.

The management of product life cycle includes the best knowledge of processes and their system boundaries. All recycling processes have in common that their input material has already had a complete life cycle; therefore it is more difficult to find exact input data for the LCA of the recycling process. Attention has to be paid to uncertainties in performing LCAs in recycling processes. These days life cycles of secondary resources are no longer within the system boundary from 'cradle to grave'; instead we have to look at a life cycle from "cradle to cradle" (Braungart, Mc Donough, 2002).

LCA helps decision makers taking into account environmental contribution on the basis of material and energy flows. Material Flow Analysis (MFA) is a systematic assessment of the flows and stocks of materials within a system defined in space and time (Brunner & Rechberger, 2003). It con-

nects the sources, the pathways, and the final sinks of a material. An MFA delivers a complete and consistent set of information about all stocks and flows of a particular material within a system. The MFA can be regarded as a method to establish the inventory for an LCA.

A short history of MFA can be found in Binder (2009) and goes back to roots in the early 1960's to studies on material balances. Brunner and Rechberger's, 2003 publication is now the established MFA reference.

Material Flow Assessment can be easily applied to recycling processes because it takes into account all material flows entering and leaving the recycling process (system boarder). Since the input in recycling processes is often a mixture of various material streams the exact composition is never known. There is often a lack of information due to unknown parameters in material composition or processing steps (Pehlken & Müller, 2009). Due to the high potential of recycling processes contributing to a sustainable management of resources (e.g. energy savings and material efficiency) it is necessary to assess the material flows with regard to their environmental impact (Bringezu & Bleischwitz, 2009; Salhofer *et al.*, 2004). Assessing the material flows involves the characterisation of materials and their properties. According to secondary (recycling) materials this is only possible with determining a range of properties values (e.g. water content lies between 5 and 7 %).

CASE STUDY – MUNICIPAL SOLID WASTE

Municipal solid waste can be described as household waste that we produce each day. Have you ever thought about its fate after it leaves your house? There is a high potential for resource recovery in these waste materials and waste processing plants are able to separate valuable material flows from non-valuable flows. This chapter gives an example on the information that is given by a survey on a processing plant after a period of more than 20 months and about 140 single samples taken all year.

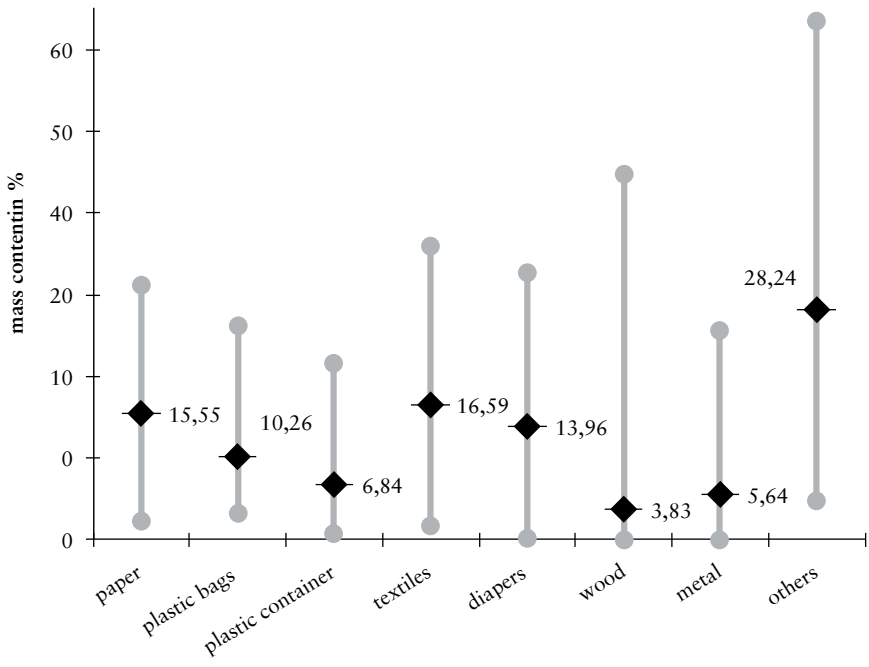
Dividing into Material Groups

Since municipal solid waste is a very heterogeneous material it is helpful to divide the sample into material groups. This is an advantage, because material groups have their own properties and therefore the sample preparation might be made easier or give rise to less sampling preparation errors. Each sample of the waste treatment plant can be divided into the main material classes:

- Paper
- Plastic bags
- Plastic containers
- Textiles
- Diapers
- Wood
- Metal
- Others

Figure 1 shows the variation of mass contents in each sample. The value represents the mean value of all single samples. The vertical indicator gives the value of the Maximum and Minimum found in the examination. It is obvious that there is a high variation of all samples around the mean value (e.g. material wood: mean value = 3.83 mass-%; Maximum value = 44.75 mass-%; Mini-

FIGURE 1
Variation of Mass Content of Municipal Solid Waste Samples
(based on 140 single samples)



mum value = 0.00 mass-%). This is a common situation for residual waste. The example of wood was due to the existence of one bowling ball in one sample whereas in the next sample there was no wood at all. Within the material textiles the result is similar: mean value = 16.59 mass-%; Maximum value = 35.85 mass-%; Minimum value = 1.70 mass-%. The maximum value was caused by a complete pair of trousers in one single sample. Due to the extreme variations in single samples it is beneficial to look at collective samples, like a day performance for example. Taking, for example, the average of 5 single samples over a period of time (e.g. one day) will smoothen the high variations and thereby reduce the risk of getting an uncharacteristic high or low average value which could be a more reliable basis for decisions on further procedures than a single substance value (without averaging) would be (Pehlken, 2010).

It is evident that municipal solid waste has high deviations within its material components and therefore dividing the sample into material groups is helpful for further assessment. Material groups often follow similar analytic results due to the elementary composition, which makes analysis easier if material groups are analysed separately instead of together. Because each material group may have its characteristic signature with respect to the mass contents of one or more compounds of interest, a primary source of substance value in the sample can often be determined. e.g. a higher nickel or copper content in a sample can be expected when a sample contains much textile, because this material group generally contains higher levels of nickel and copper. Another example: a high calorific value of a sample is generally caused by the increased presence of materials from the plastics material group. The strategy of separating the material groups in the sample before analysis of each group separately is part of a guideline for sampling waste materials in Saxony, Germany (Sachsen, 1998).

The particle size (given as a mass or weight in this case) of all single particles of the material groups > 40 mm have been measured and, as an example, for the material group plastics the particle mass distribution is shown in **Figure 2** and **3**. In most recycling materials, we find left-orientated skewed distributions (Uerkvitz & Goetz, 1997; Völker, 2001) such as log-normal distributions.

The log-normal distribution is a positive skewed distribution. In environmental observations, most often a positive skewed distribution is found. This can easily be explained by the fact that concentrations can never be less than zero and that there are occasional high concentrations. Although a log-normal distribution is not as extremely skewed as environmental data some-

FIGURE 2
Histogram of 892 Single Particles of the Paper Fraction in a Linear Horizontal Scale

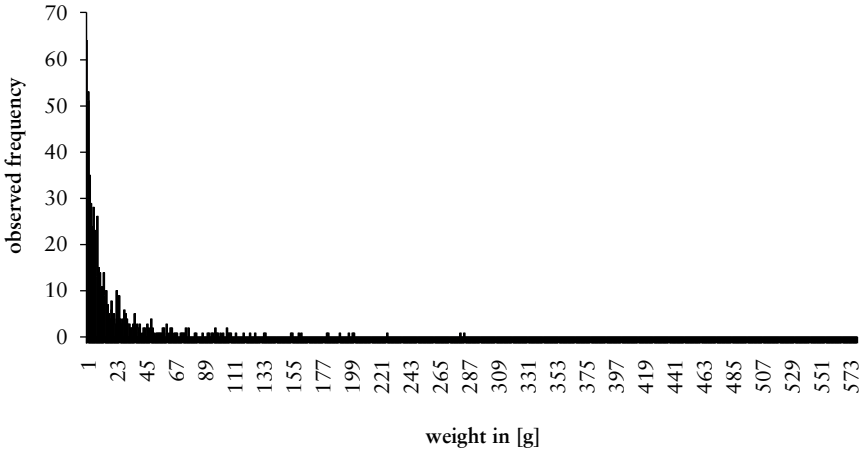
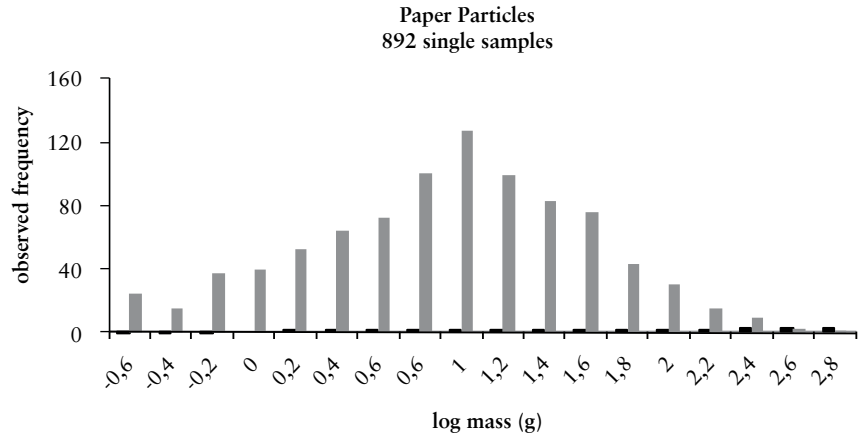


FIGURE 3
Histogram of 892 Single Particles of the Paper Fraction in a Logarithmic Horizontal Scale



times are, it is often thought to be an acceptable assumption for environmental data distributions (ISO, 2002).

Usage of the log-normal distribution has the benefit that after a logarithmic transformation, it becomes a normal distribution, making statistical analysis potentially easier.

Selective Crushing Behaviour of Materials

An important step in sample preparation is the comminution (i.e. crushing and grinding). The purpose of this step can broadly be described as: getting a smaller particle size to allow representative subsampling or to liberate materials. The particle size reduction and the liberation of materials during crushing and grinding will both effect the further processing. Subsequent processing steps are influenced by the quality of crushing and grinding. If one's objective is to separate components in the sample, the liberation grade of the main components within the sample is essential for the subsequent separation success. Due to presence of finer particles after crushing, more particles can be found in a sample and with more liberated particles the probability seems to scale with the ratio of the number of particles in the sample and the number of particles in the population from which the sample is taken.

Before starting with crushing and grinding the appropriate crusher has to be found. Each material (except the metal fraction) has different properties and shows different behaviour during the comminution process. **Table 1** shows an overview on material property and stress. Each process engineer has to answer the following question: 'What is the best suitable crusher or

TABLE 1
Shatter Properties of Waste Materials

		Way of stress			
Property	**Waste examples**	**Pressure**	**Drill**	**Cutting**	**Shear strain**
Hard/abrasive	Glass, Ceramics, Metal, Sand, Stone	+	-	-	-
Medium hard	Salt, Duroplastic	+	+	-	-
Soft	Organics, Thermoplastic, Textiles, Paper, Wood	0	0	+	+
Brittle	Glass, Ceramics	+	+	-	-
Elastic	Thermoplastic, Elastomer, Metal	-	0	+	0
Viscous/durable	Plastics, Organics	-	+	+	+
Fibred	Paper, Textiles, Plastic fiber	-	-	+	0
Sticky	Plastics, Organics	-	-	+	0

This table shows relations between qualitative properties and should therefore be used as a guideline only (Pehlken, 2010). Level of applicability: +=high; 0: moderate; -=low

grinder for my material to achieve the requested particle size for further treatment?'.

The shatter properties of solids are a key issue for the breaking mechanism of a material property. For hard and brittle materials the impact of pressure and drilling is the best whereas soft and durable materials need cutting and shear strain to perform best. Additionally, it is very important to use a functional unit that is working under little selective grinding.

DISCUSSION AND CONCLUSION

There is a big challenge of secondary resources to save our primary resources. Due to our limited primary resources and the goal to live in a sustainable environment recycling technologies will improve. Materials Flow Assessment and Life Cycle Assessment (LCA) can support the determination of the future potential of waste streams entering the recycling process. Information on material properties generated with LCA and MFA can contribute to the product design, the production phase and the recycling performance of a product. Traditional LCA models are static and are not suitable for dynamic modelling.

To be able to plan for changes in waste flows, decision-makers require future studies of material flows. There is a high potential for research work on field dynamic modelling to forecast material flows with regard to LCA. Uncertainties are often related to recycling processes and therefore it is necessary to take into account the consequences of their impact on assessment methods. To develop reliable models for the forecast of resources there is a need for a large amount of data on material properties. The access to existing recycling networks and databases is useful.

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5

Sustainability Reporting out of a Prisoner's Dilemma

Thomas Kaspereit

ABSTRACT

Listed firms increasingly strive for a sustainable appearance, which has made sustainability reporting very popular in recent years. This would be completely rational if sustainability reporting could enhance shareholder value. This paper investigates from a theoretical perspective which conditions are sufficient for the individual and collective rationality of sustainability reporting. The analysis leads to the conclusion that, due to the competition between firms, sustainability reporting generates separation equilibrium as long as the reporting costs are proportional to the reported level and the marginal costs of reporting differ with the true level of sustainability. Although it might be preferable, a pooling equilibrium with no sustainability reporting cannot be sustained, which is a result of the so-called 'prisoner's dilemma' that firms find themselves caught within.

Keywords: Sustainability reporting, game theory, signalling theory, prisoner's dilemma

INTRODUCTION

Several studies have raised the question of whether environmental and social disclosures are incrementally informative for capital market participants (Richardson & Welker, 2001; Marshall *et al.*, 2008; Clarkson *et al.*, 2010). This question strictly relates to the issue of whether and how environmentally and socially responsible behaviour is taken into account when making investment decisions and performing firm evaluations (Moskowitz, 1972). This paper starts from the position that considering environmental,

social and economic issues simultaneously has a positive effect on shareholder value. It contributes to the literature by developing a comprehensive theoretical framework that describes conditions under which reporting on corporate sustainability is individually and collectively rational, and under which conditions it is probably not. The conclusion is made that firms might be caught in a 'prisoner's dilemma' when sustainability reporting is collectively irrational and highly sustainable firms are forced to maintain sustainability reporting at a high level even though they would prefer to abandon sustainability reporting altogether.

THE EFFECT OF CORPORATE SUSTAINABILITY ON THE MARKET VALUE OF FIRMS

The literature on the effects of corporate sustainability on firm value has become extensive in recent years (Dowell *et al*., 2000; Godfrey, 2005; Sharfman & Fernando, 2008). However, the lines of argument that can be found are similar. If it is assumed that management acts rationally and mainly on the behalf of shareholders, introducing corporate sustainability is either supposed to enhance expected cash flows, reduce investment risk, or both. This enhancement of future cash flows can result from a correlation between sustainability and efficiency of production processes as well as cost savings effects with regard to waste disposal, environmental charges, or recruitment (Klassen & McLaughlin, 1993, 1996; Lo & Sheu, 2007). It is also conceivable that corporate sustainability reduces expected cash flows due to higher expenditures for new factories or other implementation costs, but that this is outweighed by the reduction of the cost of capital, and the net effect on firm value is positive. The reduction of the cost of capital can be attributed to generating positive moral capital among communities and stakeholders, which can serve as an insurance-like protection for a firm's relationship-based intangible assets, and in turn reduce its exposure to stakeholder risks (Godfrey, 2005). From this perspective, corporate sustainability can be regarded as a tool to manage environmental, social and economic risks.

Empirical results about the effects of corporate sustainability on expected cash flows, the cost of capital, or their aggregate market value are mixed, but generally indicate that in recent years corporate social and environmental performance has indeed been positively related to financial performance and market value (Orlitzky *et al*., 2003; Brammer *et al*., 2006; Bird *et al*., 2007; Semenova *et al*., 2009).

The theoretical analysis here is based on the assumption that a positive effect of corporate sustainability on the market value of a firm would exist provided that the degree to which the principle of corporate sustainability is followed by an individual firm was fully observable by capital market participants. However, in reality, corporate sustainability is hard to measure, and for the majority of investors is not directly observable. Firms need to communicate their sustainable behaviour if they wish to benefit from it in the form of increased shareholder value. Sustainability reporting is intended to be an instrument for signalling corporate sustainability. Whether it can in fact serve this purpose depends on some of its characteristics which will be described in detail below.

SUSTAINABILITY REPORTING AS A SIGNALLING INSTRUMENT AND THE DEFINITION OF INFORMATIONAL EQUILIBRIA

Spence (1973; 1974) described how the hiring of workers can be regarded as an investment done under uncertainty. The uncertainty exists with respect to the productivity of workers, which is not known to the employer at the time they are hired. Here, the employer has to make an estimate about this characteristic. Only after some time can this estimate be confirmed or disproved. To influence the estimate of the employer, a worker can signal his abilities and productivity through education.

The same framework can be applied to firms and with respect to their level of corporate sustainability. Capital market participants do not know the true level of corporate sustainability when they invest in a certain firm. Only after some time will they observe whether the firm's cash flow and risk profile are consistent with a stakeholder- and environment-oriented organisational structure. However, firms can attempt to signal their corporate sustainability to capital market participants through sustainability reporting. They can even feign a degree of sustainability that is different from what they actually do. Whether this strategy pays off in the short run depends on whether capital market participants consider the signal to be reliable, and in the long run whether this belief is confirmed by reality. What is required is an equilibrium of self-confirming beliefs. Self-confirming here means that the incentives for the firms arising out the beliefs of the capital market participant make the company act in a way that confirms these beliefs. If, for instance, capital market participants more greatly value firms that report a high level

of sustainability, this increase must outweigh the costs of reporting for highly but not for weakly sustainable firms. If weakly sustainable firms also have an incentive to report a high level of sustainability, the expectations of the capital market participants will be disproved and require adjustment.

Properties of Separating Equilibria

In order to describe the properties of equilibria in which sustainability reporting is sufficient for distinguishing highly from weakly sustainable firms, the population of firms is assumed to be nearly homogeneous, i.e. all firms are identical in every aspect except the degree to which they follow corporate sustainability. Corporate sustainability might be observed by employees, clients and other closely related stakeholders (e.g. people living in the neighbourhood of production plants), although it is impossible for capital market participants to screen all of their potential investment opportunities for sustainable behaviour. Further, it is assumed that the population of firms is divided into weak and high sustainability, i.e. only two categories. The proportion of firms which follow a high degree of sustainability is λ_h, and the proportion of firms with a low degree of sustainability λ_l.

Two important functions have to be defined. The first describes the effect of corporate sustainability on the market value of the firm before the direct costs of reporting are considered. Since the true level of corporate sustainability is not directly observable by capital market participants, this function Δ is a function of the reported level of corporate sustainability D rather than the true level:

$$\Delta = \Delta(D). \tag{1}$$

The specific characteristics of $\Delta(D)$ are not well known. Theoretically, even its first derivative could be both positive or negative. This results from the unanswered question of whether the benefits of sustainability outweigh its costs on the corporate level. In addition, it is not even known whether capital market participants expect firms with a higher reported level of corporate sustainability to be more sustainable. Setting these problems aside for a moment, it can be noticed that the reported level D of corporate sustainability is under the discretion of management. Management decisions will be influenced by the true level of corporate sustainability θ if the costs of reporting depend on it. Consequently, the second important function to

be defined is the cost function C of reporting a certain level D of corporate sustainability:

$$C = C(a(\theta), D) = a(\theta) \cdot D \tag{2}$$

It needs to be emphasised that C only refers to the direct costs of reporting. These are the costs for issuing a sustainability report and, if a higher degree of sustainability is reported than actually followed, the expenses for so-called 'greenwashing' (e.g. organising charity events and their exploitation by marketing). It does not include other costs relating to real sustainable behaviour and processes. Through this function, the costs of sustainability reporting are defined as the product of the reported level D and a factor a. This factor itself is assumed to be a function of the true level of corporate sustainability. Spence (1973) makes the crucial assumption that the costs of signalling are negatively correlated with the true level as he implicitly defines $a(\theta)=1/\theta$ (Hindriks &Myles, 2006, p. 271). In this way, a higher positive level of true corporate sustainability would always lead to lower costs of reporting a certain degree of corporate sustainability. An infinite number of other functions that serve these conditions exists, such as the inverse sigmoid function $a(\theta) = e^{-\theta}/(1+e^{-\theta})$ or the simple quadratic function $a(\theta)=1/\theta^2$. Which function best proxies the true relationship between the costs of sustainability reporting and real corporate sustainability is an empirical question.

According to the assumption of rationality, firms maximise their total increase in shareholder value when they choose between different disclosure levels. Their decision problem can be expressed as

$$\max_{\{D\}} \Delta(\mathrm{D}) - a(\theta) \cdot D \tag{3}$$

where the costs of reporting are measured as the present value of the cash flows resulting from the expenses of reporting.

Sustainability reporting is only an efficient instrument of capital market communication if it reliably separates highly sustainable from weakly sustainable firms. So the solution to the maximisation problem (3) requires a higher reported level of sustainability for highly sustainable firms than for weakly sustainable firms. This is ensured when the net gains in shareholder value for highly sustainable firms are higher if they disclose a high level of corporate sustainability rather than report a low level; for weakly sustainable

firms the net gains in shareholder value need to be smaller if they choose to disclose a high level of corporate sustainability compared to the case that they report a low level. With D_h (D_l) indicating a high (low) reported level of corporate sustainability and a_h (a_l) indicating the cost coefficient for highly (weakly) sustainable firms, this translates into the mathematical expressions

$$\Delta(D_h) - a_h(\theta_h) \cdot D_h > \Delta(D_l) - a_h(\theta_h) \cdot D_l \tag{4a}$$

$$\Delta(D_l) - a_l(\theta_l) \cdot D_l > \Delta(D_h) - a_l(\theta_h) \cdot D_h. \tag{4b}$$

If conditions (4a) and (4b) are fulfilled, sustainability reporting manages to separate highly sustainable from weakly sustainable firms. For the weakly sustainable firms, there is no point in making any efforts to appear sustainable at all. This results from the fact that capital market participants immediately realise that a firm is of low corporate sustainability if it reports a lower level than D_h. Hence, in such a separating equilibrium D_l will be zero. Conditions (4a) and (4b) provide the lower and upper boundary of the reported level of corporate sustainability for the highly sustainable firms:

$$\frac{\Delta(D_h)-\Delta(D_l)}{a_l(\theta_l)} < D_h < \frac{\Delta(D_h)-\Delta(D_l)}{a_h(\theta_h)}. \tag{5}$$

Since reporting a higher level of sustainability is assumed to be more costly, and only two different levels of corporate sustainability exist, there is no incentive for highly sustainable firms to report a higher level of corporate sustainability than the minimum to ensure that they are distinguished from the low level firms. Thus, they will report a level of corporate sustainability that is marginally higher than that expressed by the left-hand side of inequation (5). This inequation further shows that, if the marginal costs of reporting as well as the effect of reporting on shareholder value differ, there will always be a level of sustainability reporting that ensures separation of the highly from the weakly sustainable firms. Therefore, different marginal costs of reporting and different effects of reported levels of sustainability on shareholder value are sufficient conditions for the existence of a reporting level D_h that ensures separation.

Violation of the Critical Assumptions

If the assumption of different marginal costs of reporting or the assumption of variable effects of reported sustainability on shareholder value does not

hold, the firms will end up in a pooling equilibrium in which no effort is spent on sustainability reporting. The proof is quite simple: If the marginal costs of reporting do not differ, no D_h exists that satisfies inequation (5). Both highly and weakly sustainable firms see the opportunity to gain an increase in shareholder value of $\Delta(D_h)$ if they report a higher level of sustainability than the others. Since the incentives do not differ between the groups, in the first round they will report up to the level at which the costs of reporting equal the positive effect of being seen as highly sustainable. Hence, equal marginal costs of reporting and competition between both groups make sustainability reporting an instrument that has neither a value for the individual firm, nor one that can serve as a signal to separate the highly from the weakly sustainable firms. In the second round, capital market participants will anticipate that sustainability reporting has no information value and disregard it when making their investment decisions. Therefore, in the third round no firm has an incentive to report on sustainability at all. Only then can an equilibrium with self-confirming beliefs be reached.

Constant effects of reported sustainability on shareholder value imply that capital market participants do not value corporate sustainability or sustainability reporting from the very start. This leads to the same outcome as no difference in the marginal costs of reporting, although here it is even more direct. When firms see that their effort in sustainability reporting will not be rewarded, there is no incentive to spend any effort in doing it, and firms will renounce the use of this instrument in general.

Properties of Pooling Equilibria

As shown above, a lack of divergence in the marginal reporting costs leads to pooling equilibria in which sustainability reporting is of no use. Since by assumption sustainability reporting is the only potential signalling instrument, in such an equilibrium capital market participants cannot distinguish between highly and weakly sustainable firms. Therefore, if the proportions of both groups are known or at least can be estimated accurately, every firm will gain an average increase in shareholder value of $\lambda_h \cdot \Delta(\theta_h) + \lambda_l \cdot \Delta(\theta_l)$. Note here that the increase in shareholder value depends on the true level of corporate sustainability rather than the degree with which sustainability is reported.

Even when none of the critical assumptions is violated, the pooling equilibrium might be preferable for both highly and weakly sustainable firms. That is true if the average increase in shareholder value exceeds the increase

highly sustainable companies would gain for the shareholder in a separating equilibrium:

$$\lambda_h \cdot \Delta(\theta_h) + \lambda_l \cdot \Delta(\theta_l) > \Delta(D_h) - a_h(\theta_h) \cdot D_h. \tag{6}$$

The value of D_h is determined from the left-hand side of inequation (5). Thus, it follows

$$\lambda_h \cdot \Delta(\theta_h) + \lambda_l \cdot \Delta(\theta_l) > \Delta(D_h) - a_h(\theta_h) \cdot \frac{\Delta(D_h) - \Delta(\theta)}{a_l}. \tag{7}$$

Knowing that $\lambda_l = 1 - \lambda_h$ as well as that in a separating equilibrium only highly sustainable firms report a high level of sustainability [$\Delta(D_h = \Delta(\theta_h)$; $\Delta(D_l) = \Delta(\theta_l)$], rearranging leads to

$$\lambda_h > 1 - \frac{a_h}{a_l}\lambda \Leftrightarrow \lambda_h < \frac{a_h}{a_l}. \tag{8}$$

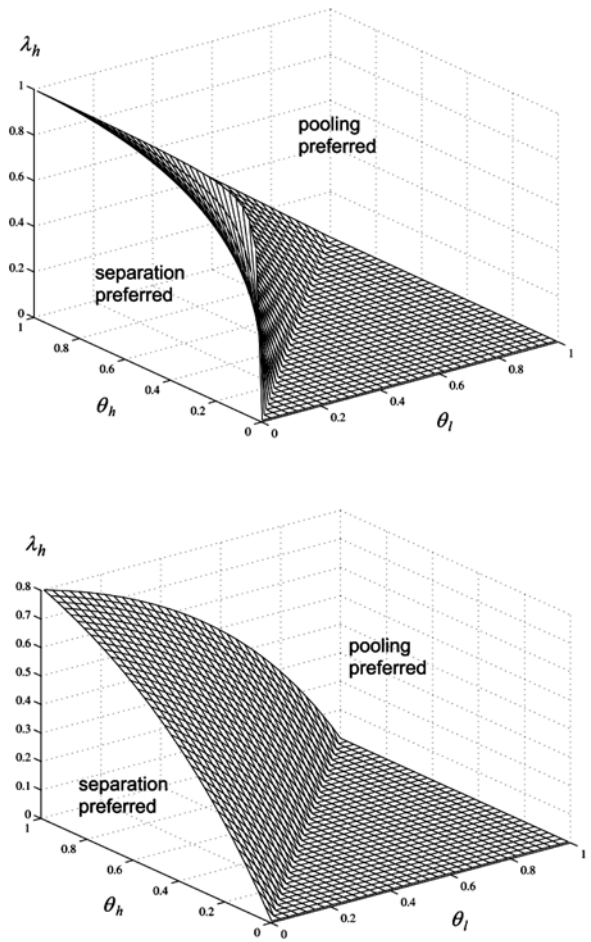
Equation (8) shows that a pooling equilibrium with no signalling is preferred if the highly sustainable firms are a majority, where majority is defined as a proportion exceeding $1\text{-}a_h/a_l$. The inequation spans a surface boundary in the three-dimensional space that divides the vectors (λ_h, a_h, a_l) in those of preferred pooling (above) and separating equilibria (below). **Figure 1** shows this for cases of $a(\theta)=1/\theta$ and $a(\theta) = e^{-\theta}/(1+e^{-\theta})$.

Whether a pooling or separating equilibrium is preferred depends on the concrete values of the parameters λ_h, θ_h and θ_l. They indicate to a point above the surface boundary if the true levels of corporate sustainability do not greatly differ, the costs of sustainability reporting are not very sensitive to the true level of corporate sustainability, and/or when the proportion of highly sustainable firms is relatively large. If the cost functions of sustainability do not differ at all, the surface boundary would be a hyperplane at the bottom of the three-dimensional space. Here, pooling would always be preferred.

SUSTAINABILITY REPORTING AS A SIGNALLING GAME WHEN POOLING IS COLLECTIVELY PREFERRED

The analysis so far has shown that under certain circumstances both highly and weakly sustainable firms would prefer to abstain from any sustainability

FIGURE 1
Preferences for Separating and Pooling Equilibria when Costs of Sustainability Reporting are Proportional to the Inverse of True Corporate Sustainability (left-hand side) and Determined by an Inverse Sigmoid Function (right-hand side)



reporting rather than enforce a separating equilibrium. Now the question arises of whether a pooling equilibrium of no sustainability reporting is actually sustainable. Even though a pooling equilibrium might be collectively preferable, it may also be individually rational to deviate from it.

To predict how firms act when pooling is collectively preferred, sustainability reporting will be modelled below as a game between the two

blocks of highly and weakly sustainable firms. The standard procedure to predict the outcome of such games is to search for strategic choices that are stable, i.e. no party can be better off by unilaterally changing its strategy (Kohlberg & Mertens, 1986). As Nash (1951) pointed out, pairs of opposing 'good [reporting] strategies' are sought here. In the framework of sustainability reporting, the strategies are the reported levels of sustainability D_i and D_{-i}. The subscripts i and $-i$ indicate the different blocks of firms. A so-called Nash equilibrium is then defined as

$$\Delta(D_i^*, D_{-i}) \geq \Delta_i(D_i', D_{-i}) \quad \forall\, D_i', i. \tag{9}$$

Every strategy D_{-i} can be answered by the other party in three ways: applying the same strategy, i.e. reporting the same level of sustainability, deviating to a higher level, or deviating to a lower level. When deviating to a higher level is chosen, only a marginal deviation can be rational since this ensures that the increase in shareholder value is $\Delta(D_h)$ instead of the pooling value, while costs are minimised. Deviating to a lower level can only be rational if the zero level is chosen because the zero level is the cost-optimal alternative of all reporting levels that result in an increase in shareholder value of $\Delta(D_l)$.

It seems rational to deviate to a marginally higher level $D_i = D_{-i}+\mathrm{d}D$ if the net gain from winning $\Delta(D_h)-\Delta(D_l)$ exceeds the costs of reporting, $a_i(\theta_i)\cdot D_i$. Therefore, $D_i = D_{-i}+\mathrm{d}D$ is the best response to strategy D_{-i} as long as

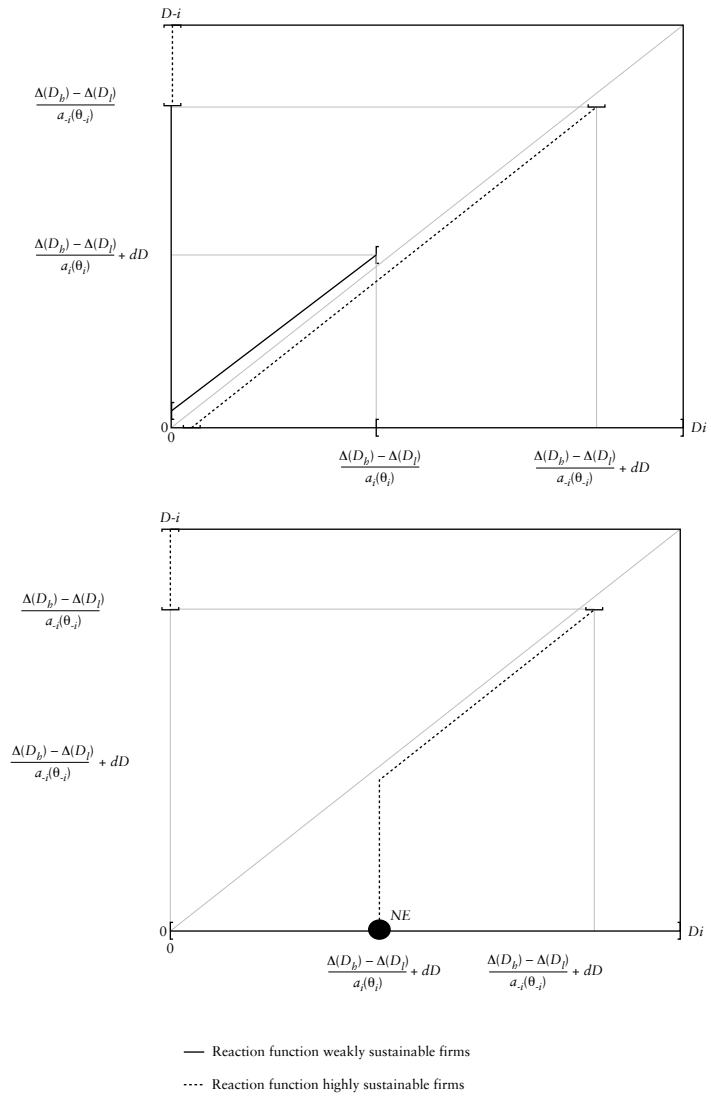
$$D_i < \frac{\Delta(D_h)-\Delta(D_l)}{a_i(\theta_i)}. \tag{10}$$

If D_{-i} equals or exceeds the right-hand side of inequation (10), $D_i = D_{-i}+\mathrm{d}D$ must be marginally higher, and deviation to the zero level is the best response. If D_{-i} is lower, it is always possible to find a value of D_i that is also lower than the right-hand side of inequation (10) but marginally higher than D_{-i}. As can already be seen, reporting the same level of corporate sustainability is never a best response to any other strategy. The reaction function is given by

$$D_i(D_{-i}) = \begin{cases} D_{-i} + \mathrm{d}D, & D_{-i} < \dfrac{\Delta(D_h)-\Delta(D_l)}{a_i(\theta_i)} \\ 0, & D_{-i} \geq \dfrac{\Delta(D_h)-\Delta(D_l)}{a_i(\theta_i)} \end{cases}. \tag{11}$$

The left-hand side of **Figure 2** shows the reaction functions of both parties when the cost coefficient a_i is half as high for the highly sustainable

FIGURE 2
Reaction Functions of Weakly and Highly Sustainable Firms Showing the Best Response to Each Others' Reported Level of Sustainability (left-hand side) in a Multi-Period Framework with High Costs of Changing the Reported Level of Sustainability (right-hand side)



firms than for the weakly sustainable firms. The functions are discontinuous at the critical levels of reported sustainability as defined by inequations (10) and (11) and consequently do not cross.

Hence, no combination of D_i and D_{-i} can be found that satisfies condition (9), and no Nash equilibrium exists. The consequences of this insight are profound. Standard game theory does not provide an answer regarding which level of reported sustainability the firms are supposed to choose. The solution to this problem could be setting up a multi-period framework in which one party is selected as the beginner and the other as the follower. Here the follower could give a best response to the decision of the beginner. In the next period the beginner reacts with his response and so on. It can easily be seen that this would end up in cyclical behaviour: In the interval from zero to $D_i = (\Delta(D_h)-\Delta(D_l))/a_i(\theta_i)$, the firms overbid each other until the highly sustainable firms marginally cross the border, and the weakly sustainable firms fall back to the zero reporting level. In the next round, the best response for the highly sustainable firms is reducing their reported level to a value marginally above zero, and the cycle begins again.

Such behaviour is in reality not observable, at least not in the short run. Firms do not permanently change their corporate sustainability strategy in response to the strategies of others. Choosing a certain level of corporate sustainability and sustainability reporting is a strategic decision that cannot be altered continuously. After all, this would result in additional costs due to the perpetual changes and a decline in the company's credibility resulting from their permanently altering signals they were sending. These costs are not considered in the basic model. If the costs of altering the reported level of sustainability are considerably high and outweigh any gains in shareholder value, the firms will choose a level of reported sustainability that ensures that in the following rounds no change has to be made because the other party would overbid the own level. Here, the best response is the one with respect to all of the following rounds. The only levels that fulfil this condition are $D_i > (\Delta(D_h)-\Delta(D_l))/a_i(\theta_i)$ for the highly sustainable firms and $D_{-i} = 0$ for the weakly sustainable firms. The multi-period reaction functions are then shaped as shown in the right hand side of Figure 2. The only point of intersection lies at $D_i > (\Delta(D_h)-\Delta(D_l))/a_i(\theta_i)+\mathrm{d}D$; $D_{-i} = 0$) and depicts the Nash equilibrium (*NE*) that satisfies condition (9). Hence, even if a pooling equilibrium is Pareto-dominating, the only equilibrium outcome is a separating equilibrium in which the highly sustainable firms report a level of sustainabil-

ity that barely forces the weakly sustainable firms to abstain from sustainability reporting. Thus, in this case weakly and highly sustainable firms are caught in a situation that is referred to as a (multi-period) prisoner's dilemma (Tucker, 1950). The individually rational behaviour leads to a collectively inefficient outcome.

CONCLUSION, LIMITATIONS, AND ISSUES FOR FURTHER RESEARCH

The analysis of corporate sustainability reporting from a game theory perspective leads to three conclusions:

a. If the critical assumptions of differing costs for different levels of true corporate sustainability hold, there is always a level of reported sustainability that ensures a separation of the highly from weakly sustainable firms.
b. If the highly sustainable firms are a majority and/or the advantages in the costs of sustainability reporting of the highly sustainable firms are relatively small (i.e. condition (8) holds), both highly and weakly sustainable firms would prefer to abstain from sustainability reporting and set up a pooling equilibrium instead.
c. A pooling equilibrium can only be sustained if the critical assumption of differing costs does not hold. Otherwise the outcome of the game is always a Pareto-dominated separating equilibrium (prisoner's dilemma).

Therefore, the predicted outcome of the analytical model depends on the specific values of its parameters. These values can only be determined by observing the actual business world and further empirical studies. Intuition can also provide some hints. Issuing sustainability reports is nothing more than issuing words and sometimes pictures. However, especially if the degree of sustainability is overstated, they are not completely without cost and can even be assumed as negatively related to the true level of corporate sustainability since expensive measures may need to be taken to maintain the facade. Furthermore, the amount of firms discovering the potentials of corporate sustainability appear to be on the continual rise along with the amount of sustainability reports that are being issued (Kolk, 2003; Jose & Lee, 2006; Barkemeyer *et al.*, 2009). Thus, intuition indeed suggests that the highly sus-

tainable firms enforce a separating equilibrium even though they would prefer the pooling solution, and both highly and weakly sustainable firms are caught in a prisoner's dilemma.

The analysis conducted here very obviously has some limitations. First of all, the assumption that only two kinds of firms exist is not realistic. Various degrees and dimensions of true sustainability exist, and every one of them may be rewarded by the capital market in a different way. In reality, there is an *n*-firm game rather than a two-party setup. In addition, true corporate sustainability was considered in this paper to be a constant, even though companies can choose their true levels, at least in the long run. Consequently, not only the reported level is subject to the game theory analysis, but the true level of corporate sustainability as well. The most important limitation of our analysis seems to be the assumption that firms will gain the average increase in shareholder value if both parties report the same level and do not differ from each other in their reporting practices. This implies that capital market participants have knowledge about the true proportions of highly and weakly sustainable firms in the population. The question thus arises from where this knowledge might result when no effective reporting about corporate sustainability exists. The answers to this question are sparse indeed, so the most promising one is experience from the past: Capital market participants can learn from former investments what impact exposure of their firms had on economic, environmental, and social risks.

Further analytical research can aim at mitigating some of the limitations mentioned above. Nevertheless, even more interesting would be the search for answers to the empirical questions that have emerged. How do the costs of sustainability reporting relate to the true level of sustainability? And would it indeed be preferable for firms to abstain from sustainability reporting and implement more reliable instruments for signalling true corporate sustainability? The possible methodical approaches to answer these questions vary greatly. Content analysis provides the opportunity to measure the reported level of sustainability, while in-depth sustainability rankings from certain agencies deliver proxies for the true levels, and can even serve as explanatory variables.

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6

The Development of a Game-Based Teaching and Learning Tool to Aid the Selection of Sustainable Building Materials

John L. Clarke

ABSTRACT

This paper describes the research, development, design, production and testing of a prototype set of playing cards entitled 'Eco-Construction Trumps'. These are intended to be used as a teaching and learning resource within an educational setting and as a source of reference for the built environment professions. They contain data on the sustainability credentials of common building materials and the aim is for the cards to be used to stimulate debate on how, in practice, decision-makers need to balance the differing criteria that are used to establish the environmental impact of construction materials. Research has shown that there is a disparate body of existing knowledge related to the subject matter which until now has not been collated into a single resource. Through interactive workshops, participants' perceptions of using the cards are analysed in relation to game-based learning initiatives.

Key words: sustainable construction materials, environmental impact, game-based learning, experiential learning, teaching and learning resource

INTRODUCTION

The design, construction, operation and use of buildings has a significant impact on the natural environment in terms of energy use, the burning of fossil fuels, CO_2 emissions, the depletion of finite resources, air, water and ground pollution, biodiversity and the production of waste.

The built environment in the UK accounts for 50% of all CO_2 emissions amounting to 360 million tonnes of CO_2 released into the atmosphere

per year (BRE, 2003) and produces 120 million tonnes of waste (WRAP, 2007) and studies have shown (Horvath, 2004) that up to 29% of all solid waste going to landfill originates from construction and demolition. During the process of decomposition this can result in the release of methane, a greenhouse gas, with 21 times the global warming potential of CO_2. There is an ever-increasing need for the provision of built environments as the global population is anticipated to exceed 9 billion by 2050 and there is strong scientific consensus that human endeavours, such as construction, will contribute exponentially to global warming with resultant effects on climate change and sea level rises, with potentially disastrous effects for life on earth.

Legislation (Climate Change Act, 2008) sets legally binding national greenhouse gas reduction targets of 34% by 2020 and at least 80% by 2050 compared to 1990 levels. There have been a number of initiatives over the past few decades focussed on reducing the environmental impact of the built environment. The recognition that building practices need to change are evidenced by revisions in legislation with targets for zero carbon and low water usage new-build housing by as early as 2016 and new build non-domestic buildings by 2019 for England and Wales (DCLG, 2007).

As well as global, national and regional environmental benefits of a more sustainable built environment, there are social advantages in terms of 'healthier' buildings which reduce the risk of sick building syndrome, increasing the health and well-being and optimising the productivity of occupants plus economic benefits by investing now in a more sustainable and secure future, as indicated in the Stern Report (Stern, 2006).

ENVIRONMENTAL IMPACT OF BUILDING MATERIALS

420 million tonnes of materials are used in the construction of buildings in the UK each year (Lazarus 2002) which accounts for 30-50% by volume of all manufactured goods, excluding food production (Roaf, 2004). 120 million tonnes ends up as waste from construction, demolition refurbishment and excavation processes and it has been estimated that 20 million tonnes of *unused* materials end up in landfill each year (WRAP, 2007). Over their entire lifecycle, materials used in construction contribute a significant amount to the environmental impact of the construction sector in terms of the extraction of finite raw materials, their processing, transportation, manufacture into building products, packaging, installation on-site and their destination after primary use.

In order to reduce the environmental impact of building materials those responsible for creating and maintaining our built environment must engage with sustainable material issues at each stage of procurement, design, construction and beyond the design life of the materials. For example, during the construction phase alone, research has shown that CO_2 emissions can be reduced by as much as 30% through a careful selection of low environmental impact materials (Gonzalez and Navarro, 2006).

The issue needs to be addressed across the whole construction cycle from the brief through to construction of the project and beyond the life of the building. This has led to the development of a range of analytical techniques collectively called environmental life-cycle assessment (LCA). There are also a number of guides, resources and initiatives aimed at tackling the environmental impact of construction materials, including the Building Research Establishment (BRE) Green Guide to Specification and the Waste & Resources Action Plan (WRAP) 'halving waste to landfill' initiative.

However, research has shown (Greenspec, 2010) that there is a quite disparate body of existing data related to the sustainability credentials and environmental impact of construction materials due in part to the complexity of the market with a wide variety of materials and alternatives available, lack of comprehensive research in this field and often unsubstantiated manufacturers' claims. Therefore it is difficult for built environment students and professionals alike to access clear, concise and impartial data without undertaking time-consuming information-gathering and research activities.

GAME-BASED LEARNING

The need to understand and apply sustainable building practices is continually increasing. The ability to absorb technical information can be daunting for built environment students and professionals alike and the value of games, used to support training and learning, has been widely recognised for many years (Coleman, 1971). Lujan and Di Carlo (2005) argue that "*the packed curriculum leaves little time for students to acquire a deep understanding of the subject or to develop life-long skills such as critical thinking, problem solving, and communication*." It has been shown that lecturing merely exposes students to content, and exposure is not sufficient for learning. Active processing of information, not passive reception of information, leads to learning (Bolles, 1988).

An area of neglect is the role and responsibility of educators to make learning fun. This is important because students must become life-time learners, particularly in the ever-changing field of sustainable construction methods, materials and technologies. The use of innovative educational games can increase enthusiasm and reinforce previously presented didactic information (Odenweller *et al*, 1998). Games create a challenging, constructively competitive atmosphere that facilitates interaction among learners in a friendly and fun environment (Lujan and Di Carlo, 2005).

Active and experiential learning strategies reach all types of learners in the visual, auditory and tactile learning styles. Research by Fleming (1992) suggests that visual learners have a preference for seeing. Auditory learner's best learn through listening to debates and discussions. Tactile learners prefer to learn via experience; moving, touching, and doing.

The development of 'Eco-Construction Trumps' is an attempt to collate a wide body of sustainability data on construction materials into a single resource in order to assist in the selection of sustainable materials but also to act as an educational catalyst to encourage debate and discussion on a complex topic. Rather than focusing on one material's environmental effects, which may not provide much of an explanation out of context, it is often more valuable to perform a comparative assessment of construction materials. Franklin and Peat (2003) describe the use of such aids to "*stimulate group discussion, by bringing together information and concepts from a number of sources to assist learners in the pulling together and linking of material.*"

In a recent report it has been highlighted that the key challenge for effective learning with games is for the experience to be undertaken in relation to clear learning outcomes as well as being made relevant to real world contexts and practice (De Freitas, 2005).

The success of game-based learning strategies owes to active participation and interaction being at the centre of the experience, and signals that current educational methods are not engaging students enough. Experience with and affinity for games as learning tools is an increasingly universal characteristic among those entering higher education and the workforce. (New Horizon Report, 2009)

Accordingly, this project intends to bring the concept of gaming into the classroom of built environment students, who, as experience shows, learn best within applied and action-based settings (Cavanagh, 2011).

GAME DEVELOPMENT

The research, development and production of the game-based teaching and learning resource, entitled 'Eco-Construction Trumps', was funded by the Centre for Sustainable Communities Achieved through Integrated Professional Education (C-SCAIPE) based in the School of Surveying and Planning at Kingston University London. The design was an in-house collaboration with a multimedia developer within the Information Services Department at Kingston University. Initially 2,000 packs have been produced by a professional playing card manufacturer to distribute among prospective students at open days and at exhibitions and conferences raising awareness of both sustainability issues in the built environment and the profile of Kingston University, London.

The aim is to bring their operation within the learning environment acting as an aid to support the wider built environment curriculum in order to stimulate debate on how, in practice, decision-makers need to balance the differing criteria that are used to establish the environmental impact of construction materials.

The game can be used across disciplines, age groups and educational levels but has been specifically designed for use in an undergraduate built environment setting. The potential beneficiaries will therefore comprise anyone concerned with the environmental impact of building materials such as teachers, students, academics and existing built environment professionals.

The cards focus on 6 key sustainability criteria: embodied energy, embodied carbon, recyclability, landfill decomposition, toxicity and durability of 30 common construction materials bringing together a wide variety of otherwise disparate sets of data into a coherent and accessible teaching, learning and reference resource (see **Figure 1**) allowing for direct comparison and evaluation through experiential game-based learning.

Included in the pack are instructions on how to play the game and concise definitions of each of the sustainable features against which different construction materials are able to be compared. Each of the categories is described below:

Embodied Energy

Measured in mega joules per kilogram, embodied energy takes into account all the energy consumed over a defined lifecycle of a material. In this case from 'cradle-to-gate' which is the extraction of raw materials through manu-

FIGURE 1
Example of Eco-Construction Trumps Format and Content

facture and transportation to site. (Lowest score wins). Longer lifecycles can be considered and discussed such as 'cradle-to-grave' to the end of a materials' useful life and 'cradle-to-cradle' representing the complete cycle beyond end-of-life.

Embodied Carbon

Measured in kilograms of carbon per kilogram, embodied carbon also measures all energy consumed during the defined lifecycle, but takes into account the source of the energy and its impact on the environment. (Lowest score wins). Discussion can focus on renewable and non-renewable sources of energy throughout the process.

Recyclability

Recyclability is the capacity of a material to be captured, separated from a waste stream and processed for conversion or reuse. (Highest score wins). Discussion can focus on the selection of composite or mono-materials. Primary mono-materials consist only of themselves as provided by nature e.g. wood, straw and clay. Secondary mono-materials are industrialised but are still homogenous e.g. steel or glass. These can be recycled repeatedly but composite materials can be more difficult to segregate and therefore, recycle.

Landfill Decomposition
A landfill site is basically a disposal facility where waste is permanently buried. Different materials decompose, or biodegrade, at different rates (measured in years) and have different environmental impacts depending on their chemical composition. (Lowest score wins). Diverting waste from landfill is key. This encourages other uses for the materials, prevents methane gas production and frees land for more productive uses.

Toxicity
The degree to which a material can harm humans, animals or natural systems. Toxicity can refer to the effect on a whole organism, such as an animal, bacterium or plant, as well as the effect on a substructure of the organism, such as a cell or an organism. (Lowest score wins). Building materials can have toxic effects in their production through industrial processes, in-use contributing to Sick Building Syndrome, impacting on the health and well-being of occupants and also on the natural environment after disposal, causing ground, air and water pollution.

Durability
The number of years the product will last before needing to be replaced. The more durable a material is the better the component performs from a sustainability perspective. (Highest score wins). Generally, long term durability of a building, its components and materials is desirable but can be at odds with the need for adaptability and the need to recycle and reuse elements.

Other criteria were considered, such as recycled content, embodied water and organic content but preliminary research indicated a lack of empirical data at the time, indicating the need for further research in this field. There were also considerably more construction materials that could have been included but design limitations meant only 30 could be selected. This supports the argument for the development of further packs into a series of Eco-Construction Trumps broadening the scope of the cards as a comprehensive design tool and teaching and learning resource.

RESEARCH STUDY METHOD

One of the main barriers to uptake of games in a learning context is the lack of empirical data to support the hypothesis for its effectiveness, as well as a

lack of understanding about how these games might be used most appropriately in practice.

The study used a questionnaire to investigate participants' perceptions of the value and importance of the active learning and cooperative activities they undertook during workshops. Three workshops were undertaken with 32 participants in order to elicit both qualitative and quantitative data about perceptions from playing the game. The workshops ran for an hour. The game was played for the first half hour in groups of five or six and for the second half hour the participants were asked to complete a questionnaire with time for discussion afterwards. Two of the workshops were held at 'Ecobuild 2011' (a sustainable construction conference and exhibition) and one workshop was held at The University of Brighton with MA students on the Sustainable Design course.

FINDINGS FROM WORKSHOPS

The questionnaire elicited a great deal of useful data regarding the perceptions of the respondents to playing the game. Figure 2 shows responses to the question 'what 3 words come to mind when you think of the cards?' represented in a 'word cloud' which gives greater prominence to words that appear more frequently in the source data. Clearly the most popular answer was 'fun' which has been highlighted as a key driver for using game-based learning. The second most popular response was 'informative' again reinforcing previous research findings that learning can occur through game-based initiatives and thirdly' 'engaging' indicating that interest was maintained. In descending order of significant frequency came 'interesting', 'play', 'thought-provoking', 'useful', 'materials', 'competition' and 'education'.

When asked 'how did you find playing the game?' 43.7% of the respondents found the game 'very easy' and 56.3% found the game to be 'relatively easy' to play whilst none found the game 'difficult' or 'very difficult'. Additional comments suggested that 'it's a good, fun icebreaker to engage people' as the participants took a short time to familiarise themselves with the game play 'it took a while to get going but then we flew!' As the game was not facilitator-driven self-directed learning was encouraged. Some of the participants found the definitions and concepts a little difficult to grasp but this encouraged discussion and debate based on the definitions on the cards.

In terms of usefulness in their field of work 46.9% found the game 'quite useful', 34.4% found the game 'very useful', 15.6% found it to be

FIGURE 2
A 'Word Cloud' Indicating Feedback from Workshops (wordle.net)

'moderately useful' and 3.1% thought it not to be useful. Many of the participants related the subject matter to elements of course content or directly with work they were undertaking stating that the game offers the research on these materials in a very accessible and interactive way and that the cards reinforced the success of 'play' in information sharing.

When asked 'how has your understanding of sustainable material selection improved as a result of playing the game?' all respondents indicated some improvement with 6.7% stating their understanding had improved 'completely', 40% 'significantly' and 53.3 %, moderately'. Additional comments included that playing for longer or a few more times would increase understanding. One participant stated that the game helped the understanding of the whole process of evaluating material impact.

In terms of engagement with the game 63.3% were 'very interested' and 36.7% were 'interested' with no respondents stating they were either 'bored' or 'slightly bored'. One respondent stated that 'competing always ex-

cites people!' 41.4% would 'definitely' recommend the cards to colleagues and 58.6% would be 'likely' to recommend the cards to colleagues.

Other questions related to understanding the data which many stated became clearer after reading the definitions and discussing their meanings during the game. Some of the data was not available which frustrated some players and interrupted the flow of the game whilst some were surprised at materials they had considered to be of high environmental impact that proved to have an overall lower impact e.g. concrete.

There were many suggestions on how the cards could be used in different or innovative ways including as a research resource 'it makes finding information really easy instead of trawling through the internet!' and as an educational tool on training courses or to engage members of the public and non-specialists. There were also a number of ideas for developing and expanding the resource to enable comparison of specific materials, for example, a whole set dedicated to insulation materials and related topics such as renewable energy versus non-renewable energy sources, sustainable communities and lifestyle habits.

Criticisms of the cards included the need for clearer definitions and that some of the data was too general. Some participants questioned the validity of the data, illustrating the difficulty of quantifying sustainability criteria from a number of data sets and product champions who wanted their material to be shown in the best environmental light possible, even if in contradiction to some of the research findings. Another criticism was the inability of the cards to be updated and that they could quickly become obsolete in the light of future research and construction material developments. This is a good case for having an online version that could be easily updated and either played remotely online or printed, for use as a physical resource.

CONCLUSION

The need for a more sustainable built environment is widely accepted and construction materials have significant potential throughout their lifecycle to have positive benefits for the environment by reducing our reliance on finite resources, eliminating damaging production processes and long–distance transportation of materials, making it easier to recycle and reuse materials, using materials in a durable way and specifying non-toxic materials with low embodied energy from renewable sources.

Sustainable construction materials also have social and economic benefits in providing healthier indoor environments which encourage greater productivity and profitability through the health and well-being of occupants and ultimately the population, saving on national health expenditure, having more durable and adaptable buildings, designing-out waste avoiding increasingly expensive disposal costs and cutting out costly sourcing of virgin materials.

The range of green building materials and products that are currently available has grown exponentially in response to the growth in awareness of environmental issues and the emergence of sustainable building rating systems. They offer a range of aesthetic options, perform well and are cost-competitive.

Education and raising awareness within the current built environment sector and of future professionals is key to the adoption of sustainable working practices and understanding of the impact of construction materials. This can often be seen as an extra layer of complexity in what is already a very complex industry. It has been shown that game-based learning has a place in contributing to educational provision where these complex issues can be tackled in a fun, informative and engaging way.

Combining environmental impact criteria into a card game encourages a non-lecturing educational experience and provides an opportunity to engage students, staff and professionals in discussion and creates a source of reference that will assist in sustainable construction material selection. It is generally thought that students have better retention and understanding of knowledge when taught by active as opposed to passive methods. Therefore, the curriculum must be adjusted to incorporate active methods that provide educational experiences designed to develop life-long learners and students who are capable of solving novel problems and challenges, in short, self-educators. It is hoped that use of the cards will lead to adjustments in some teaching & learning strategies.

It is hoped to develop this concept further for a professional audience allowing for even wider dissemination and potential impact beyond built environment undergraduates and into practice and industry. There is scope for developing a series of cards based on the Eco-Construction Trumps theme expanding on the original set with additional construction materials related to other sustainability criteria. There is also potential for comparison of exemplar sustainable buildings on their sustainability credentials.

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7

Problems of practical CEMIS (Corporate EnvironmentAL Management Information Systems) usage

Horst Junker
IMBC GmbH (horst.junker@imbc.de)

Corinna V. Lang
Hochschule Anhalt (c.lang@wi.hs-anhalt.de)

Jessica Sangmeister
IMBC GmbH (jessica.sangmeister@imbc.de)

ABSTRACT

Companies reacted to ecological laws and regulations by developing end-of-pipe technologies, which become operative at the end of the value chain without any direct influences on the manufacturing processes.

Beyond these passive environmental activities in politics and society a comprehensive sustainability discussion took place, which faces the trilogy of economical, ecological and social challenges to companies. Companies, which intend to meet these challenges, are forced to consider the complete value chain regarding the aspects of saving resources and the minimisation of waste and emissions.

There is a demand for CEMIS to support the ecological as well as the economical corporate efficiency through tracking the resources used i.e. materials and energies, especially their efficient use.

Within the last decade a research project has reviewed more than 40 projects to implement CEMIS in Small and Medium Enterprises (SMEs). The following explanations show in which corporate areas the use of CEMIS is demanded in business practice. It derives categories of application areas from the empirical findings and the reasons why the management of SMEs did not provide the desirable attention to CEMIS.

INTRODUCTION

CEMIS have been a topic of scientific research for about two decades. The results of this research seem to be anyhow insufficient. CEMIS is defined as an application-oriented science – the so called hyphen informatics. Consequently, the results of the academic work on and of CEMIS should be relevant for the practitioners within companies. But up to now, having a first glance it is to be observed that environmental protection activities are not sufficiently efficient to gain essential contribution to improve (e. g.) the national environmental situation. The objective of CEMIS is to support the idea of corporate environmental protection by the provision of adequate methods of informatics.

As a result, obviously the efforts of the academic CEMIS to support corporate environmental protection are anyhow very modest. At least one of the reasons for the inefficiency of CEMIS concerning corporate environmental protection seem to consist mainly in the fact, that academic researchers do not and possibly will not notice the urgent problems to be solved in companies. The suspicion is not to dismiss that the scientific research interests are not ruled by corporate necessities with the result that there is a big gap between the actual research work and the practical requirements of companies.

The purpose of an application-oriented science should be to focus its work on such topics the companies need. However, precondition is an intimate knowledge of companies. In the last decade we realised about 40 CEMIS-oriented projects with (mostly SME) companies. On the basis of this rather comprehensive experience it should be possible to demonstrate the gap between theoretical interests and practical requirements. For this reason, first, the state of the actual scientific discussion of CEMIS will be presented. Thereafter, a comprehensive and aggregated overview and characterisation of the above mentioned projects will be given. And, as a conclusion, the gap between theory and practice will be described.

TRADITIONAL FRAMEWORK OF CEMIS

As far as hyphen informatics are concerned, information systems shall generally support the solution of problems of concrete application areas. Therefore, the objective of CEMIS consists in an explanation of corporate environmental phenomena. Furthermore, information systems are dealing with the management of data and processes. They consist of men and machines, which execute their tasks in a cooperative manner, which are connected by cooper-

ative relations to use them for collecting, storage, processing and transmission of information. Such a description of information systems provides an indication of a principally complex and comprehensive application background. IT-systems to support singular, less complex tasks, cannot be called to be an information system. Consequently it is impossible that there will be a CEMIS on the basis of EXCEL.

In the history of companies' activities for environmental protection, these activities were in focus of corporate interests rather late – starting in the 1980s. The integration of environmental activities into the corporate range of tasks was forced on the one hand by the beginning environmental legislation, which obliges the companies. Legislation was not any longer willing to offer the possibility to the companies to externalise the costs for the disposal of environmental damages caused by the production processes. On the other hand by ISO 14001 and EMAS two norms for environmental management were published. Companies were able to follow these norms voluntarily. In any case the initiation of corporate examination of environmental phenomena was mostly initiated externally.

The idea of the environmental management systems as an instrument of an environmental policy was to strengthen ecological responsibility. Topic of environmental management systems is the natural environment, respectively the nature. It "is the entity of all factors in the form of air, water, soil, renewable and not renewable raw materials, weather, climate and ecological processes, which effect companies or which are effected by companies" (Müller-Christ, 2001, p. 4).

The objective of the realisation of environmental management systems is to contribute to an ecological improvement of resource efficiency, especially regarding the input of energy, water and raw material and the output of emissions and waste. It is assumed that the economic benefits of environmental management systems consist of cost savings as well as internal and external benefits. Internal benefits might be an improvement of legal security, transparency or an improved staff motivation. External benefits are reflected in better relationships to customer and groups of stakeholder on the market (Hamschmidt, 2001).

However, empirical surveys demonstrate that environmental management measures in the corporate practice are focused on the operative layer meaning they are directed inward. Corporate optimisations and the utilisation of cost reducing potentials are predominant. Environmental manage-

ment systems are seldom used for market-orientated strategies and ecological product innovations. The question remains open, whether a realisation of environmental management systems leads to a formulation of ambitious environmental objectives (Hamschmidt, 2001).

Concerning the existing reality of companies it is to state that the intention has failed to a large extent to integrate objectives of environmental protection in the common corporate target system. The influence in the strategic business objectives by environmental departments or environmental officers is usually very small.

One of the reasons for this issue is the unsatisfactory construction of the norm for environmental management systems. For example ISO 14001 provides the following procedure for its corporate implementation:

- Environmental policy definition
- Planning
- Implementation and processing
- Control and correction measures
- Assessment by the top management (Gastl, 2005)

Especially, there are no guidelines to transform business objectives into the planning phase with the result that planning, control, processing and monitoring of environmental activities are largely assigned to the operative management layer. The amount of laws and regulation of the last three decades impose extensive restrictions and burdens of proof. Thereby decentralised requirements arise which are covered by IT-systems of very different levels of success and quality. As a result often applications e.g. for waste, waste water, emissions, hazardous materials etc. has been developed by using existing standard software systems or by consulting a local software developer. Such software solutions could satisfy the requirements directly, but from an intercompany or scientific point of view they are afflicted with all disadvantages of local stand-alone solutions (Kürzl, 1999). Such an isolated solution requires less comfortable data management, is often time consuming and is related to an extra workload.

EXISTING DEFINITIONS OF CEMIS

Overall it has to be accepted that CEMIS has failed to offer support for a mitigation of deficits in the early implementation phases, although business in-

formatics offer procedures to get from a defined policy to the implementation of measures by a multi-level strategy (Heinrich, 2005). By the usage of the process model of information management it would be possible to define term and content of CEMIS in a much more precise manner.

By missing that, in theory and practice manifold application systems are identified as CEMIS without a persistent and generally binding definition (Schlatter, 2000). Mostly any employment of information technology to process environmental relevant data is said to be a CEMIS.

Subsequently some definitions of CEMIS in the German speaking literature will be presented:

- CEMIS are a summary of all information systems, which serve the corporate environmental management (Kramer 1993)
- CEMIS serve the information technical support of corporate environmental protection (Hilty, 1997)
- [...] are systems to administer environmental information within the enterprise (Günther, 1998)
- CEMIS are organizational-technical systems for systematically obtaining, processing and making environmental relevant information available in companies (Rautenstrauch, 1999)

All definitions convey the impression of a high degree of fussiness and to a certain degree of ambiguity. This is owed to the fact that the authors try to attempt to catch in their definition the characteristics of all possible theoretically thinkable environmental-oriented software systems. This assumption will be confirmed by the following attempt of a definition:

> "In analogy to business information systems CEMIS is an information system, which is used to collect, document, plan and control corporate environmental impacts and supports the environmental management activities. Further, as information systems are understood systems of different complexity. According to this a CEMIS can be either a spread sheet to calculate environmental indices or specific software to analyse material flows or to balance environmental impacts within the scope of an ecobalance." (Beucker, 2002, p. 4)

FIGURE 1
Morphological box for CEMIS (Rey & Schnapperelle, 1999)

	characteristic	value							
environmental organisation	strategy	preventive				end of pipe			
	business objectives	EMAS/ISO-certification		environmental optimisation / eco efficiency		legal compliance		presentation of environmental record	
	time horizon	strategic – long-term			tactical – medium-term			operative – short-term	
	organisation unit	management		department		environmental representative		local responsibility	
	application area	waste management	water protection	emission protection	energy management	hazardous substance management	material data administration	resource administration	material flow management
CEMIS specific aspects	tasks	report generation	process planning support	process control support	process monitoring support	procedural support / guideline	information interface	organisational support	environ-mental balancing
	functionality	analysis	modeling	simulation	real-time monitoring	document management	report generator	work flow component	
	system border	department / corporation			process			product / LCA	
IT	degree of integration	stand-alone			add-on			integrated system	

This high amount of fussiness results in a morphological box as a classification schema for CEMIS (Figure 1). Originally a morphological box has been a creativity technique, which serves the creation of ideas. A problem or a fact has to be characterised in its different characteristics (in a vertical manner). Following, for each of these characteristics it is necessary to find all possible characteristic values (in a horizontal manner). An idea in this case a (new) CEMIS – will be identified by any user-defined vertical run through the characteristic values. By variation of the considered characteristic values per run through it will be possible to generate and to define any number of CEMIS which are able to cover very different scopes of problems. Thus it will be possible to denote software systems as CEMIS, which will not fulfil the criteria that have to be fulfilled by information systems by definition. Thus it reveals that up now CEMIS has failed to acquire a precise theoretical and scientific basis. This serious deficit has extensive consequences in particular concerning the development and the implementation of CEMIS in the corporate practice.

SURVEY OF CEMIS PROJECTS

From the above mentioned projects conducted (about 40) within the last seven years by IMBC, 30 are included in the survey, some of the IMBC projects have been feasibility studies or similar. The overviews of **Figures 2a** and **2b** try to characterise the CEMIS projects by the items given by the morphological box.

All these projects are summarised in **Figure 3** to demonstrate the different areas, which are focussed by the projects. **Figure 3** should be interpreted as follows: the darker the background of the single cells of the morphological box, the more frequently the content of the projects meet this feature.

In a more intensive examination of the figure, first it will be noticed that the number of projects which have a preventive character exceeds the end-of-pipe projects. Generally it will be expected that companies – in the course of performing legal compliance – will rather provide passive environmental protection. However, in this case it becomes apparent that many projects are conducted, which will at least enable a rudimental environmental controlling by developing indices.

Concerning the business objectives it is recognisable that neither the EMAS or ISO 14001 certifications nor the presentation of environmental record plays a major role in the projects. Rather the eco efficiency and the en-

FIGURE 2A
Characterisation of CEMIS Projects

	industry	problem area	strategy	business objectives	time horizon	organisation unit	application area	tasks	functionality	system border	degree of integration
1.	traffic (LSE)*	Information flow	preventive	eco-efficiency	tactical	environmental representative		organisational support	analysis	department	stand alone
2.	traffic (LSE)	management of environmental measures	end of pipe	legal compliance	operative	environmental representative	resource administration	report generation	report generator	process	stand alone
3.	automative (LSE)	energy flow	preventive	eco-efficiency	tactical	environmental representative	energy management	process.control support	analysis	process	stand alone
4.	automative (LSE)	material flow	end of pipe	legal compliance	operative	environmental representative	emission protection	process monitoring support	analysis	process	stand alone
5.	print shop (SME)	information flow	preventive	ISO-Certification	tactical	management	resource administration	process monitoring support	analysis	company	stand alone
6.	print shop (SME)	monitoring of indices	preventive	EMAS-Certification	strategy	environmental representative	resource administration	report generation	modeling	company	
7.	print shop (SME)		preventive	presentation of environmental record	tactical	management	resource administration	report generation	report generator	inter-company	stand alone
8.	print shop (SME)	environmental data base	preventive	presentation of environmental record	tactical	management	resource administration	report generation	document management	inter-company	stand alone
9.	consulting (SME)	hazardous substances	end of pipe	legal compliance	operative	environmental representative	hazardous substance management	report generation	modeling	company	stand alone
10.	consulting (SME)	measures management	end of pipe	legal compliance	operative	environmental representative	resource administration	report generation	modeling	company	stand alone
11.	consulting (SME)	ERP-interface	preventive	presentation of environmental record	tactical	environmental representative	material data administration	information interface	modeling	process	integration system
12.	consulting (SME)	waste management	end of pipe	legal compliance	operative	environmental representative	waste management	report generation	modeling	process	stand alone
13.	plastics production (LSE)	environmental indices	preventive	eco-efficiency	tactical	environmental representative	resource administration	report generation	report generator	department	stand alone
14.	plastics production (LSE)	energy management	preventive	eco-efficiency	tactical	environmental representative	energy management	process control support	analysis	department	./.
15.	raw material (SME)	facility management	preventive	eco-efficiency	tactical	management	resource administration	process monitoring support	modeling	company	stand alone
16.	plastics production (SME)	environmental indices system	preventive	ISO-Certification	tactical	environmental representative	resource administration	report generation	report generator	process	stand alone

(*) Large Scale Enterprise.

FIGURE 2B
Characterisation of CEMIS Projects

	industry	problem area	strategy	business objectives	time horizon	organisation unit	application area	tasks	functionality	system border	degree of integration
17.	public utilities (LSE)	process optimisation	preventive	eco-efficiency	tactical	environmental representative	material flow management	process control support	modeling	process	stand alone
18.	public utilities (LSE)	environmental reporting	end of pipe	legal compliance	operative	environmental representative	resource administration	report generation	report generator	company	stand alone
19.	public utilities (LSE)	environmental law date base	preventive	legal compliance	operative	environmental representative	./.	./.	./.	company	stand alone
20.	mechanical engineering (SME)	noise register	end of pipe	legal compliance	operative	environmental representative	emission protection	report generation	report generator	company	stand alone
21.	traffic (LSE)	eco-balance	preventive	environmental optimisation	tactical	environmental representative		environmental balancing	analysis	LCA	stand alone
22.	mechanical engineering (SME)	input-output balances	preventive	environmental optimisation	tactical	environmental representative	material data administration	environmental balancing	analysis	process	stand alone
23.	environmental services (LSE)	hazardous substances information system	end of pipe	legal compliance	operative	department	hazardous substance management	report generation	analysis	process	stand alone
24.	consulting (SME)	environmental risk management	preventive	eco-efficiency	tactical	environmental representative	resource administration	process control support	modeling	process	stand alone
25.	waste management (LSE)	environmental indices management	preventive	eco-efficiency	tactical	environmental representative	resource administration	report generation	modeling	company	stand alone
26.	waste management (LSE)	waste distribution	end of pipe	presentation of environmental record	tactical	department	material flow management	report generation	modeling	department	stand alone
27.	mechanical engineering (SME)	environmental indices management	end of pipe	eco-efficiency	tactical	environmental representative	resource administration	organisational support	modeling	company	stand alone
28.	raw material (SME)	energy and material flow	end of pipe	eco-efficiency	tactical	environmental representative	material flow management	process monitoring support	modeling	company	stand alone
29.	raw material (SME)	material flow	end of pipe	eco-efficiency	tactical	department	material flow management	process planning support	analysis	department	stand alone
30.	public administration (LSE)	process analytics	end of pipe	legal compliance	operative	environmental representative	material flow management	report generation	analysis	department	stand alone

FIGURE 3
Morphological Box of Realised CEMIS

	characteristic	value							
environmental organisation	strategy	preventive				end of pipe			
	business objectives	EMAS/ISO-certification		environmental optimisation / eco efficiency		legal compliance		presentation of environmental record	
	time horizon	strategic – long-term			tactical – medium-term			operative – short-term	
	organisation unit	management		department		environmental representative		local responsibility	
	application area	waste management	water protection	emission protection	energy management	hazardous substance management	material data administration	resource administration	material flow management
CEMIS specific aspects	tasks	report generation	process planning support	process control support	process monitoring support	procedural support / guideline	information interface	organisational support	environ-mental balancing
	functionality	analysis	modeling	simulation	real-time monitoring	document management	report generator	work flow component	
	system border	department / corporation			process			product / LCA	
IT	degree of integration	stand-alone			add-on			integrated system	

vironmental optimisation as well as the achievement of legal compliance are the decisive objectives. In all projects these objectives are used equally often. Also in this case it can be observed that legal compliance was expected before to be the dominant objective. By the -in many projects developed- indicators and indicator systems the target is to achieve controlling components for influencing the corporate environmental situation in a positive manner.

The timeframe of the project is mainly medium-term and therefore assigned to the middle management field of responsibility. In this context it should be noted that there are nearly no long-term projects. Obviously no project is initialised by the top management. This fact seems to be a distinct indicator that the top management turns its attention to corporate environmental protection only in a limited fashion.

This becomes apparent by the fact that the results of most projects will affect the environmental officer's area of responsibility. Furthermore, there is no project, which is initiated in local responsibility. Very seldom projects have been performed, which results were used by the entire company or a specific department.

Concerning the application area of CEMIS no clear classification is possible. Projects aiming at legal compliance, such as projects for developing and providing indicators and indicator systems, are not precisely assignable to singular application areas. At best it can be noticed that there are no projects assigned to the areas of waste management and water protection. With reference to the other application areas the projects are rather equally distributed.

Concerning the tasks covered by the realised projects report generation is clearly outnumbered. This fact is less surprising, because CEMIS serving legal compliance have to verify that by reports. Similarly indicators for promoting environmental optimisation or eco efficiency will provide the management in form of reports. Only few projects aimed at supporting process control or process monitoring. It is further remarkable that there was just one project with the task to perform a – anyway natured – eco balance. Overall the assignment of project contents to the different application areas makes clear that only a few projects can be assumed to support typical tasks of the middle or higher management level.

Regarding the different functionalities principally covered by CEMIS it is noteworthy to mention that the projects cover a small amount of areas. None of the realised systems touches relatively challenging functionalities as simulation, real-time monitoring or workflow management. Primarily ad-

dressed functionalities, in the project – and mainly equally distributed over all projects – are analysis, modelling and generation of reports. Therefore functionalities belong to the traditional tasks of information processing.

Concerning the system border one can (negatively) notice that none of the realised systems will exceed the company borders as product eco balances or life cycle analysis will require. The systems are mostly oriented to the entire company or a single department, while the treatment of (single) processes has been done in very few projects. If it is suggested that processes will rather indicate corporate dynamic it will be clear that the provided systems will have a rather – conservative– static character.

Finally, in conclusion it can be said that –with the exception of one – all projects have so called stand-alone systems as a result. Efforts to integrate the realised CEMIS into the existing landscape of business information systems did not occur. A comprehensive consideration of all realised CEMIS reveals that the existing reality covers the possibilities of the scientific discussion to just a relatively small amount.

CONCLUSION

The imperfect stepwise development of corporate environmental strategies derived from an environmental policy leads to the result that there is no or a very small identification of the top management with the objective of environmental protection. For this reason in the corporate practice the implementation of environmental measures will be assigned to middle management for the following reasons:

- The corporate strategic management can close their mind furthermore to the tasks of environmental management and can obviously keep on to be convinced that environmental measures are exclusively a cost factor. The economic efficiency of such measures is very often consequently denied. Investment in the development and implementation of complex and efficient CEMIS are considered more difficult.
- The assignment of environmental activities (also of IT-supported environmental activities) to the middle management level leads, because of the missing strategic orientation, to rather small and simple solutions of environmental tasks.
- Because of the missing strategic importance of the required solu-

tions of tasks and the insufficient possibilities of the operative management to enforce environmental-oriented software development projects, they are very low prioritised in the project portfolio of corporate IT departments with the result that their chance to be realised is very small.

- The missing classification of intended IT-solutions in a comprehensive strategic concept implicates that mostly stand alone solutions are used and that a self-contained software system will be developed for every single (sub)problem.
- In their day-to-day business – often characterised by ad hoc-measures – the operative (environmental) management see themselves committed to the idea of passive environment protection, by which it is mainly important to comply practical constraints resulting from the requirements of legal compliance by avoidance, at least reduction of environmental damage. Software systems stimulated by that realisation are mostly output-orientated e.g. by addressing emission reduction and using end-of-pipe technologies. These measures obtain the desired results without being forced to change anything of the production processes. As one result additional efforts have to be done to fulfil (legal) environmental specifications, which naturally causes additional costs. This approach inevitably leads to the top management assumption that corporate environmental protection measures will be (nearly) exclusively a cost factor.
- The operative approach, which is rather typical in the business practice, may lead to efficient IT-supported solutions of environmental problems. But without the inclusion in a previously developed comprehensive strategic concept, which pursues the idea of active environmental protection, it will not be possible to develop and implement highly effective systems. Effective CEMIS do not serve the function, "anyhow" to mitigate or at best to eliminate already in companies arisen environmental damages, but ensure to reconfigure corporate activities and processes that environmental damages will not arise.

To achieve an adequate significance for CEMIS in the business practise and, especially, to take into account the effectiveness, the discussion about CEMIS has to be promoted at least in two directions:

- An enlargement of corporate target systems by (partly) considering the results of the sustainability discussion achieved up to now.
- Closing the strategic gap between environmental policy and environmental activities (ISO 14.001) by a (strategic) environmental information management.

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8

Lean Production and Agile Organisation: The Link Between Supply Chain and Sustainable Development

Denise Ravet

ABSTRACT

While there are separate streams of established research on lean production, agile organisation, and sustainable supply chain, the idea is to address the intersection of these three strategic initiatives in order to find synergies and competitive advantage for companies. The goal of the mission is to explore the link between supply chain and sustainable development with the insights of two main paradigms in the changing competitive environment: lean and agility. On the one side, the focus of the lean approach has essentially been on the elimination of waste and all non-value activities. On the other side, a key characteristic of an agile organisation is flexibility at different stages. The concern is to analyse how companies could manage the lean and agility principles in the supply chain with sustainable development at the different stages of the supply chain.

Keywords: Sustainable development, Supply chain management, Manufacturing, Lean, Agile, Leagile

INTRODUCTION

Due to the global economy, volatile markets, competitive pressure, shortened-life-cycle product, more rigorous quality and quicker response requirements, rising ecology consciousness: the survival of many companies depends on the ability to continuously improve quality while reducing costs. Manufacturing systems have to respond to continuous changes and sustainability requirements. Therefore significant interest has been shown in recent

years in the idea of 'lean manufacturing' (Womack *et al.*1990) and the wider concepts of the 'lean enterprise' (Womack and Jones, 1996; 2003). Lean operations with low inventory have become an essential practice. Many organisations have adopted the lean thinking paradigm in order to optimise performance and competitive advantage. Then, in recent times, the emergence of customer-driven markets has resulted in rapid changes to strategies adopted by organisations. The agile manufacturing paradigm has been highlighted as an alternative to leanness (Richards, 1996). Agile manufacturing systems work in a constantly changing global market, particularly assembly systems at the last stage of product differentiation. In these changing conditions, one of the more interesting debates in recent years was about the creation of lean production and agile organisation as the key to survival for companies. Indeed, in some situations it is advisable to utilise a 'leagile' paradigm to ensure optimal supply chain performance (Mason-Jones *et al.* 2000). Meanwhile, in the wake of concerns regarding climate change, pollution and non-renewable resource constraints, sustainability is becoming a key issue for manufacturing strategy and supply chains. These paradigms (lean, agile, leagile and sustainable) should not be considered alone or in isolation within the supply chain although they show up with opposed characteristics. Tradeoffs between these management paradigms may help organisations and their supply chain to become more competitive and sustainable. The sustainability paradigm has opened the gate for revisiting various established strategies of supply chain management to reassess their viability with new angle of sustainability in general and greening specially (Stonebraker *et al.*, 2009).

Consequently, in this context, how do lean production and agile organisations meet supply chain and sustainable development? The purpose of this study is to present the relationship between lean production and agile organisation in a sustainable supply chain perspective. First, we will present the link between sustainable development paradigm and supply chain management in order to analyse in a second part, the differences between the two paradigms lean production and agile organisation according to sustainable supply chain and finally we will study how the two paradigms combined enable highly competitive sustainable supply chains.

THE SUSTAINABLE DEVELOPMENT PARADIGM AND THE LINK WITH SUPPLY CHAIN

Definitions

Sustainable development: The Brundtland commission (World Commission on Environment and Development 1987) defined the term of sustainability as: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Sustainability can be linked with diverse issues. "Sustainability can mean different things: some see it in terms of long-term viability, generally with an environmental perspective, some see a dynamic nature in sustainability, some see it simply as lasting change, which is the way in which we will use it here" (Bicheno and Holweg, 2009). The study is especially on corporate sustainability which has been defined as a business approach that creates long-term shareholder value by embracing the opportunities and managing the risks associated with economic, environmental and social developments. Corporate sustainability has been focused with attention drawn toward the triple bottom line of "people, profit and planet" (Elkington, 1997, 2004) or "Equity, Environment and Economics" (Anderson 2006; Kleindorfer *et al.* 2005). Therefore, the concept of sustainable development is made up of three areas: economic, social and environmental sustainability. For an organisation, it is translates as a focus on a respect for: profit-economic; people–social; and environment– environmental. Sustainability emerges as a way of considering the environmental and social values of business decisions alongside their economic value.

Supply chain: In the early 1980s firms realised that their competitiveness was not just determined by what they do, but also by what their upstream suppliers and downstream suppliers were doing. Supply chain capabilities are a significant determinant of competitiveness. "Value chains compete, not individual companies" (Christopher, 2000). "Supply chain is a group of partners who collectively convert a basic commodity (upstream) into a finished product (downstream) that is valued by end-customers, and who manage returns at each stage"(Harrison, Van Hoek, 2005).

Sustainable Development and Supply Chain

Several factors lead firms to pursue sustainable supply chain practices: pressure from stakeholders (Zhu *et al.*, 2008), environmental standards (Ron-

dinelli and Berry, 2000), effects of environmental performance, on firms' reputations (Christmann, 1998), cost reduction (de Brito *et al*, 2008) and competitors (Walker *et al.*, 2008). Moreover, environmental regulations, have forced manufacturers to re-examine the entire lifecycle and environmental impacts on their products. Such compliance efforts have already resulted in cleaner, sager operations, reduced use and acceptable substitutions for hazardous substances, increased product recyclability and recovery, and improved transparency of information available to suppliers, trading, partners, employees, and customers that impact all the supply chain. Consequently, many manufacturing companies are adopting sustainability initiatives in response to internal drivers such as cost reduction, commodity risk management, and upholding corporate culture and external drivers (consumers want the right product at the right cost to the right place at the right time and to be green).Thus, a sustainable supply chain focus requires working with suppliers and customers, analysis of internal operations and processes, environmental considerations in the product development process, and extended stewardship across products' life cycles (Corbett and Klassen, 2006; Mollenkopf, 2006).

But, sustainability issues are adding complexity and risks to the already challenge of managing supply chains such as inventory, cycle time, quality, the costs of materials, production and logistics (Lee, 2010).Three distinct phases of supply chain are identified in the literature (Shukla, 2004) and at each phase of supply chain there are impacts on sustainability measures: Inbound supply chain implies green-design, green sourcing, Manufacturing supply chain or Internal supply chain implies green manufacturing, Outbound supply chain it implies green logistic and green reverse logistic. However, although sustainability measures often seem worthwhile individually, they may in the grand scheme generate unintended consequences, such as higher financial, social, or environment costs (Lee, 2010). Consequently, these sustainability measures must be coordinated across every stage of the supply chain with adjacent operations. Therefore, the sustainability paradigm may have influence on the supply chain and many supply chain decisions may have impacts on the environment, the social aspects, the communities and the wider supply chain.

A DISTINCTION BETWEEN LEAN PRODUCTION PARADIGM AND AGILE ORGANISATION PARADIGM

"Agility should not be confused with leanness. While leanness may be an element of agility in certain circumstances, by itself it will not enable the organisation to meet the precise needs of the customers more rapidly" (Christopher, 2000). That's the reason why it is important to review these two paradigms in order to understand the link with supply chain management and sustainable development.

THE LEAN PRODUCTION PARADIGM

Origins

The origins of lean manufacturing initiatives can be traced to the Toyota Production System (TPS) and were initiated by Ohno (1978) and Shingo (1989) at Toyota with its focus on the systematic efficient use of resource through level scheduling. The terms 'lean production' or 'minimum workshop as Ohno (1978) states, provides a way to do more and more with less and less stock, less human effort, less equipment, les movement of material, less time and less space while coming closer and closer to providing customers with exactly what they want. They used the Japanese word *"muda"*, which were defined as any human activity that absorbs resources but creates no value (Dettmer, 2008).Then, the term 'lean production' was coined by Womack *et al.* (1990) in their book entitled "The machine that have changed the world" in order to show a better way to organise and manage customer relations, the supply chain, product development, and production operations. This is a vision of a world transformed from mass production to Lean Production which has dominated much of the theory and practice of production systems design. In this context, the idea of 'lean thinking' has been expounded by Womack and Jones (1996) and they have emphasised lean enterprise rather than lean production (Womack & Jones, 2003).

Definition

The term leanness is often used in connection with lean manufacturing to imply a 'zero inventories' just-in-time approach (Christopher, 2000). The main goal is on the systematic identification, reduction and elimination of all waste from the manufacturing processes in order to create value for the customer. It is the single most powerful tool available for creating value while eliminat-

ing waste in any organisation (Womack and Jones, 1996). It means also developing a value stream to eliminate all waste including time, and to enable a level schedule (Naylor *et al*., 1999). Furthermore, while most of the research stresses that competitiveness of lean production comes from physical savings on the technical side, a focus has been done on the 'psychological efficiency' the peripheral of the organisational mechanism. Lean production system has been one of the competitive advantages for Japanese enterprises, and the cultural element behind it (Recht and Wilderom, 1998). Consequently, lean production is not just a technological system but also a concept implemented throughout the whole company, which especially requires consensus on corporate culture (Wong, 2010). That is the reason why formulating a definition that captures all the dimensions of lean is a formidable challenge (Pettersen, 2009). Today it is the paradigm for operations that can be found in a wide range of manufacturing and service strategies.

Principles and Supply Chain Strategies

The lean thinking which includes lean production can be summarised in five principles: *"precisely specify value by specific product, identify the value stream for each product, make value flow without interruptions, let the customer pull value from the producer, and pursue perfection. By clearly understanding these principles, and then tying them all together, managers can make full use of lean techniques and maintain a steady course"* (Womack and Jones, 2003). Lean processes create value through the elimination of waste in the supply chain (Disney *et al*, 1997). Therefore, lean supply chain strategies focus on waste reduction, helping firms eliminate non-value adding activities related to excess time, labor, equipment, space and inventories across the supply chain (Corbett and Klassen, 2006). At the present time, the lean production paradigm positively impact many markets sectors where cost is the primary order criteria (Hill, 1993). Lean concepts work well where demand is relatively stable and hence predictable and where variety is low and volume is high (Christopher & Towill, 2002).

Lean Production, Supply Chain Strategies and Sustainable Development

The causal relationship between lean processes and environmental sustainability has been much debated in literature (King and Lenox, 2001). According to the lean principles, lean production drives more effective and effi-

cient resource utilisation, reduces waste and energy consumption, optimises direct and indirect resources and helps ensure a better product at less cost. The lean model requires less stock, less space, less movement of materials, less time (Shahin, Janatyan, 2010). *"Lean thinking must be 'green' because it reduces the amount of energy and wasted by-products required to produce a given product. Indeed, examples are often cited of reducing human effort, space, and scrap by 50 % or more, per product produced, through applying lean principles in an organisation this means that lean's role is to be green's critical enabler as the massive waste in our current practices is reduced"* (Womack, 2000). Therefore, lean production and sustainable development are often seen as compatible initiatives because of their joint focus on waste reduction (Mollenkopf *et al.*, 2010). As a matter of fact, whereas mass production focuses on big batches, lean focuses on small batches and quick changeover (Womack and Jones, 2003) thereby avoiding all unnecessary production or inventory. So the environmental impact that a shift from mass production to lean production could produce is important. Recent academic research (Hines, 2010) explore how lean can be successfully and sustainably applied to organisations and find the most compelling reason for organisations adopting lean is the economic and environmental benefits of going green. Becoming greener can reduce operating costs significantly and add customer value, two primary tenets of any lean initiative. A lean solution for manufacturing ensures that plants, lines and machines run at peak efficiency, a key component of enabling sustainability. Nevertheless, lean strategies that employ just-in-time (JIT) delivery of small lot sizes can require increased transportation, packaging, and handling that may contradict a green approach (Mollenkopf *et al.*, 2010). So, a pure JIT approach may have a negative environmental impact. Rothenberg *et al.* (2001) indicates that not all lean processes and waste reduction are positively related to environmental performance or pollution reduction. Furthermore, although 'lean' currently produces environmental benefits and establishes a systematic continual-improvement-based waste elimination culture, lean methods do not explicitly incorporate environmental performance considerations, foregoing some environmental improvement opportunities. Lewis (2000) suggested that being lean can curtail the firm's ability to achieve long –term flexibility and sustainable competitive advantage. It seems that the principles of lean must be linked with another set of initiatives, 'green'.

THE AGILE PARADIGM

Origins

The foundation of what it means to be agile was described by Goldman, *et al.* (1995). The concept of agility has its origin in flexible manufacturing systems (FMS) such as machine flexibility, volume, mix, and routing flexibilities (Aitken *et al.*, 2002). Then, the idea of manufacturing flexibility was extended into the wider business context (Nagel and Dove, 1991). The original manufacturing concepts have now been expanded to encompass a much wider management capability to be able to respond to dynamic and turbulent markets (van Hoek *et al.*, 2001). Agility involves not only responding to market changes but also gaining competitive advantage from such volatility (Sharifi and Zhang, 1999). In order to achieve this goal, companies require flexible capabilities in many areas, such as new product development, manufacturing and logistics (Zhang *et al.*, 2002). The supply chain agility is an important integrative element within this management concept (Baker, 2008).

Definition

Bal *et al.* (1999) give the following definition: *"Agility is the basis for achieving competitive advantage in changing market conditions"*. Agility means using market knowledge and a virtual cooperation to exploit profitable opportunities in a volatile marketplace (Naylor *et al.*, 1999). Christopher (2000) indicates that to become more responsive to the needs of the markets requires more than speed but also a high level of maneuverability that today has come to be termed 'agility' and provides key elements about the concept: *"Agility is a business-wide capability that embraces organisational structures, information systems, logistics processes, and, in particular, mindsets and a key characteristic of an agile organisation is flexibility"*. Prater *et al.* (2001) give the definition of agility which involves firms being able to respond to change within a useful time frame. However, it is then important to make the distinction between agility, flexibility, responsiveness. Baker (2008) suggests that the term 'agility' is more normally used at a higher (e.g business wide) level whereas 'flexibility' tends to be used at a lower (e.g operational) level. 'Responsiveness' only applies to the market or external side (delivery lead-time, volume or output, product mix...), (Bicheno and Holweg, 2009).

Principles and Supply Chain Strategies

In general, agility is used in a customer facing sense (e.g in an external context) as the ability to respond and benefit from market changes, for example by suggesting additional inventory buffers, spare capacity, or by postponing the product customisation. So, an agile organisation means to create supply chains that are able to adapt to changes in demand, product or technology in a short timeframe. *"The agile supply chain is an essentially practical approach to organising logistics capabilities around end-customer demand. It is about moving from supply chains that are structured around a focal company and its operating guidelines towards supply chains that are focused on end-customers"* (Harrison, Van Hoek, 2011). To be truly agile, a supply chain must possess a number of distinguish characteristics (Christopher, 2000): market sensitive means the supply chain is capable of reading and responding to real demand, virtual supply chain are information-based rather than inventory based process integration means collaborative working between partners, a confederation of partners linked together as a network. The agile supply chain must develop capabilities for responsiveness and flexibility along the different echelon: manufacturing flexibility (Oke 2005; Kara and Kayis 2004, Schmenner and Tatikonda, 2005), supply chains like warehouse (Baker and Halim 2007), volume flexibility (Salvador *et al*. 2007), supplier role in manufacturing flexibility (Kayis and Kara 2005). Therefore, various dimensions of flexibility in supply chains are identified and categorised such that the first three flexibility dimensions namely product flexibility, volume flexibility and routing flexibility are shop floor capabilities that impact on supply chain (basic flexibility); secondly other three dimensions like delivery flexibility, transshipment flexibility, and postponement flexibility are hierarchically located at company level (system flexibility); while another four flexibility dimensions i.e sourcing flexibility, response to market flexibility and distribution or access flexibility are linked to the customer-supplier relationships in the supply chain (aggregate flexibility) (Whadha *et al*.2009a; 2009b). The agile paradigm is needed in less predictable environments where demand is volatile and the requirement for variety is high, where the order winner (Hill, 1993) is availability (Christopher & Towill, 2002). It is about the ability to match supply and demand in turbulent and unpredictable markets.

Agile Organisation, Supply Chain Strategies and Sustainable Development

The implication of uncertainty for supply chain processes is that they need to respond rapidly to unknown problems and to avoid negative impacts. There are two relevant features of agility: flexibility and complexity (Calvo *et al.,* 2008). Flexibility has been identified as a key productive factor for success or competitive advantage (Suarez *et al.* 1995) but it is required to handle a high variety of products. The variety of products increases the complexity (Wiendahl and Scholtissek, 1994). So, the cost of agility may be linked with actions like buying flexible machines, efficient information systems to share data in real time, capacity enhancement to tackle sudden demand, extra manpower to cope with extra production volumes and decreased time of production, selecting, developing and nurturing of highly dependable multiple suppliers to provide supply flexibility, developing capability for faster transportation in terms of larger fleet, technological upgradation...(Shukla *et al.*,, 2010). Moreover, if a customer requires the company to deliver once a day, the company may not be able to fill up a truck, even through partial truckloads waste energy (Lee, 2010). However, based on flexibility and the response to customer, agility also includes cost reduction, high quality of products and the delivery conditions and service (Goldman & Nagel, 1991). Collaboration with multiple companies, different relationships with business partners or to outsource the work to a third party may be a solution (Lee, 2010).Therefore, it is difficult to assess whether agility with flexibility incorporation adversely affects or collaborates with supply chain sustainability.

HYBRID STRATEGIES LEAN PRODUCTION AND AGILE ORGANISATION: THE LEAGILE PARADIGM

Origins

While there are separate streams of established research on lean and agile organisation and sustainable supply chain, few authors (Mason-Jones *et al.*, 2000; Christopher & Towill, 2002) have addressed the intersection of these strategic initiatives. The goal is to make a connection between supply chain and sustainability in lean production and agile organisations in order to identify the possible synergies. It is important because firms may be missing synergies available through improved concurrent implementation (Mollenkopf *et al.,* 2010). *"In pursuing the lean paradigm and agile paradigm in isolation, the*

power of each paradigm may be lost" (Mason-Jones *et al.*, 2000). Moreover, lean and agile are not mutually exclusive paradigms and may be married to advantage in a number of different ways. The two approaches can complement each other, and in many cases there is the possibility to find for a hybrid lean/agile strategy to be adopted (Christopher &Towill, 2002). The two ideas of lean and agile can be brought together as a hybrid 'leagile' solution (Naylor *et al.*, 1999). Hybrid strategies can be developed to create cost-effective supply chains and proposes an integrated manufacture/logistics model for enabling the essential infrastructure (Christopher & Towill, 2002). In some situations it is advisable to utilise the *Leagile Paradigm* (Mason-Jones *et al.*, 2000).

Definition

Leagile is the combination of the lean and agile paradigms within a total supply chain strategy by positioning the decoupling point so as to best suit the need for responding to a volatile demand downstream yet providing level scheduling upstream from the marketplace (Naylor *et al.,* 1997).

Principles and Supply Chain Strategies

Basically, the agile organisation is adopted where demand is volatile and lean manufacturing adopted where there is a stable demand. Both agility and leanness demand high levels of product quality and total lead-time has to be minimised to enable agility, as demand is highly volatile and thus difficult to forecast (Christopher & Towill, 2002). Practical ways of combining lean and agile paradigms could be adopted by different strategies like the de-coupling point. The aim is to be lean up to the de-coupling point and agile beyond it, (Hoekstra and Romme, 1992). Mason-Jones *et al.* (2000) developed that many supply chains can adopt a lean capability up to a given downstream process, and then adopt an agile capability thereafter. This enables high productivity, low cost processes to start with, followed by responsive processes to allow high levels of customisation thereafter. So, lean material flow is upstream of agile material flow. Hence, lean precedes agile on two counts; geographically and temporally. According the taxonomy for pipeline selection (Christopher *et al.*, 2006), a matrix suggests that there might be four possible generic supply chain strategies according to three-dimensional classification (products, demand, replenishment lead-times): lean (plan and execute), leagile (postponement), lean (continuous replenishment), agile (quick response). One such 'hybrid' solution is to utilise lean principles when designing supply chains for pre-

dictable standard products and agile principles for unpredictable or 'special' products; lean supply chains where service is the order winner and agile supply chains where service is the order winner as described by Mason-Jones *et al.*(2000). It may be that total demand for a product can be separated as 'base' and 'surge' demand. Base demand is more predictable and less risky so lean principles can be applied, using agile approaches to cope with surge demand (Christopher *et al.,* 2006). It is also likely that products may require different kinds of pipeline according to their position within the product life cycle.

Leagile Organisation, Supply Chain Strategies and Sustainable Development

As lean production and agile organisation combines the benefits of both supply capabilities, is it also the case for the benefits of the sustainable supply chain? So, how could these different paradigms, lean production and agile organisation, combine together to have an impact on Sustainable

Development? As has been mentioned before, according to the links between each of two paradigms and sustainable development, lean production and agile organisation may have synergies and conflicts about sustainable supply chain. Indeed, the leagile paradigm may add to the complexity of managing the sustainable supply chain due to different environmental impacts. There could be divergence and convergence according to the different targeted markets. For example, a reduction in system resources may negatively affect the supply chain's flexibility. Moreover, a supply chain may be currently utilising its resources efficiently, and producing the desired output, and have sustainable effects but will the supply chain be able to adjust to changes like product demand, supplier shortages, manufacturing unreliability and maintain the same sustainable effects? From these perspectives, lean production and agile organisation might have contradictory sustainability effects. According to this conflict, firms may be able to identify trade-offs or develop solutions that mitigate undesirable consequences (Mollenkopf *et al*., 2010). There is a need to develop a systems approach to understanding how firms can best manage these concurrent paradigms to optimise the sustainable supply chain as a whole. The green supply chain literature has examined the importance of working across the supply chain with both customers and suppliers on environmental initiatives, which has been shown to lead to improved firm performance (Vachon and Klassen, 2006b). Companies should pursue broader structural change than they typically do. These may include sweep-

ing innovations in production processes, the development of fundamentally different relationships with business partners that can evolve into new service models (Lee, 2010). More research on the subcomponents of the supply chain should be undertaken to understand how to obtain synergies from the drivers, overcome the barriers, and make trade-offs where necessary (Mollenkopf *et al.*, 2010).Points of convergence have been identified and some principles could be either a driver or a barrier, depending how firms optimise the trade-off between the two paradigms. It seems to be important to make an assessment of the points of convergence and divergence across these paradigms in terms of sustainable supply chains. Best practices could be identified for implementing leagile sustainable supply chains and could be driven by key performance indicators that could measure or monitor the sustainability of a supply chain. The lack of commonality across drivers, barriers, convergences and contradictions could be explained by the different hybrid supply chain strategies and markets targeted by the companies.

CONCLUSION

An attempt has been made to present 'lean', 'agile' and 'leagile' paradigms and the link between the supply chain and sustainable development. Lean production and agile organisations have impacts on the sustainable supply chain and *vice versa*. It seems that the only way companies can recognise and navigate trade-offs or conflicts in their supply chains is to treat sustainability as integral to operations (Lee, 2010). Key performance indicators and measurement methods like supply chain carbon footprint could provide some information about the implementation of these hybrid strategies, to ensure that all supply chain members meet agreed-upon sustainable standards and targets. However, lean production and agile organisation should be integrated with a set of initiative from the sustainable supply chain strategy in order to develop a sustainable system approach culture. With this kind of approach, companies could improve both their sustainability and their overall performance.

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CHAPTER 4

Mobility and Energy

Edited by
LAURENT GUIHÉRY

Chapter Introduction

Laurent Guihéry

World crisis! Euro crisis! "Double-dip recession"! The world today seems to be obsessed by short term news, financial alerts, asking for rapid answers from governments, politicians, parliaments. The current Euro-Crises and debt crisis for example seem to have the power to put the whole European project in question, eliminating from the debate, among many other topics, the convergences of European countries towards sustainable development for instance. The debate about the debts brings up doubts on the future of the European Union which were not imaginable two years ago. It is time for a comeback to a long term strategic agenda, for example towards climate change and green growth!

Who remembers today the European targets towards sustainable development?

Let's take the example of mobility. In its resolution of 6 July 2010 on the role of urban transport in Europe, the European Parliament asked the Commission to introduce Sustainable Urban Mobility Plans (SUMPs) for cities of more than 100000 inhabitants and, with due respect to the principle of subsidiarity, encouraged cities to draw up mobility plans which propose an integrated transport concept with the objective of reducing environmental damage and making mobility healthier and more efficient. Facing these challenges, the European Parliament proposes clearer and measurable targets to be achieved in 2020 with reference to 2010 (European Parliament, 2010):

- a 40% reduction in the number of deaths and serious injuries among active and passive road transport users
- a 40% increase in the provision of parking areas for heavy goods vehicles in the trans-European road network (TERN) in each Member
- a doubling of the number of bus, tram and rail passengers (and, if relevant, ship passengers) and a 20% increase in funding for pedestrian- and cycle-friendly transport concepts
- a 20% reduction in CO_2 exhaust emissions from road passenger and freight traffic to be achieved through suitable innovations, the promotion of alternative energies, and logistical optimisation of passenger and freight transport
- a 20% reduction in the energy used by rail vehicles compared with the 2010 level and capacity and a 40% reduction in diesel use in the rail sector, to be achieved through targeted investments in rail infrastructure electrification
- a 30% reduction in CO_2 emissions from air transport throughout EU airspace by 2020; thereafter, any growth in air transport must be carbon-neutral
- financial support for the optimisation, development and, where necessary, creation of multimodal connections (platforms) for inland waterway transport, inland ports and rail transport and a 20% increase in the number of such platforms;
- at least 10% of TEN-T funding to be dedicated to inland waterway projects

On the issues of climate change and sustainable development, the good ideas and innovations we experienced over the last 10 years towards environmental innovation, motivated and accurate debate seems to be over, or now limited to experts, in a more *underground way*, except maybe in Germany which has always based their public policy on long term environmentally friendly strategy[1]. Opposite to Germany, which is accelerating on this topic, the UK, France and many other countries have limited their spending in this direction; cut environmental oriented research spending and tax incentives towards greening energy electric mobility for example.

1 See the decision of the Federal Government to exit from atom energy in Germany

Where is the debate, the explanation?

Facing parliaments to draw decisions over night on financial matters or debt management, it does not feed the impression in citizens minds that these solutions are well prepared or that the citizens are democratically involved in any way in European politics.

Today, the necessary and legitimate framing discussion about the Union's mid- and long-term-perspective is absolutely missing, for example concerning climate change and damages for the next generations.

How to achieve the targets defined by the European Parliament's objectives towards sustainable development? Why act now?

The aim of this chapter is to confirm the accuracy of the powerful analysis of sustainable development scientists develop. In this perspective, more than before, we suggest a *jump* towards a new balance between supply and demand based on greening economic life, from natural resources management to production, transportation and consumption. Green growth and business, new mobility patterns in our countries should create also a more balanced social development, maybe reducing the level of *inequalities* we face today in modern European countries.

Behind this jump, there is indirectly a change in the balance between operators in mobility: new operators are emerging (IT start ups for example and young people as managers, a new generation is then leading. This dynamic of change concerns not only behaviours, patterns and practices but also the generation is changing.

Mobility of people is at the centre of this dynamic, as we will see in the next chapter: we need to understand sustainable mobility in a large way, from patterns of mobility and tools to manage it, for example CRM and Traffic Management, to change the shape of some sector, IT for instance towards a new greening IT framework.

In managing, controlling or supporting our jump to a new green production and consumption system, IT is playing today a key role in modern society and is at the centre of innovation, especially in developed countries. As Bohas and Bouzidi (p.167) notice, it cannot be considered any more as immaterial and then need to be integrated in the whole perspective of sustainable development. Green IT has now emerged as a new sphere of research and activities. What seems to be interesting is that at the same time IT is provides dematerialisation of activities but also potential pollution and environmental damages. Some reports points out the fact that few companies are involved

and then that this number is declining, mainly due to the economic crisis. It confirms the first comments of our introduction that this financial and economic crisis is undermining confidence in this qualitative Jump towards sustainable development

As we can observe in all chapters, long term action is a key common element from all the contributions. And, as we will in the conclusion of this chapter, it needs some state intervention, mainly from the European Union (research framework), both on the side of infrastructure development (See Chapter conclusion) and but also for regulation. There is also a need of developing indicators and assessments tools[2].

Sustainable Development: A Way Out of Today Crisis

If we try, in this introduction, to move from today short terms answers towards a strategic and structuring long terms answer, we have to identify first and rank the issues that is facing world economies and societies today. In terms of emergency, and ranked by priority, we can list the following issues:

- Issues nr. 1: first issues coming rapidly: scarcity of natural resources, especially oil.
- Issues nr.2: then increase of population which has an impact on the world balance and accelerate the consumption of natural resources.
- Issues nr.3: and, in a third rank, the climate and environmental change which is on the agenda of today experts and governments

If you look to the actions of international organisations or governments in the world, actions on issues 1) and 2) are difficult – or impossible - to manage in term of political actions: scarcity of natural resources are quite impossible to manage, and on this issue, the world is moving towards a "cold run" or "cold rush" – as we got a "cold war" twenty years ago. Issues 2) refer to private liberty, self-development and individual freedom. Except China, it is impossible to implement political action on this point.

Then what remains is the issue 3 – climate change – which will came later in terms of "thread" but which is more likely to be managed by politicians and citizen. On this point we can start from a large acceptability by the

2 Sometimes, Bohas and Bouzidi (*p.167*) noticed that some counterproductive results can appear: IT means for example not less paper printing but an increase in printing papers.

population. This way of thinking can then be assimilated to a reversed action: from actions in issues 3 - because of a high acceptability of the population - to find a solution facing climate changes – to solve then issues 1 and 2 where there is a lack of acceptability and political will.

Thinking Environmental Actions: A Long Tradition in Europe and a Wide Common Agreement Among the European Actors

The key point is in Europe the large agreement on sustainable development and all countries are expressing, once again, the importance, for Europe, of a common European framework. Key elements are environment management and co-management, political action towards reducing Co^2 emission, cooperation and partnership, research.

The largest agreement among European member states can be found on cities environmental management and actions. Environmental damages occur indeed mainly in cities or large urban areas. Cities are now representing 50 %

Common European Sustainable Development Actions: The Case of Cities

Urban thinking towards sustainable development is a common value of European countries and seems to be relevant for the future of our study: it started in Stockholm in 1972, which is not surprising if you consider the experience of Scandinavian countries in environmental analysis. In June 1990, the European Commission delivered his first Green Book towards urban development and Environment. This report is showing a clear European experience and history towards "urban culture" and a good level of co-operation between cities. In Rio in 1992, the agenda 21 adopted by 173 chief of state and governments is highlighting the crucial role urban sustainable development. In 1994, the Charta of Aalborg, the European Conference on sustainable city, is considering cities as a key factor for implementing policies against environmental damages. In March 1996, a report is published giving us some definition how it can work: refusal to centralised top down approach and interest in a bottom up approach. Then the famous Charta of Leipzig was adopted in May 2007 and focused on integrated urban development and less developed suburbs. But the Charta of Leipzig is also proposing tools to achieve these goals on a European level, which ask for policy action and recommendations. In Marseille in November 2008, the ministers in charge of urban development of the European Union discussed on "sustainability and solidarity in cities" and have proposed a common framework to get in more operational actions: "Reference framework for sustainable cities", which will be available in 2011. In Tolede, on the 21th and 22th juin2010, a meeting of the European Ministers in charge of urban action and housing has highlighted again the role of Urban Integrated Plan (Declaration of Tolede).

of the world population – and 75 % in France. Cities are key players of social, political and economic life and are motors of innovation (based on the famous effects of positive externalities of knowledge). In cities, clusters develop themselves; networks of experts can spread out, and start up spirits can be activated through convergence of financial means, competencies, supply/demand of services and infrastructures. Cities are driven by "externalities", both in positive way (knowledge, innovation, motivation) and negative (negative external effects: pollution, noise, insecurity, congestion (to be considered as negative externalities here, for example public transport "suffering" from car congestion). This is why on the issue on actions – the target of our papers - cities are good framework. And transport and mobility are at the centre of this action!

Consumer Behaviour at the Centre of the Society's Change Towards Environment

As we observe in *Benjamin Wagner vom Berg's* (p. 177), managing customer behaviour is at the crossroad of mobility and sustainable development. In economic theory, two points influence individual mobility decisions: price change and information provision. In this perspective, social networks are essential, as Bohas and Bouzidi points out in his chapter one. The mechanisms of social influence are very powerful toward societal change for sustainable development, such as the roles that friends, family and co-workers can play in an individual's car purchase decision (Axsen and Kurani, 2011). Axsen and alii are for example showing that, by integrating data from consumer surveys, social network observation, the process and importance of social influence is essential for increasing the acceptability of a new behaviour or new action: Axsen (and alii) looks at consumer experiences with plug-in hybrid vehicles in California (case study). Car buyers consult their friends, families and even strangers to determine the benefits of plug-in hybrid vehicles: perceptions of cost savings, reliability, environmental impact, ability to convey a pro-environmental message to others. Axsen's paper (with K.S. Kurani) shows then that social discussions of car hybrid technology can influence car buyers' core values and identity in a "shifts towards environmental values, which occurred in several households, particular when the car buyer found social support among important reference groups, such as family or co-workers" (ITF, 2010).

On the same perspective, Benjamin Wagner vom Berg (p. 177) also starts from the idea that thinking separately sustainability, mobility and customer relations (CRM) means missing the key issue of sustainable develop-

ment. To achieve the target of a modern sustainable mobility and development, many tools from marketing analysis have to be integrated in a global perspective: he is thinking in terms of an interrelation of these three logics, which is a good point. Intelligent information system linked with an efficient CRM plays then a crucial role for managing mobility, which can have a direct impact on the mobility of people. And, on the opposite, expectations of behaviours or changes of behaviours through information and learning relationship through an efficient CRM can be oriented toward sustainable development and green mobility.

In this perspective, he is taking a more dynamic approach than Bohas and Bouzidi (p. 167) in the sense that CRM acts directly on the consumer choices, in the same way as Asxen (Axsen, 2011). It means on the **demand side** or at the frontier between demand and supply. Bohas and Bouzidi are referring more on the **supply side** of sustainable development actions in the IT sectors. Both chapters are really complementary.

Wagner vom Berg (p. 177) focus on electric vehicles too, the future of car mobility if we follow the today main European manufacturers. The property of cars is really changing and is not a key factor of life success among young people. But electric car constitutes a good opportunity to change the balance between mobility's operators, from car manufacturers, public transport companies to private people in their mobility behaviours. For Wagner vom Berg, it means a potential change of mobility behaviour mobility behaviour. Intermodal mobility is also at the crossroad between information, infrastructure and people. Information system plays also a key role today for managing intermodal mobility.

The case study of Jinengo (p.177) – software application for a sustainable and intermodal trip planning, project from Carl von Ossietzky University – is a good example in this direction: starting from the output of a trip planner, this application is also giving information on costs and sustainability (carbon emission, etc...). Connected with a CRM, this application analyses data to suggest better means of transport corresponding to the transport behaviour and the objectives of sustainable development.

Transport, Mobility, Technology:
At the Crossroad of Modern European Life

In all three contributions to this chapter, mobility is linked with the renewal of the thinking in terms of location and new means of transport linked with

just-in-time information based on collaborative tools, miniaturisation, carbon footprint and product life cycle management. The old vicious circle of urban mobility[3] for example has to be updated: on this issue, Europe has a leading experience in the world for balancing concentration of people and activities with quality of life/business development. Transport[4] plays then a key role in cities life today and is undoubtedly linked **with innovations** (IT, traffic management, see *Puskorius p.187*). But environmental actions is facing today scarcity of public finance and, in some countries (South Europe), high level of unemployment and sometimes dissatisfaction, and also social matters (inequalities, poverty, sometimes riots,...).

Recommendations of the next three chapters suggest:

- ✓ Learning from each other is a key success factor for further development toward sustainable mobility. And transferring experiences at the level of the European Union, could be a good means of improving the quality of life of European citizens in a 'best practice' strategy
- ✓ Acceptability by the population: is one of the key elements of success of any scheme. Look to the waste of time and money in the now famous case of Bahnhof 21 in Germany (Stuttgart)[5]
- ✓ In today's climate of increasing scarcity of public finance (leading to a lack of large infrastructure development in the future) seamless links between transport in cities is one possible solution. By using IT and information system (GPS and Mapping, IT in just in time, Google transit, etc) a more efficient transport system can be realised. Examples of this include: integration of all modes of transport in a mobility platform; in Lyon (Velov) rent-a-bike systems are connected with the Tube (Metro, Tramway) and car parking facilities (for electric vehicles); electric mobility and car sharing (depending on the country: Europes systems are based on two models, in the South 'individual model' and north 'communautarism model')

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3 Increase in car mobility which lead to pollution and scarcity of space in urban areas, urban sprawl which implies huge environmental damages, but also social damages of spatial exclusion in a long term perspective.

4 Thinking of the future of mobility means thinking of the mobility of "old people" because the population is becoming older. By 2020, we expect 20 % of people in some European countries with a "**limited mobility**" ("Personnes à mobilitéréduite" in French)!

5 see the refusal of tolling infrastructures in urban areas (Lyon)

- ✓ As costs of individual mobility become more expensive due to the increase of natural resources (petrol) there is likely to be more and more limited classical car mobility. Public transport, bikes (Copenhagen: 30% of travel is by bike), and electric cars should become more and more important. One of the key influences in this change is the purchasing power of households, even under periods of economic growth and an exit from todays' economic crisis. In the end, we come back to the key need for balance between individual freedom and sustainable mobility.

1

Sustainable Development and Information System: Which Approaches for Which Contributions?

Amélie Bohas - Laïd Bouzidi

ABSTRACT

The production of a computer requires the use of at least 240 kilograms of fuel (that is to say approximately nine times the weight of the computer), 22 kilograms of chemicals and 1500 liters of water. (Kuehr *et al*., 2003). With the rate of growth of the current power consumption of the Internet, namely 20% per annum, the academic of Dresden, Gerhard Fettweis, estimates that this one area of society will consume in 2050 as much energy as all humanity today (weekly WirtschaftsWoche, AFP, March 5, 2008).

In the light of this observation, the argument that computers and more largely Information and Communication Technologies (ICT)[1] are not concerned about energy use is no longer valid. Today, due to depletion or even destruction of certain natural resources and ecological imbalances, the sector of Information Technologies (IT)[2] cannot be unaware of its environmental impacts any more. This reflection is not entirely new, some works, at the origin of the program Energy Star,[3] had already been initiated at the beginning of the Nineties in the United States. Nevertheless it has been necessary to wait more than ten years, before a real awakening emerged and a new research and sphere of activity appeared; that of Green IT. It is around this concept and its details of imple-

1 ICT are understood here in a global meaning as the whole of information technologies to which are added telecommunications equipment and telecommunications services (EITO, 2002)

2 IT refer the combined industries of hardware for office machines, data processing equipment, data communications equipment and of software and services (EITO, 2002).

3 This program, which has generated the label with the same name, aims to reduce energy consumption of equipments in use

mentation that this paper concentrates. The objective of this paper is present current thinking on the situation in terms of definitions and of positioning but also to analyse to what extent Information Sytem (IS)[4] – taking into account its intrinsic characteristics – can contribute to Sustainable Development (SD)[5]. Finally, some perspectives of thinking in this field will be presented.

STATE OF THE SITUATION

Definitions and Positioning of the Problem

It was around the year 2005, in the middle of a wave of regulations aimed at an awakening of organisations about their environmental externalities that the concept of Green IT or Green Computing emerged (Law NRE in France, European Directive 2002/96/EC on the WEEE, European Directive 2002/95/EC on the restriction of the use of certain hazardous substances).

This awakening was the result of the integration of the requirements of SD, and in particular of the environmental dimension, in the field of the data processing and more largely of IS. Besides, for Jenkin *et al.* (2010), "*Green information technologies and systems refer to initiatives and programs that directly or indirectly address environmental sustainability in organisations*".

One of the solutions to the problem is a question of taking into account environmental externalities generated by IT. What Pensel (2009) defines as responsible computer science, "*must assume three dimensions social, environmental and economic to guarantee the perenniality of IS*". When any two of these dimensions are present the term involved changes as follows. 'Equitable' computer science is located at the intersection of the social and economic dimensions, 'livable' computer science at the interface of the social and environmental dimensions, and 'viable' is the term used when only environmental and economic dimensions are taken into account.

Contrary to this approach, which retains only the negative effects of IS on the environment, there is another concept which is focused on the potential

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4 IS stands for "the whole of means (organisation, actors, processes, computer systems) necessary to the treatment and the exploitation of information in the prospect of objectives defined at the level of strategy, activities and regulations" (General Commission of Terminology and Neology, Gazette, 10 October 1998)

5 The official definition of SD describes it as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland, 1987)

of contribution of ICT to SD and its mode of implementation in organisations, namely the Corporate Social Responsibility (CSR) (Pensel, 2009). Thus, *"IS can be regarded as a whole of tools in favour of a CSR policy"* (Pensel, 2009). Earnings and savings are liable to be substantial thanks to improvements in data processing due to Horizon 2020 and are particularly discussed in the report "Smart 2020".[6] In particular, this study estimates that the dematerialisation of activities and exchanges could make it possible to save 20.7 million tons of CO_2 from the date of the report to 2020 in France alone.

The fight against greenhouse gas emissions and in particular the reduction of the carbon footprint of companies is one of the constants of the matter binding ICT and SD. O'Neil (2010) defines Green IT as being *"a collection of strategic and tactical initiatives that directly reduces the carbon footprint of the computing operation of an organisation"*. Among the environmental impacts, the carbon footprint is the first and most abundantly quoted. The social aspect is often the poor relation of discussions surrounding 'sustainable' ICT. There is more concern with the environmental side because it's *"the dimension more recently studied and so the most ignored as well as dimension carrying the principal stakes for Humanity like the climate changes"* (Faucheux *et al.*, 2010).

Regarding the evolution of the problem, one can say that this new area of thought saw a peak in 2007 as testified on the one hand by the Gartner Group's graph (Hype Cycle for emerging technologies, 2009) and on the other hand by the last study of Forrester Research[7] which revealed that firms setting up Green IT programs in 2010 represented no more than 30% of the companies compared against 50% in 2007. This, in addition to the fact that it emphasised the effect of the economic crisis on this type of project, indicates that organisations still have a lot of difficulty in comprehending all the stakes related to this sort of problem and that they are lacking the tools for managing this field (40% reproach the absence of a clear return on investment).

The other potential limiting factor related to the implementation of actions within this framework, resides in their systemic nature and the difficulty in measurement of their net contribution at the global level. This is because

6 SMART 2020 "Enabling the low carbon economy in the information age", report published in 2008 by the Climate Group within the framework of GeSI (Global e-Sustainability Initiative): http://www.smart2020.org/

7 "Market Update: The State Of Green IT Adoption, Q2 2010" Daniel Krauss, Christopher Mines, Charles Green

of the possible pernicious effects to which these initiatives, initially beneficial, can lead. Hilty (2008) identifies two ways in which these negative effects could be caused by the initial benficial act: those of induction and those which he describes as a rebound effect. In the first case, induction refers to a rise of the global consumption of a good or service induced by the purchase or the use of another good or service. In the second case, the concept of rebound effect finds its foundations in economics and evokes as regards SD *"a potential obtained by gains of efficiency which would be counterbalanced or even exceeded by an increase in the consumed quantity"* (Binswanger, 2001; Schneider, 2003). Consequently measures taken within the framework of a policy of Green IT could finally turn out to be counterproductive with regard to the expected results.

Nevertheless, numerous companies are undertaking actions in this field and interest in this topic is growing (as evidenced by the multiplication of managerial publications and conferences on this subject). So then the question of how to act arises which the following section will try to answer.

How to Act?

Traditionally IS is analysed under three dimensions. Firstly, under both the technological dimension which comprises the technical base and material architecture necessary to the exchange, the treatment and the information storage, and the applicative side which represents the whole of the software and applications necessary to fulfill the support functions and the business activities of companies.

Secondly under the business dimension which includes the functions, the processes and the procedures specific to the trade of the organisation in question, combining the operational level and the level of governance and steering. This last addresses the problems of improvement of processes, of strategic alignment of IS, of organisation, and accompaniment to the change in particular through training.

Thirdly under the human dimension which corresponds to the identification and the management of the various actors at the technological level as well as at the functional one: cartography of the actors, qualification of the profiles and identification of the needs.

SD is a transverse dimension which can be approached in each of these three described areas.

On the Level of the Technological Dimension

The introduction of a company's Green IT programs are often initially done in a technological way. This is achieved through two approaches, firstly by better usage of existing infrastructure – that characterises a behaviour known as adaptive (Mathieu and Bohas, 2011) – and secondly, by the fact of any new IT or IS project has the criteria of durability introduced at an early – this allows more anticipation of future needs to be visioned and accounted for (Mathieu and Bohas, 2011).

In the first case, companies will seek to reduce the use of their resources in particular the energy consumption of their IT as well as the volume of their Waste Electrical and Electronic Equipment (WEEE). Indeed, contrary to the ideas conveyed up to now according to which ICT are responsible only for *"a low electric consumption and a weak carbon footprint"* and generate only small amounts of waste being *"immaterial"* (Rodhain and Fallery, 2010), their environmental externalities are quite real and must be taken into consideration. Thus in France Breuil *et al.*, (2008) estimate the electricity consumption due to ICT to be *"between 55 and 60 TWh per annum, that is to say 13.5%"*. And with regard to their end of life, the volume of waste is important and is constantly increasing: *"the aggregate output of electronic waste is estimated today at approximately 40 million tons per annum primarily in Europe, US and Australia."*[8]

To treat the energy intensive aspect of their computer stock, companies are able to implement steps of rationalisation and to install systems of measurement in order to manage their consumption as well as possible. They also seek to increase the energetic efficiency of their datacentres and the use rate of their computers. For this purpose, they can resort to practices of virtualisation both on their work stations (Thin clients infrastructure type) and on their servers for which they also carry out operations of consolidation. On the level of the urbanisation of their computers rooms, firms can conduct refits taking care to separate the hot alleys from the cold alleys and using powerful air-conditioning equipment.[9]

For purposes of reducing the volume of WEEE, the best strategy remains to increase the lifespan of the materials. This objective can be achieved

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8 http://www.ecoinfo.cnrs.fr/

9 For more information on these different technical solutions, see the book "Green IT les meilleures pratiques pour une informatique verte", Chapter 5 "Le parc informatique" and Chapter 6 "Evoluer vers des datacenters verts"

through a change of period of depreciation accompanied with an extension of the manufacturer guarantee, or thanks to re-use by the means of gifts, partnerships with organisations of reconditioning, etc. This lengthening of the lifespan of the materials can sometimes require companies to skip updates in versions of software. Indeed later versions of software alone, requiring more and more power for their operation, can force companies to replace their computer stock for increasingly powerful equipment.

In the second case, in order to anticipate the environmental issue, firms have the opportunity to formulate a policy of responsible purchases upstream. This will enable changes in particular the integration of ecoconception criterions in calls for tenders and the use of ecolabels to guide choices. It will also be likely to take the form of a clause of SD in contracts with suppliers or even a choice of suppliers on the basis of their environmental and social performances.

On the Level of the Business Dimension

The integration of the requirements of sustainability in the business dimension of IS refers to the determination of objectives on three dimensions (environmental, economic and social) and to the implementation of adapted procedures (impressions, energy savings, etc). In a mature approach, this results in the redaction of strategic plans over a period of three or five years so they include all of these elements as well as the means necessary to enable their implementation, in terms of material resources and competences.

Within their IS governance and with an objective of prevention and control (Jenkin *et al,* 2010), companies define a plethora of integrated indicators on the environmental footprint of computers. This search for reduction of the negative impacts of firms on their environment is not only limited to the sphere of their computer system but extends to their entire activities. From this point of view, companies are able to use their technologies according to two prospects (Faucheux *et al.*, 2010):

1. as a quantifier within the framework of modeling the carbon emissions for the activities of organisations;
2. as a catalyst in the effort of firms to be durable.

This last point can take various forms. Firstly ICT can be employed within the framework of a policy of communication aimed at creating an internal 'SD culture' on the one hand, and informing customers and suppliers, on

the other hand, about the initiatives of firms as regards their durability. Secondly, this can be through a dematerialisation approach of procedures and documents. On this last point, the installation of an electronic management of documents is sometimes considered. Thirdly, IS can be made profitable through the aim to reduce displacements of employees by the provision of collaborative tools facilitating remote exchanges and work. Lastly, in order to secure the risk of social contesting and regulatory evolution (Mathieu and Bohas, 2011), companies must resort to a proactive strategy and implement a monitoring system. There still, IT represents an opportunity to automate this process and meet the needs for monitoring on environmental, legal and social aspects.

On the Level of the Human Dimension

As far as the human dimension is concerned, actions undertaken by organisations as regards durability when applied to IS, primarily refer to consciousness-raising actions about good practice, firstly regarding reductions in the consumption of energy and paper. Companies thus seek to encourage their employees to acquire certain behaviours such as double-sided printing, the extinction of work stations, a minimum at the end of the day and a maximum for lunch break. In the case of printing, another 'bad hypothesis' related to ICT, is that of 'Zero paper' (Rodhain and Fallery, 2010). Indeed, it was believed for a long time that ICT were going to make it possible to remove paper from companies, now several authors (Cohen, 2001; Huws, 1999; Erkman, 1998; Moktharian, 2003) have shown that ICT actually contribute to increased consumption because of the greater volume of information which they make it possible to reach (Moktharian, 2003).

From the organisational point of view, firms can decide to name a SD referent within their IS department in order to relay the CSR policy in the decisions taken in this field.

On the social aspect, the integration of SD in the field of IS also refers to the consideration of people with disabilities and to those suffering from long-term illness, through the increased accessibility of documents, Internet sites and applications, and increased deployment of teleworking.

Why Act? Which Stakes?

There are numerous motivations in favour of a sustainable IS for an organisation. Among the most famous and quoted are the reduction of costs, regulatory conformity, stakeholder satisfaction (in particular transactional ones),

the desire to initiate a CSR approach or more specifically the ethics of the businesses and research of new growth factors through eco innovations. Some data on the development of the sector reveal the need for firms to seize such opportunities: thus, *"the part of ICT in the investment of companies doubled or tripled according to countries in a quarter century, growing from 6,8% in 1980 to 14,4% in 2000 in France and from 15 to 30% in United-States"* (Faucheux *et al.*, 2010).

At the heart of the stakes related to the integration of the principles of durability in the field of IS, the energy stake is central and tends to become a global stake. Indeed, energy resources are limited while demand does not cease increasing, whether it is for personal ends or professional. Therefore, in a context of rises in the costs of energy, the search for efficiency becomes paramount and is found as well in companies of electricity industry itself. Indeed the requirement of efficiency encouraged the European Union to lead a reorganisation of the electricity market very early on, which is not without consequences for its current members and its candidates for entrance like Turkey. In this context, firms must take account of and control the energy costs of their information processing system. In addition, with regard to the climate situation, it should be noted that *"the electric consumption of ICT generate 2% of the world greenhouse gas emissions"*[10], that is to say as much as civil aviation (Tassin *et al.*, 2010 p169). But even if electricity in France is only slightly carbonaceous, taking into account the great proportion of nuclear power, organisations must integrate these emissions of ICT in the calculation of their carbon footprint.

The Need for Quantifying and for Qualifying the Degree of Durability of IS

The factors discussed above show the complexity and the heterogeneity of methods of integration of SD in the field of IS (Mathieu and Bohas, 2011). Vis-à-vis this multiform character, they reveal, moreover, the need for establishing a scale measuring the degree of durability of IS. This would offer to firms, by the means of a package of indicators, the opportunity of measuring the level of integration of the requirements of SD in their IS and thus to evaluate the performance of their IS on each of three dimensions: economic, social and environmental. In a vision by the risk, it is a question of reducing the

10 IT Hardware Energy Consumption, Worldwide, 2005-2012, Study Gartner, December 2008

negative impacts of IT on the environment while increasing their efficiency with an aim of satisfying the urgent economic requirement and the social pressures, all while conforming to the legal obligations. In a contributive approach, organisations seek to identify and develop the sources activities of creation of environmental value for themselves and their stakeholders. Overall, they come within the scope of an approach based on global performance and perceive ICT from the point of view of their contribution to the latter. On the aspect of the potential of IS in terms of SD, several avenues emerge depending on their intrinsic characteristics, it is the object of this second part.

POTENTIAL CONTRIBUTIONS OF INFORMATION SYSTEM TO SUSTAINABLE DEVELOPMENT

The potential contributions[11] of IS to SD can be categorised according to at least three prospects:

1. according to their field of contribution, i.e. economic, social, environmental (Faucheux *et al.*, 2010; Tassin *et al.,* 2010)
2. according to their function of use with respect to SD (Faucheux *et al.,* 2010) i.e. to measure / quantify, reduce, model / simulate, supervise, mobilise (Corne *et al.,* 2009 ; Rodhain and Fallery, 2010)
3. according to their intrinsic characteristics i.e. a nature conducive to exchange and information sharing, the capability to optimise existing processes and resources and a predisposition for the follow-up and steering of the human activities.

Using this last typology, several examples of contribution of IS to SD are detailed in this section.

A Tool of Exchange and Sharing

IS is, by nature, a tool of exchange and sharing. It consequently constitutes a formidable means to support remote work and to create a SD culture. Firstly,[12] in a context of a rise in the costs of fuels, of pollution of urban

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11 The term "potential" encapsulates here the view that contributions are for the moment those which are considered by the firms and some researchers, but for which existing data either don't make it possible to prove their real benefit or do it but without any possibility of generalisation to all sectors.

12 For more information on teleworking, teleactivities and more globally the contribution of ICT to mobility of firms and more generally to transports, consult the following pages of the book "Sys-

spaces, of saturation of public transport infrastructures, ICT enable the concept of the work location to be renewed and its organisation by uncorrelating activity from its place of realisation (Tassin *et al.*, 2010). By supporting, in any place, a connection and the accessibility of information, they offer new working methods and *"an obvious solution to cause a drop in the carbon emissions related to the transport of people"* (Berhault, 2009). Thus, as Manuel Castells[13] underlines it (quoted by Berhault, 2009) *"ICT make it possible at the same time the decentralisation of tasks and their coordination in an interactive network of communication in real time, both between continents and between floors of the same building."* Teleworking being 'protean' (Tassin *et al.*, 2010), various methods can be considered according to two prospects: to work at home or in teleworking centres. The latter have the advantage of *"meeting the needs for social interaction of the teleworkers"* (Faucheux *et al.*, 2010) and of creating social value overall (Tassin *et al.*, 2010; Berhault, 2009).

Among the other contributions of ICT to the field of transport, the development of future transport modes seems paramount. Thus, thanks to the Internet, car-pool and self car sharing solutions are organised from all sides. But ICT also have a part in the deployment and the management of 'soft' transport such as the bicycle or walking (Tassin *et al.*, 2010). These means of transport relying on human energy would have a beneficial effect on health and the well-being of people in contrast to all the other transport modes.

Secondly, with regard to the role of IS in the development of an SD culture, several thoughts emerge around what Berhault names *"the advent of a planetary consciousness and an online community"*. As Rodhain and Fallery (2009) state *"ICT are not only communication infrastructures conveying contents, but relation spaces where actors get involved in too*". So, as well as their information role, these tools are likely to fulfil prevention and control functions but also to be means of actions through exposure messages. Through the reactivity they offer and their spreading capacity on a worldwide scale, they represent an excellent means to mobilise a community at the international level. What authors describe as a *"social experimentation movement takes place"*. Social networks via the Internet act to intensify this action, in the sense that they materialise belonging to a community and offer

tèmes d'information & Développement Durable" from Tassin *et al.* (2010): p39-40 ; p117-123, p.132-137, 153-157.

13 Manuel Castells, *La société en réseaux*, Fayard, 1996

this opportunity to increase webs of relationships and consequently, mobilisation and action fields.

In this context, for firms, to defend their reputation vis-à-vis the risk of social dispute becomes paramount. Firms can rely, on the one hand, on their collaborative tools to federate internally and on the other hand, on their tools of institutional communication, to inform and reassure about the environmental and social pressures they have to deal with. The transparency of information, in the respect of the data confidentiality of firms, is then essential. However, it is advisable to provide some limits to the arguments developed above, in particular on ICT applications to the field of transport. Thus, Moktarian's works (1988, 2003) reveal the absence of substitution of trips by telecommunication. It is more an effect of 'complementarity' which would be observed.

A Tool in Favour of the Optimisation of the Existing Business Processes and Resources Use

In the field of the optimisation of the use of the resources, the contribution of IS to SD is done by the replacement of physical goods by virtual flows. In the search for efficiency, the miniaturisation of products contributes to reduce the input/output ratio. In the same order of idea, technological innovation can make it possible to *"improve energy efficiency"*[14] (Rodhain and Fallery, 2010). It indeed offers the opportunity of increasing the output of the existing infrastructures through:

1. new components which are less energy-guzzling,
2. processes enabling consumption to be more accurately measured and controlled
3. alternative sources of energy (solar energy, wind energy...) used within the framework of a search for an optimal combination with traditional energies (smart grid). The building and transport sectors are the first concerned with the objectives of reduction of the energy consumption.[15]

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14 On that subject, consult the report of the European Commission entitled *"ICT for Energy Efficiency"* published on 24 October 2008

15 On the reduction objectives of energy consumption at the level country, consult action plan for energetic efficiency approved on March 2007 by European Council.

Dematerialisation, by substituting paper documents with digital versions and trips by remote exchanges, supplies interesting possibilities for a better use of resources.

Supply chain management can be quoted as an example to illustrate the contribution of IS to the optimisation of processes. This one occurs at two levels. Firstly, IS offers a better traceability of the products thanks to the use in particular of chips RFID and with referencing of the raw material. Secondly, it enables an optimised management of time and rate of filling of trucks or cargo boats as well as rounds and turnovers. The resulting gains are then both economic and environmental (Tassin *et al.*, 2010). These considerations find an echo with the work of Puškorius in the third paper of this chapter[16] which reveals the advantages of *"traffic planning and administration modeling using the computer"*. Thus, the recourse to data processing for this type of use in particular makes it possible to easily identify the critical pathways and activities and to calculate for each node the latest and earliest finishing times.

Nevertheless, it is advisable to be careful with regard to these elements, in particular on the positive effects expected as regards dematerialisation. In the first place, if one take an interest in the dematerialisation of the products, it is necessary to be vigilant on a counter-process that Faucheux *et al.* (2010) indicate under the term of 'devirtualisation' which consists of 're-materialising' of the virtual products (Tassin *et al.,* 2010). The authors quote in particular the example of printing of online documents, of CDs burnt from MP3 music, etc. In the second place, if one considers *"the effect of the Electronic Commerce on transport"* (Rodhain and Fallery, 2010), the environmental profits carried out are very often compensated or even exceeded by the negative impacts generated during goods conveyance. Moreover, with regard to the reduction of the consumption of resources, IS actually plays an ambiguous role, since while contributing to profits of efficiency, it supports mass production by facilitating access to new products thanks to abundant information and to an optimised logistics system inducing a reduction in transport charges.

A Tool of Supervising and Steering

To finish, another category of contribution of IS to SD lies in its potential as regards supervising and steering. From this perspective, IS, *"as a means of preserving environment"* (Rodhain and Fallery, 2010) can fulfill several func-

16 See paper 3: "Traffic Planning and Administration Modeling Using the Computer"

tions with respect to SD: from a mere observation to the contribution to the durability of human activities (Faucheux *et al.,* 2010).

Using the Green IT strategies typology suggested by Jenkin *et al.* (2010), and supplemented by Mathieu and Bohas (2011), several examples of applications are presented. Within the framework of a strategy of the type 1 known as *"Prevention, control and eco-efficiency"* strategy, firms have recourse to tools for simulation to help them in their decisions relating to the environmental risks and resources management (Rodhain and Fallery, 2010). In order to evaluate their environmental impact, they use tools for measuring the carbon footprint. The analysis of the results provided by this software then constitutes a precondition to the actions of reduction (Corne *et al.,* 2009; Tassin *et al.,* 2010). For instance, the Smart Meter is a technology contributing to energy efficiency. Indeed, it enables a precise monitoring in real time of energy consumption.

When companies enter into a strategy of type 2 with objectives of eco-conception and reduction of environmental externalities, they use Product Life Cycle Management (PLM) software. These make it possible to manage in an optimal way the product life cycle through a Life Cycle Analysis (LCA). The field of intelligent buildings in particular has many applications of this type of strategy e.g. optimisation of lighting, heating, air-conditioning, lifts (Corne *et al.,* 2009).

Lastly, in type 3 strategies, the so-called "*SD and ecoeffectivity*" strategy, which constitutes the most mature and proactive approach on this topic, firms profit from their technologies to improve their processes and in this way contribute on a broad scale to the durability of their trade. Consequently, on the CO_2 emissions side and according to the objectives which they strive to reach, they can use *"an ERP quantifying the CO_2 level due to freight transport, a calculator which with expenses accounts determine the emissions of CO_2 of the employees, a website of e-learning to avoid travels due to training, an 'intelligent' sail to supplement merchant ships traction and like this reduce fuel consumption, a website for car pool"* (Corne *et al,* 2009). They can also improve effectiveness of the processes of management of waste thanks to the use of geographical information systems (GIS) (Tassin *et al.,* 2010) and electronic labels (Rodhain and Fallery, 2010).

The example of sustainable CRM (Customer Relationship Management), quoted by Wagner vom Berg in paper 2 of this chapter,[17] is another

17 See paper 2 entitled "**Sustainable CRM – leading customers to a sustainable mobility**"

application of ICT to SD made possible thanks to the monitoring and steering of activity. Indeed, through the data which it makes possible to collect and analyse, sustainable CRM offer the opportunity to engender a radical change in the behaviour of consumption of the customers of the company. This evolution can then create new economic models.

AVENUES OF INVESTIGATION

Being a subject as little explored as the integration of SD in the field of IS, avenues of investigation are numerous and cover a variety of areas. The choice was made here to present only three of them which can be considered, within the framework of this chapter, as prerequisites for the support of IT to the durability of firms and more globally for the preservation of an ecological balance of the Earth.

The Need to Regulate

Many agree that ICT alone will not be sufficient. (Rodhain and Fallery, 2010; Hilty, 2010) and that it is consequently necessary to consider inciting measures aimed at encouraging firms (and private individuals) to take the route of SD.

Although laws, standards and codes of conduct already exist as regards environmental protection (O'Neill, 2010; Tassin *et al.,* 2010; Breuil *et al*., 2008), researchers, with politicians, must think of the nature of new regulatory measures which could be taken in this context. Because, as it was mentioned above in this paper, companies often act initially to conform to regulation even if theoretically *"to assume a CSR means to be involved beyond the only obligations imposed by the Legislator"* (Caroll, 1979 quoted by Pensel, 2009).

The Issue of the Awareness of the Future Generation

On the side of the change of the behaviours, in addition to the consciousness-raising of the employees (Tassin *et al.,* 2010), companies and more globally Civil Society have to develop the awareness of future generations. Researchers can support them in this task by analysing which are the initiatives which most strongly contribute to engender an ecological conscience in these populations.

Thus, is it necessary to encourage employees to adopt eco-actions not only at work but also at home so that in their turn they develop the aware-

ness of their close relations? Which role can ICT have in these actions of education in favour of the future generations? Are they adapted to this public through new pedagogical tools such as learning games?

In the Search for an Approach with Indicators

As it has been noticed through the various examples covered, in the current state of the reflections, it is difficult, or even impossible, to establish in a reliable and quantifiable way the role of ICT as regards environmental contribution. Researchers have proposed indicators (Rahman and Akhter, 2010) but these are often limited to the analysis of a dimension of the process and are seldom generally applicable with the sector as a whole.

Considering this lack, researchers must create an approach with a package of indicators of measurement of the degree of durability of IS and of its 'sustainable' performance. This approach will have to enable indicators to be contextual in order to evaluate, for each firm, the potential of contribution of IS to SD.

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2

Sustainable Mobility Accelerated by a Sustainability CRM

Benjamin Wagner vom Berg

INTRODUCTION

Today companies, governments and the public are recognising that resources are limited (e.g. oil) and different other problems are occurring in the economic, environmental and social dimension that are resulting from our economic actions and our consumption behaviour (Belz & Peattie, 2009). Because of this, sustainability is growing into a major topic for companies as well as for customers.

Especially the energy sector is seeking for alternatives, because it has to deal with huge environmental impacts (hazardous nuclear power, carbon dioxide (CO_2) emissions by fossil burning plants) and upcoming shortages (peak oil). A report of the Intergovernmental Panel on Climate Change (IPCC) proclaims that it is possible to produce 77 % of the worldwide energy needed with renewable power plants like wind energy, solar and others (Edenhofer *et al.*, 2011).

Mobility has a huge impact in the energy and sustainability context. So 26% of worldwide CO_2 emissions by combustion of fuel are coming from transport and 35% of total energy consumption in Europe comes from transport with 71% by road traffic (EEA, 2011). If we are looking at these statistics, switching to electric vehicles (EV) seems to have a huge potential for a fundamental change to more sustainable transportation with less CO_2 emissions and energy consumption. But also EVs have environmental impacts and furthermore technical shortcomings. So a 1:1 substitution of combustion en-

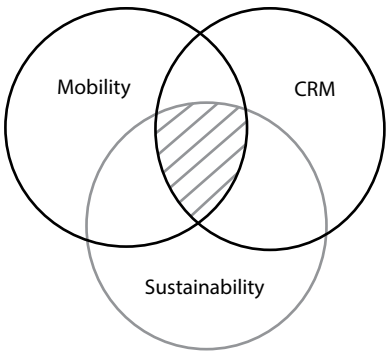
gine cars by EVs is both not sufficient according sustainability and on basis of today's technology not possible (Wagner vom Berg *et al*., 2010). Because of this EVs need the support of special business models and using concepts as well as logistic solutions to be successful on mass markets (Weidlich, 2009). Multimodal or intermodal transportation provides a logistic solution to compensate for the technical shortcomings of EVs and also a solution for moving more sustainably (Arnold *et al*. 2010). Intermodal transportation means a big change for our mobility behaviour and also a more complex planning of trips depending on the number and kind of means of transportation we combine. It is getting even more complex and different to our used mobility behaviour when we try to move as sustainably as possible. This requires intelligent information systems for planning and organising mobility. New business models for a sustainable mobility can only be successful if the customer is willing to change his mobility behaviour and accepts these new offers.

Marketing is the instrument to provide offers to customers and also to influence consumption behaviour. The integration of environmental aspects in the marketing area was already happening at end of the 80's within Green Marketing e.g. by eco-labeling, is still in progress (Peattie, 1995; Grant, 2007). Another newer and also important approach is sustainability marketing that is described as follows: *"In other words, sustainability marketing represents an evolution of marketing that blends the mainstream economic and technical perspectives with the emerging concepts of relationship marketing and the social, ethical, environmental and intergenerational perspectives of the sustainable development agenda"* (Belz & Peattie, 2009). So there is a change from just economic and technical objectives forward to sustainability objectives. An important building block within sustainability marketing is to shape consumer lifestyle and behaviour in a way that would both expand the market for the offered products and achieve sustainability goals (Belz & Peattie, 2009).

These approaches have also consequences for Customer Relationship Management (CRM) as a part of marketing but these consequences and the effects are not discovered in all aspects, especially when we are talking about CRM in a technical way as an information system. One important goal of such a Sustainability CRM has to be the modification of customer behaviour towards a more sustainable consumption according to the above mentioned approach of sustainability marketing. One contribution of a Sustainability CRM could be in this context to identify customers who are open for sustainable offers and who are suited to a certain offer.

So the approach described in this work is located in the intersection of the three main research fields of mobility, sustainability and CRM (Figure 1) and tries to show a solution to support a sustainable mobility with Sustainability CRM as an accelerator.

FIGURE 1
Intersection of Mobility, CRM and Sustainability



At the end a case study will be introduced within an academic ICT project that develops an agent-based application that provides sustainable mobility services to customers via a smart phone app or/and a website. An integrated CRM-System uses these data to analyse them and to provide (based on customer segmentation according to customer preferences) sustainable offers for specific target groups to modify their mobility behaviour towards more sustainable travel.

MOBILITY

Mobility in the meaning of mobility of persons who are moving from A to B has a strong connection to sustainability because depending on the mean of transport (e.g. train or car) the impact on resource consumption, environment and global climate is different. Changing our mobility behaviour has a huge potential to support a more sustainable lifestyle (Black, 2010). A definition for sustainable mobility is given by the mobility report 2001 prepared for the World Business Council for Sustainable Development: Sustainable mobility is *"the ability to meet the needs of society to move freely, gain access, communicate, trade and establish relationships without sacrificing oth-*

er essential human or ecological values today or in the future" (MIT & CRA, 2001). For a sustainable mobility we need both the potential of new technologies and a bevaiour change to avoid ecological damage while ensuring economic efficiency and quality of life (Schade *et al.*, 2011).

Electric Mobility

Actually we recognise a big hype about electric mobility and different branches are working on creating new markets for EVs like car manufacturers and energy companies. The beginning shortage of oil and the impact of combustion engine cars on air pollution in cities and on global climate by CO_2 emissions led to the need for alternatives for conventional cars. Especially when we are looking at emerging markets like China or India it is doubtful whether our western patterns of car usage will work in the long term. Also it has to be considered if just using EV's instead of conventional cars would solve these problems (Weidlich, 2009; Brake, 2009).

At first view many of the problems seem to be solved by EV's. Air pollution in cities doesn't occur with EV's. But air pollution itself is still a topic. This depends on the way of production of electric power that is needed for using EV's. If we are using coal-burning power plants there is no pollution directly caused by the car but indirectly by power production. This is also the case for CO_2 emissions. So the reduction of CO_2 emissions by the use of an EV compared with a combustion engine car in a well-to-wheel analysis depends on the power production mix (EPRI, 2007). There is a big discussion about how strongly the use of EV's reduces CO_2 emissions compared to the use of combustion engine cars. For example Greenpeace is criticising that reduction of CO_2 emissions by the use of EV's is much smaller than proclaimed from car manufacturers and energy suppliers (Totz, 2008). The concrete values of the reduction are very different between related studies and influenced by the chosen power-mix and vehicle types (small or big cars, diesel or gasoline etc.) that are compared. Still it is indisputable that EV's give at least the chance for a significant reduction of air pollution and CO_2 emissions.

When we have a look at the vehicle itself and the resources, we need to build it, there is no big difference between conventional cars and EV's. When we have a look at resources like lithium the resource consumption by an EV is even bigger than by a conventional car, because of the accumulator (Notter *et al.*, 2010).

According to the moving and usage characteristics there is still a big gap between EV's and combustion engine cars. This comes from the accumulator of EV's that only allows driving a short distance compared to conventional cars. Also time for recharging the battery is still quite long, so flexibility is much smaller. There are already existing technical concepts to reduce this gap, e.g. with the swapping-station system for batteries by Better Place, but the infrastructure is expensive and does not exist today (Wagner vom Berg *et al.*, 2010). When we have a look at the moving behaviour this problem seems bigger than it is in reality. Most of the trips especially when we are looking at bigger cities lie in a range that can be done by EV's. But at the end we have to admit, that under the actual technical circumstances, EV's can't substitute combustion engine cars 1:1 and they have to be combined with other means of transport (Weidlich, 2009).

Another reason for new car-substituting-concepts is the changing significance of driving a personal car. This significance has changed besides other reasons because of shorter innovation and usage circles for cars and a changing mobility behaviour (e.g. large-scale and small-scale mobility can be done with different transport means) (Schade *et al.*, 2011). The car is still important as a lifestyle object but especially for younger people other objects like mobile phones are getting more important. Less young people own their own car and especially in larger cities they use alternative means of transportation like public transport. In Japan a new phrase for this has already been coined: "*Kurumabanare*" which means "*going away from motorisation*" (Weidlich, 2009).

Electric mobility offers the chance for introducing new business models and also the participation of new market players besides car manufacturers (Arnold, 2010) to break up with old concepts of individual mobility both concerning the supply by the providers and the use by the customers. Here is a big opportunity to change mobility behaviour under the criteria of sustainability.

Intermodal Mobility

One aim according sustainability of combined mobility is the reduction of CO_2-emissions by obtaining synergy effects by combining different means of transport (Seidel, 2010). Intermodal transportation means the transportation of people or goods by more than one form of carrier during a single journey. Multimodal transportation is the more general term and describes the use of

several transportation means as well for different trips as within a single trip. Intermodal transportation is not a new topic, e.g. the USA passed already in 1991 the Intermodal Surface Transportation Efficiency Act (ISTEA).

Within the creation of new business models for multimodal mobility so far in practice not sufficiently accepted concepts (e.g. Car sharing) could be integrated into a service that is attractive to customers. These different services can be offered by one provider within one contract e.g. similar to a contract for mobile communication (Weidlich, 2009) where the EV and the infrastructure are included. The centre of attention is no longer the supply of a vehicle, but the supply of services for mobility (Landmann *et al.*, 2009). This creates possibilities for custom-made and sustainable offers to the customer for his/her individual mobility requirements. For the market penetration by such new business models the customer acceptance and the customer satisfaction are crucial.

One main problem within intermodal mobility is that planning an intermodal trip is usually complicated and takes a lot of time (Seidel, 2010). The vision of a sustainable mobility based on intermodal mobility of the Fraunhofer ISI includes information services for mobile devices that provides fast information about the fastest, cheapest and most sustainable means of transport and guide the customer using the best alternative. This could be a car-sharing-service, public transport etc. (Schade *et al.*, 2011).

SUSTAINABILITY

The usually quoted definition for sustainability is that of the Brundlandt commission (1987) "*Sustainable development is development that satisfies the needs of the present, without removing the ability of future generations to meet their own needs*" (Hauff, 1987). This definition makes clear that sustainability means more than a long-term protection of profits and enterprise maintenance. Sustainable management means to act resource-protective and to take further goals from the social and also the cultural range into focus. These goals can quite contradict profit-oriented goals (Müller-Christ & Hülsmann, 2007). To classify the dimensions of sustainability the three pillars of sustainability according the Lower German House of parliament can be used: ecological dimension, social dimension, financial (economical) dimension (Deutscher Bundestag, 1998).

To support sustainability in the different dimensions there are three strategies that has to be combined for an overall strategy:

- Consistency: adjustment of the material flows and the energy production to natural circuits by independency or total integration of production circuits into natural circuits to avoid damages to natural circuits.
- Efficiency: minimisation of material and energy consumption by increasing resource productivity with intelligent using concepts and technological advancements.
- Sufficiency: reduction of consumption and adjusting it to resource and production capacities in terms of sustainability. (Huber, 2000)

For companies this means that they have to accomplish more than just satisfying the needs of their customers. They have to assume ecological and social responsibility. It is not enough to avoid or to diminish external effects but they must also work on solutions for essential problems (Bookhagen, 2001). This maxim leads directly to a fundamental change of scope and concepts in marketing and especially in CRM.

CRM

> "We want a company that focuses on nothing but serving the customer."
>
> – Jack Welch, CEO General Electric Company

Customer Relationship Management is one major part of customer based management of Companies. One most important goal is thereby to create economic success over influencing the quantity, quality and duration of customer relations (Hippner & Wilde, 2006). A definition of CRM reads as follows: "*CRM is a customer-oriented enterprise strategy, which tries with help of modern information and communication technology, to develop and strengthen profitable customer relations in the long term by holistic and individual marketing, sales and service concepts*" (Hippner & Wilde, 2002). The term CRM names the strategy and the software (often also eCRM or CRM-system). Within the customer-oriented strategy CRM is a central component to reach the classical company targets, enterprise maintenance and economic success (Kaiser, 2005). The term of sustainability in combination with CRM is mostly used in the context of a sustainable customer relation in sense of a long-term relation (Homburg, 2008). Long-term is usually interpreted as long-term profitable.

CRM is an essential part of marketing. The aim in the classical marketing theory is selling or purchasing in a market with the instruments of the 4P's of the marketing-mix: Product, Price, Place, Promotion. (McCarthy& Perrault, 1975) In the following we are looking at two alternative marketing approaches that are taking sustainability into account instead of just economic values.

Green Marketing

Green marketing is a very important approach in the area of integrating sustainability into marketing since end of the 80's. The actual "Green Marketing Manifesto" from Grant (Grant, 2007) is providing a precise vision for Green Marketing and provides three levels:

a) Green-setting new standards – communicate: having commercial objectives only (where the product, brand or company is greener than alternatives, but the marketing is straightforward about establishing the difference). Eco-Labeling is an important instrument within this approach
b) Greener – sharing responsibility – collaborate: having green objectives as well as commercial objectives (the marketing itself achieves green objectives, for instance changing the way people use a product)
c) Greenest – supporting innovation – cultural reshaping: having cultural objectives as well (making new ways of living and new business models normal and acceptable). IT and especially Web 2.0 are seen as enablers for new business models in the market, e.g. by offering a service for video conferences that makes people travel less. Another mentioned example for alternative c. is to launch a scheme to enable people with a green car - that don't use it to much - to lend, to rent, to share or to co-own the car with other people

Sustainability Marketing

Green marketing is focusing on environmental aspects (Belz & Peattie, 2009). In contrast to that sustainability marketing keeps social, environmental and economical aspects in mind. The managerial approach of sustainability marketing according to Belz and Peattie takes the intersection of socio-ecological problems and consumer wants as the basis for all companies' activities in marketing (values and objectives, strategy, marketing mix, marketing trans-

formation) that have to be adapted to sustainability. Sustainability Marketing applies planning, coordination, enforcement and control of all market and non-market transaction activities for prevention or decrease of ecological and social problems. The aim is to reach company goals by satisfying the needs of actual or potential customers with the use of competitive advantages and assurance of societal legitimacy (Kirchgeorg, 2002).

Sustainability CRM

The previously described marketing activities can be supported by CRM on a strategic level and on a system level. The linkage from both Green marketing and Sustainability marketing to CRM is still missing attention and there are only a few works that address this linkage.

One important goal of a Sustainability CRM is leading the customer towards more sustainable behaviour. This requires the possibility of influencing the customer by CRM. Kantsperger (2006) describes techniques to influence customer behaviour on the basis of learning theory, instrumental conditioning and model learning by using mechanisms of reward and punishment. The keyt consideration is that *"Unprofitable Customers are not bad customers, but they are not profitable, because corporate strategy and the ways of customer care are allowing non profitable customer behaviour. Customer profitability is always a function of design of customer relation and customer behaviour can be influenced in various ways."* (Rapp, 2000).

This sentence includes several interesting implications. First of all, customer behaviour can be influenced by CRM. Corporate strategy and customer care are important factors. If the corporate strategy includes sustainability-related goals, CRM might be an instrument to influence the customer behaviour in a more sustainable direction. The word modification in this context implies that not only a one-time influence but also a long-term change of customer behaviour is possible. Differentiation and individualisation are important aspects to build an intense and intelligent customer relation that is characterised by principles of a 'learning relationship' (Kantsperger, 2006). So it is crucial to consider the characteristics of the customer to find and apply the most effective marketing activities for different groups of customers. This leads to the field of customer segmentation.

In CRM the offers to customers are determined, among other procedures, by target group planning. So customer groups have to be identified, which are open for sustainable offers. Already existing works try to profile

green customers e.g. by socio-demographics (Diamantopolous *et al.*, 2003) to identify relations between demographic data and environmental awareness. A similar approach is to segment customers by psychographics. There are several studies that relate psychographics with ecological consumer behaviour (Straughan & Roberts, 1999). In many cases segmentation by psychographics is more profound than by demographics, but it is also much more complex to get psychographic data about (potential) customers.

In addition to this CRM offers chances to present the company efforts and activities in sustainability to the customer.

Taking sustainability into account of CRM means also changes to the CRM database. Sustainability data has to be stored and analysed (e.g. energy consumption, CO_2 emissions etc.). This sustainability data can appear in many different contexts (mobility, energy, pollution etc.) and has do be understood and transformed to knowledge and actions. Ontology's (formal, explicit specifications of a shared conceptualisation) can help to describe the context and to support the analysing process.

In the end there are also possibilities to make the technical CRM process itself more sustainable e.g. by electronic mailing instead of paper mailing or using CRM software in a cloud. This technical focusing on energy and resource efficiency is also called Green CRM and already described by technical experts in the SAP and Microsoft area (Ehrenberg, 2010).

CASE STUDY: JINENGO

Background

Jinengo is the name of an academic project of Carl von Ossietzky University Oldenburg, department of Business informatics. The name derives from the Chinese words '*Jieneng*' what means 'saving energy'. The goal of the project is the creation of a software application for sustainable and intermodal trip-planning that is also named Jinengo. The application is connected to a standard CRM-System.

Application

The application offers the user a comfortable way to plan all trips (daily trips, vacation trips, business trips etc.) about a smart phone. The user will set parameters for the trip (destination, date, time) and preferences (costs, comfort, flexibility etc.) and as a result gets back different possibilities with different

means of transportation for the trip. The following means of transport are planned to be included as a first step: train (Deutsche Bahn), public transport, car-pooling (e.g. car2gether), car-sharing (e.g. car2go) and the personal car (electric or conventional car).

For every single combination the user gets information about costs, sustainability and further information. The sustainability is expressed in CO_2 emissions and energy consumption. Also other information e.g. the weather will be integrated and considered in the suggested alternatives. The user is then able to choose according to his preferences and according to sustainability. To provide the necessary information the application will use already existing services for the offered means of transportation (e.g. from Deutsche Bahn) and CO_2 calculators for car emissions (e.g. OPTIRESOURCE by Daimler AG). In a further step also a booking option can be included. The adaptive application is based on a SOA-architecture with mobile software agents (Memari *et al.*, 2010) that also can be developed by third party developers or even by the user. For providing the necessary information the application can encapsulate and use already existing (web) services. User feedback and usage is leading (automatically) to adaptation of the software in an evolutionary way, survival of the fittest (best service). Keeping diversity will enable the application to reduce risk e.g. of a biased evaluation of CO_2 emission by averaging different sources.

CRM Integration

The application will be connected to a standard CRM-system to provide user and usage data to the CRM database. The user model (user information, preferences etc.) and ontology's (travel ontology, user ontology etc.) will be stored in the CRM database. Furthermore dynamic data (travel requests, comments etc.) are stored in CRM. All these data will be analysed to find out user patterns and to do customer segmentation. In the following section an example is given:

To make customer travel more sustainable, alternative means of transport must be identified (e.g. train) which are more sustainable to the preferred means of transport (e.g. car). There are some important variables that are considered in this context:

- Actual preferred means of transport
- Availability of the alternative means of transport

- Travel distance
- Travel frequency
- Travel preferences (comfort, costs, flexibility...)

To apply different marketing activities e.g. a mailing campaign by e-mail we have to identify users with similar variables. Then we can make this group of users a specific offer according their preferences. To get deep knowledge from the data BI Tools are integrated to apply methods like data mining, OLAP or also Fuzzy Logic (Meier & Werro, 2007). The Entity Relationship Model (ERM) of the CRM-System is modified to store data with sustainability aspects and to use different ontology's. The goal is to modify the architecture and to create processes that allows to support and to lead the customer to a more sustainable way of moving.

Consideration of Business Models

To bring Jinengo to market there are different business models conceivable. As a first option it is possible to use Jinengo as a customer front end to provide a service of multi-modal mobility that includes the use of different offered means of transport. Here the customer pays for the transport services he uses for his trips provided after criteria of sustainability. In this case there still can be a trade-off between sustainable goals and profit goals because the most sustainable offers don't have to be the most profitable ones for the provider.

A second option is to offer Jinengo as a pure information service where the user can get the necessarily information for his sustainable trip-planning. The user pays e.g. for the single trip-planning transaction or only for premium services. The service could also be financed by advertisement like e.g. Google. In this case there is no connection between the chosen mean of transport and the profit of the provider and so no trade-off exists.

A third option that also can be included in option one or two is to sell the generated user and usage data to mobility providers like Deutsche Bahn. The providers can gain profit from this data by using it for their CRM/marketing and they can adjust their services and products to the preferences and needs of the customers.

The second and the third option are already used in the web 2.0 area very successfully (e.g. Twitter, Google, Facebook etc.)

CONCLUSION AND OUTLOOK

To bring EVs to a mass market they have to be combined with other means of transport. This affords the chance for new business models and for a serious change in our mobility towards more sustainable options. Intermodal mobility services with information about sustainability already exist e.g. as is offered by the German railway company Deutsche Bahn. Deutsche Bahn offers not only travel planning for rail journeys but also sustainability information (CO_2 emission comparisons between train and car) and intermodal services like car-sharing and bike-rental. But still Deutsche Bahn is only one provider with a limited offer that is not able to cover the mobility needs of the people in a holistic way. Sustainability plays a role but it is not an initial motivation for the business which still has profit oriented goals. Looking at the presented levels of Green marketing the services from Deutsche Bahn, according to sustainability, could be classified on level a (green – setting new standards – communicate). To generate a serious change towards a more sustainable mobility much more is necessary. New offers and business models have to be presented from the company side and perhaps much more importantly: people have to be motivated and have to be willing to move more sustainably. This is also the responsibility of the companies. Marketing and especially CRM seem to be important instruments in this process. But the example Deutsche Bahn shows that mobility providers are working serious on solutions that are located in the area that is addressed by this work. Jinengo could be a useful framework to evaluate these ideas seriously.

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3

Traffic Planning and Administration Modelling Using the Computer

Stasys Puškorius

INTRODUCTION

Numerous authors have investigated different situations of traffic planning and administration, for example: Demeulemeester and Herroelen (2002); Gordon *et al.*(1990); Qian & Zhen-Hua (2010); Barkley (1994); Spinner (1992); Badiru (1993); Harrison (1992); Busch (1991); Randolph & Barry (1992); Puškorius (2009); etc.

Traffic administration encompasses a number of problems. Two of which are analysed in this article, namely: the identification of an optimal solution for delivering goods from multiple storage facilities to diverse customer groups; and the optimisation of planning procedures at different traffic administration levels.

IDENTIFICATION OF AN OPTIMAL SCHEDULE FOR DELIVERING THE GOODS

Problem Formalisation

The problem of goods delivery is formulated as follows.

Suppose there are 4 storages (S_1, S_2, S_3, S_4) and 5 customers (V_1, V_2, V_3, V_4, V_5).

There are particular resources of customer interest in every one of the storages: a_1= 45, a_2= 20, a_3 = 55, a_4 = 50. The total amount of given resources in all storages equals 170 units.

Every customer needs: b_1= 20, b_2= 20, b_3 = 30, b_4= 40, b_5= 60 units of these goods. It is called customer applications.

We should satisfy all applications and achieve the minimal total costs of goods delivery to all customers, i.e. to arrange an optimal schedule for goods delivery.

Solution: at first it is essential to find out the costs of delivery of one unit of goods from a particular storage to a particular customer. To achieve that aim we evaluate the distance between storages and customers, type of transport, delivering time and other factors. Let us say, that after given evaluations, we have calculated the necessary costs of delivering one unit of goods from a particular storage to a particular customer - c_{ij}. Here index i explores the serial number of a storage and index j – serial number of a customer. Suppose the costs of delivering one unit of goods to a particular customer are explored in **Table 1**.

The amount of goods transported from storage S_i to customer V_j we indicate as x_{ij}. In this particular case the amount of variables equals 20 (4X5).

We should identify, which of the goods' delivery schedule is the cheapest one, i.e. optimal values of given variables should be defined.

It means that we should minimise the given function:

$$L = \sum_{i=1}^{4} \sum_{j=1}^{5} c_{ij} x_{ij}.$$

TABLE 1
The Costs of Delivering One Unit of Goods (coefficients c_{ij})

	Coefficients c_{ij}				
Storages	V_1	V_2	V_3	V_4	V_5
S_1	c_{11}=10	c_{12}=6	c_{13}=7	c_{14}=8	c_{15}=5
S_2	c_{21}=8	c_{22}=7	c_{23}=9	c_{24}=4	c_{25}=4
S_3	x_{31}=10	c_{32}=9	c_{33}=7	c_{34}=6	c_{35}=5
S_4	c_{41}=4	c_{42}=5	c_{43}=6	c_{44}=10	c_{45}=8

Variables x_{ij} should correspond with two groups of requirements:

- Total amount of delivered goods from every storage should not exceed resources in a particular storage, i.e. the following inequalities should be correct:

$$x_{11} + x_{12} + x_{13} + x_{14} + x_{15} \leq 45,$$

$$x_{21} + x_{22} + x_{23} + x_{24} + x_{25} \leq 20,$$

$$x_{31} + x_{32} + x_{33} + x_{34} + x_{35} \leq 55,$$

$$x_{41} + x_{42} + x_{43} + x_{44} + x_{45} \leq 50.$$

- Total amount of delivered goods from all storages to every customer should correspond to the particular application:

$$x_{11} + x_{21} + x_{31} + x_{41} = 20,$$

$$x_{12} + x_{22} + x_{32} + x_{42} = 20,$$

$$x_{13} + x_{23} + x_{33} + x_{43} = 30,$$

$$x_{14} + x_{24} + x_{34} + x_{44} = 40,$$

$$x_{15} + x_{25} + x_{35} + x_{45} = 60.$$

We apply the 'Northwest Corner' method (Puškorius. 2009) to find out a feasible (primary, one of those possible) solution on the schedule. The given schedule is explored in **Table 2**. The preparatory stage is finished.

TABLE 2
Feasible Goods Delivery Schedule (values of x_{ij} variables)

	Variables x_{ij}					
Storages	V_1	V_2	V_3	V_4	V_5	**Resources**
S_1	x_{11}=20	x_{12}=20	x_{13}=5	x_{14}=0	x_{15}=0	45
S_2	x_{21}=0	x_{22}=0	x_{23}=20	x_{24}=0	x_{25}=0	20
S_3	x_{31}=0	x_{32}=0	x_{33}=5	x_{34}=40	x_{35}=10	55
S_4	x_{41}=0	x_{42}=0	x_{43}=0	x_{44}=0	x_{45}=50	50
Applications b_j	20	20	30	40	60	170

Problem-Solving

We utilise an Excel programme. As far as we have even 20 variables, it is recommended to mark up the cells entered with primary data and those with optimal variable x_{ij} after the problem-solving:

- ✓ Cells C1:V1 are filled in with symbols of variables x_{ij}.
- ✓ Cells C2:V2 are filled in with particular values of variables x_{ij}
- ✓ Cells C3:G6 are filled in with values c_{ij} of particular coefficients:

TABLE 3
Distribution of Variables x_{ij} in Cells

	C	D	E	F	G	H	I	J	K	L
1	x_{11}	x_{12}	x_{13}=5	x_{14}	x_{15}	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}
2	20	20	5	0	0	0	0	20	0	0
	M	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**
1	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}
2	0	0	5	40	10	0	0	0	0	50

TABLE 4
Distribution of Coefficients' c_{ij} Values in Cells

	C	D	E	F	G
3	10	6	7	8	5
4	8	7	9	4	4
5	10	9	7	6	5
6	4	5	6	10	8

- ✓ Cells A3:A11 are filled in with values of: 1) resources: A3 – 45, A4 – 20, A5 – 55, A6 – 50; and 2) of applications: A7 – 20, A8 – 20, A9 – 30, A10 – 40, A11 – 60.
- ✓ Cells B3:B11 are filled in with formulas of marginal requirements: Resource-related formulas (cells B3:B6):

Cell B3: =C2+D2+E2+F2+G2; (Figure 45 appears)
Cell B4: =H2+I2+J2+K2+L2; (Figure 20 appears)
Cell B5: =M2+N2+O2+P2+Q2; (Figure 55 appears)
Cell B6: =R2+S2+T2+U2+V2; (Figure 50 appears)

Applications-related formulas (cells B7:B11):

Cell B7: =C2+H2+M2+R2; (Figure 20 appears)
Cell B8: =D2+ I2+N2+S2; (Figure 20 appears)
Cell B9: =E2+J2+O2+T2; (Figure 30 appears)
Cell B10: =F2+K2+P2+U2; (Figure 40 appears)
Cell B11: =G2+L2+Q2+V2. (Figure 60 appears)

Cell W2 is filled in with equation of the destination function:
=C2*C3+D2*D3+E2*E3+F2*F3+G2*G3+H2*C4+I2*D4+J2*E4+K2*F4+L2*G4+M2*C5+N2*D5+O2*E5+P2*F5+Q2*G5+R2*C6+S2*D6+T2*E6+U2*F6+V2*G6.

Just after the entering of given equation figure 1260 appears.
We turn on the solution mode: Solver. The following actions are performed in the dialogue box:

- ✓ Set Target Cell: W2 (highlight cell W2).
- ✓ Mark Min as we want to minimise the destination function.
- ✓ By Changing Cells: C2:V2 (reference to all variables).
- ✓ Add (references to marginal requirements):

Cell Reference: B3:B11 (references to formulas of marginal requirements); = (all marginal requirements have "equal" sign); Constraints: A3:A11 (references to cells with free terms of marginal requirements); OK.

- ✓ Add (references to meet the requirements of all non-negative variables):
- ✓ Cell Reference: C2:V2; >=; 0; OK.

Add (references to meet the requirements of all integer-number variables): Cell Reference: C2:V2; Integer; OK.

- ✓ Solver / Keep Solver Solution; OK.

The solution we figure out as following:

L=880,
$x_{12} = 15$, $x_{13} = 5$, $x_{15} = 25$, $x_{24} = 20$, $x_{34} = 20$, $x_{35} = 35$, $x_{41} = 20$. $x_{42} = 5$, $x_{43} = 25$.

The optimal schedule of goods delivering is as follows: from the storage 1 we should transport 15 units of the goods to the second customer, 5 – to the third, 25 – to the fifth; from the storage 2 we should transport 20 units of goods to the fourth customer; from the storage 3 we should transport 20 units of goods to the fourth customer and 35 to the fifth customer; from the storage 4 we should transport 20 units of goods to the first customer, 5 – to the second and 25 – to the third. In given case the total costs of the goods delivering would be 880 LT. The cost of primary schedule for the goods delivering was 1260 LT. Consequently we save over 43 percent of means.

Through any changes in the starting conditions, the optimal solution is obtained very easily – just after entering new data. This is especially useful when there is a need to take into account constantly changing situations.

NETWORK PLANNING

The second problem to be solved is the planning process as a whole. There are three main forms of plans: textual, Gantt chart and network plan. Hereinafter analysed network planning is the most advanced from the recognised plans. Network planning has several advantages: it helps to use material, human and other resources better; highlights the problem of interaction between the particular jobs; provides weaknesses of the particular project part and manager position and thus management becomes more efficient (Puškorius, S. 2009).

While planning a complex work, we have to deal with these challenges: how to allocate material resources and employees for simple job performance; when to start and finalise every activity; what kind of difficulties could be met trying to finalise the simple activity in time and how these difficulties could be eliminated. Network planning could be divided into several stages: creation, analysis, optimisation and application. Network planning is based on the activity list with emphasised elementary or simple activities, their duration, interactions and particularly attributed indexes.

Suppose, we have the precedence relationship chart shown in **Table 5**:

TABLE 5
Precedence relationship chart

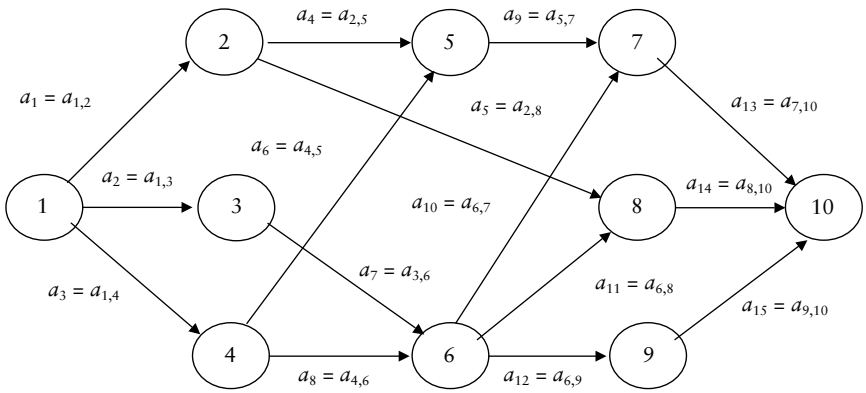
Activity	Estimated completion time, days	Immediate Predecessor	Activity index (for the Computer)
a_1	7		$a_{1,2}$
a_2	8		$a_{1,3}$
a_3	10		$a_{1,4}$
a_4	12	a_1	$a_{2,5}$
a_5	14	a_1	$a_{2,8}$
a_6	16	a_3	$a_{4,5}$
a_7	20	a_2	$a_{3,6}$
a_8	15	a_3	$a_{4,6}$
a_9	13	$a_4; a_6$	$a_{5,7}$
a_{10}	17	$a_7; a_8$	$a_{6,7}$
a_{11}	25	$a_7; a_8$	$a_{6,8}$
a_{12}	21	$a_7; a_8$	$a_{6,9}$
a_{13}	16	$a_9; a_{10}$	$a_{7,10}$
a_{14}	14	$a_5; a_{11}$	$a_{8,10}$
a_{15}	21	a_{12}	$a_{9,10}$

Creation of the Network Plan

Under above given precedence relationship chart the network chart is created (**Figure 1**).

After network plan creation we calculate its parameters: earliest finish of the events, latest finish of the events, reserves in the events, reserves in activities, critical path, and critical activities. This is already the second-stage activity of network planning.

FIGURE 1
Primary Network Chart



Network Plan Analysis

The main aims of the analysis are: to find the critical path and reserves in all activities and events. Activities situated on the critical path are called critical activities. These activities are at top importance as the final result of whole activities' complex depends on them. These activities should be precisely started at the time the previously implemented activities end. In other words, these activities can't be delayed or finalised later than planned, whereas other activities may have a time reserve. It is therefore that critical activities should be under precise manager's supervision and actions should be taken if there is a risk that they will not be started in time or continue longer.

Accordingly, the critical path is also known as the most vulnerable place in the plan. The answers to these and other planning issues are related to the quite intensive analysis, though requiring simple, but large-scale computing.

This analysis becomes easy and enjoyable, even if it is performed by means of a computer. However, it is necessary to develop the particular program; the technique of it is explained hereinafter.

The proposed technique consists of several stages.

At first, the analysis model for network schedule is developed. The algorithm of this model consists of 6 parts: data preparation, calculation of

events' early finish, calculation of events' late finish, estimation of events' reserves, estimation of activities' reserves, critical activities and critical path identification.

Data preparation is performed under the following actions:

- We activate Excel programme and select the data set order. Each simple activity is one line. The column value is indicated in the last (16) line (see **Table 6**)
- It is purposeful to change simple activities' indexes (see **Table 5**, last column) and enter them in column B
- In Column C we enter the duration of activities.
- In column A we enter symbols of particular activities that must be carried out before (see **Table 5**, column 3)

The early finish time of the event is calculated using the following formula:

$$T_{Ak} = \max_i (t_{ik} + T_{Ai}),\ k = 2,3,...n, T_{A1} = 0. \quad (1)$$

TABLE 6
Network Plan Parameter Values Calculated Using the Computer

Row No.	A	B	C	D	E	F	G
1		1;2	7	0	0	0	22
2		1;3	8	7	29	22	0
3		1;4	10	8	8	0	3
4	$a_{1,2}$	2;5	12	10	13	3	22
5	$a_{1,2}$	2;8	14	26	41	15	35
6	$a_{1,4}$	4;5	16	28	28	0	15
7	$a_{1,3}$	3;6	20	45	54	9	0
8	$a_{1,4}$	4;6	15	53	56	3	3
9	$a_{2,5};a_{4,5}$	5;7	13	49	49	0	15
10	$a_{3,6};a_{4,6}$	6;7	17	70	70	0	9
11	$a_{3,6};a_{4,6}$	6;8	25				3
12	$a_{3,6};a_{4,6}$	6;9	21				0
13	$a_{5,7};a_{6,7}$	7;10	16				9
14	$a_{2,8};a_{6,8}$	8;10	14				3
15	$a_{6,9}$	9;10	21				0
16	$a_{i,j}$	*a*	Duration of activity	*Tak*	*Tvk*	Rak	Rtij

Where T_{Ak} – an early finish time of the event with number k; the early finish time of the first event always equals zero. It symbolises the beginning of the activity, which is linked to a specific calendar date after the analysis and optimisation of a network schedule; i – values of previous events and activities directly related to the event k; n – total number of events.

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We fill in column D with corresponding formulas obtained by linking the formula (1) indexes with concrete activities and events. We enter 0 in the first line, as stated in the formula.

In the second row of column D, we enter the formula $T_{A2} = t1,2 + T_{A1}$, i.e. =SUM (D1; C1). Number 7 appears. We perform similar actions in cells

D3, D4 and D9. We do not look for the maximum in these cells, as these events depend only on one activity.

The rest of events depend on two or three activities. The neighbour cells of the event row we fill in with formulas, related to a single event affecting particular activity, other neighbour cells - with other, until all incoming events in the particular given activities are described. For example, the sequence of actions for calculations of the earliest finish time of the fifth event is as follows: we highlight cell E5, and enter the formula: =MAX (SUM (D2; C4); SUM (D4; C6)). Number 26 is explored.

The calculated earliest finish time of every event is explored in cells D1:D10 (see Table 6, column D). The latest finish time of the event is calculated using the following formula:

$$T_{vk} = \min_j (T_{vj} - t_{kj}),\ j = n,n-1,...,2;k = n,n-1,...,1, \tag{2}$$

Where j – values of later events and activities directly related to the event k.

The earliest and latest finish time of the events coincides, i.e. the following formula is true:

$$T_{vn} = T_{An}. \tag{3}$$

We fill in the column E with corresponding formulas, derived by linking indexes of formulas (1) and (3) to concrete activities and events.

Actions need to be started from the last event, because formula (3) enables the simple calculation of the late finish time of the final event; afterwards we usually work backwards through the numbers' of the events.

In the given example in cell E10 we enter the formula =D10.

Other cells we also fill with corresponding formulas, derived from the formula (2), e.g. cell E6 we fill in with formula: =MIN (SUM (E7;-C10); SUM (E8;-C11); SUM (E9;-C12)).

The reserves of events are calculated using the following formula:

$$R_k = T_{vk} - T_{Ak}. \tag{4}$$

Column F we fill with corresponding formulas, obtained by linking the indexes of formula (4) to concrete events.

The reserves of activities are calculated using the following formulas:

$$R_{aij_{ij_ij}} = T_{Vj} - T_{Ai} - t_{ij} \quad (5)$$

Column G we fill with corresponding formulas, obtained by linking the indexes of formula (5) to concrete events, e.g., the reserve of activity a1 is calculated by entering the formula =SUM(E2;-D1;-C1) in the first row of column G. Similar actions are performed in all other cells in column G.

Critical activities and events are detected very simply – their reserves should equal zero.

Critical events (see values in column F): 1, 3, 6, 9, 10, critical activities (see values in column G): 2, 7, 12, and 15.

The critical path connects all the events and activities for which reserves equal zero.

The calculating procedure of the network plan parameters is especially required in the distribution of various resources, including human resources, in examining possible ways of fulfilling particular projects, to identify the start and end dates of particular projects, also in case of unforeseen circumstances. Consequently the proposed computer-based technique for calculating these parameters is immediately vital for achieving effective management of any project, including traffic planning and regulation issues and other problems.

This technique is particularly necessary for optimisation of various plan types. Respecting the article restrictions, further analysis of network planning optimisation techniques is required. More detailed analysis related to the network plan transformation into a Gantt chart format would significantly simplify the practical application of the network plan, but is not presented here, for this methodology see Puškorius (2009).

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Chapter Conclusion

Following the Kyoto agreements in December 1997 and negotiation in Copenhagen at the end of the first decade of the new millennium, the European Union has expressed its will to reduce CO_2 emissions by 20% by 2020. The Energy – Climate plan goes much further: share of renewable energy by 20% and reduction of energy consumption by 20%.

One of the key issue today in European transport policy deals with the challenge of greening activities through a better allocation of resources and a massive jump in a new social and industrial system and new production – transportation – consumption relations.

So the main action plan is at the crossroad energy / mobility / transport. This chapter is showing interesting experiences, from different points of view, in this direction.

One key point is a link between all contributions: there is a need of regulation (Bohas and Bouzidi, p.167), a need of building common indicators (Wagner vom Berg, p.177; Puskorius, p. 187), accepted by all. Economic crisis in this beginning of 2011 is unfortunately not totally behind us and mobility program and transport can play a key role in the "re-launching" of the economy and demand.

Facing this situation, the European environmental policy is ambitious: the main goal is promoting an efficient transport system for increasing the competitiveness of the European economy – jobs and growth are behind this policy and at the same time a sustainable development towards a more envi-

ronment friendly transport activities. Today 25 % of CO_2 emissions are linked with transport.

The E.U. strategy on green transport is mostly based on the revitalisation of railway transport. As seen before, this transport mode plays an essential role in covering the European single market and in assuring the freedom of movement of persons and goods. This regulated market is in the process of being largely opened: it has been accomplished for railway freight transport and is largely implemented for passenger transport (the opening of the international passenger line to competition –"*cabotage*" - was activated in December 2009 on the European Level). Transport plays a crucial role in terms of sustainable development and the switch of some part of industrial activities towards green growth.

Greening IT (Bohas and Bouzidi, p.167), intermodal trip-planning (Wagner vom Berg, p.177), modeling traffic (Puskorius, p. 187), developing electric cars are now also considered as a new emerging market for industrialists even if some uncertainties remain on the side of demand: the question of the pricing of these innovations, the cost of electric vehicles for example is uncertain as these cars will mainly be dedicated to urban use (which car for inter-urban mobility?). Autonomy of batteries remains a critical issue in relation to customer satisfaction and acceptability: new services in cities for electric cars also have to be defined: car-sharing or car-pooling for community use of new electric vehicles, free services for battery charging, companies and local jurisdictions fleets, city logistics in electric urban freight vehicles,....

The European Union, reflecting the opinion of European citizens, is actively involved in promoting sustainable transport. This action is limited by the principle of subsidiarity, for example in innovation (IT, CRM, Transport...), but the output is learning from "best practices". European benchmarking analysis and recommendations has often been taken into account by local, regional and national public and private operators in improving both efficiency and sometimes equity too towards a more environmentally friendly quality of life.

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CHAPTER 5

Spatial Governance

Edited by
Jacques Comby - Valentina Tirloni

Chapter Introduction

Jacques Comby - Valentina Tirloni

Governance is a subject which is currently attracting much attention. Although much discussed, in practice governance is not always effectively applied. The aim of this chapter is to investigate the notion of governance and to give concrete examples of its application in different fields. Having first developed as a theme in the business world, the concept of governance also has close links to philosophy, although it has only recently taken on a certain philosophical value. This is linked to a loss of representativeness and the depolitisation of the treatment of public issues.

It is difficult to sum up the philosophical definitions proposed by Pierron and Dreux-Gerphagnon. What is certain is that governance has emerged in the wake of post modernity, and is closely linked to globalisation, risk society, precariousness of the environment and cultural diversity. An important area is the relationship between governance and politics, and even if this is not as yet well defined, it is still very much in evidence. The relationship with territory is quite central because governance allows citizens to participate in governmental choices and to re-establish themselves in civil society. But the relationship with territory is all the more central if we consider, as shown in the first paper, that law defines territory from the perspective of jurisdictions, but also that territory may present problems shared by other territorial configurations. The question is: how can we solve problems respecting legal boundaries efficiently? Governance should not be considered just as a theoretical or philosophical definition, but as a practical approach to every-

day life problems, connecting people and getting citizens to participate in political life and decision making concerning public issues. Klenke *et al.*'s paper is a good example of this, focusing on the interaction of water management and local climate adaptation strategies. In order to improve sustainable development of rural areas, many local stakeholders have embarked upon active participative cooperation. Dykes and water strategies management systems have produced some problems of salinisation, and these are expected to increase in the near future. This participative governance process has also been extended on a regional scale. On one hand, regional stakeholders are interested in this participative governance model and they contribute with useful knowledge about the territory. On the other, scientific expertise contributes with technical information about water behaviour.

But the link between territory and governance is also well presented by Depraz's paper on protected areas. In fact, the author stresses the fact that their management has considerably changed due to the introduction of a sustainable development paradigm and with the introduction of social responsibility. Considering protected areas as a means of preserving biodiversity and aesthetical nature, the author proposes to extend costs and benefits economic valuation to political issues, as shown by the Convention on Biological Diversity in 2004.

Social responsibility is also playing a main role in companies' activities, as shown by Mercier-Suissa. If profit used to be the first and unique priority of companies in the past, now it seems to be crucial for stakeholders to take into account the impact of companies' activities on the environment and all the possible consequences in terms of social responsibility. The relocation of production in France is an example of this new strategy, which is followed by companies in order to revamp their public image.

Nature and territory are not the main subjects of any governance systems, whether these are closely linked to political issues or not. Indeed, it seems that often cultural and social issues are not taken into account in the same way as sustainability, whereas they are part and parcel of the same thing and should be taken into consideration more seriously. Through the notions of heritage, such as sense of place and the compact city, Ritson defends the idea that sustainability can deal with economics without damaging the historical heritage in urban centres. In fact, if local businesses and innovation are improved and preserved, it's possible to have a more socially sustainable society.

Social interaction and new technologies are efficiently combined in Karatzas' paper. In fact, the increasing development of new technologies has permitted better sharing of data concerning the environment. Thus, using mobile devices, specialised and general environmental sensors and computational intelligence, the PES designed by the University of Thessalonika hopes to create a connected and integrated device able to connect people through social networks and to contribute to the decision making process aiming to improve the quality of life.

In conclusion, even if a precise definition of governance has still not been attained, we can nevertheless observe how the practice of governance is becoming useful and efficient in many different social, political and economic contexts. Governance is more than a theory: it is a continuous challenge each and every one of us has to face in order to improve civil society and to maintain a well-preserved environment.

1

From the Government of Space to the Governance of Territory: Sustainable Development's Contribution

Berenice Dreux-Gerphagnon
Jean-Philippe Pierron

ABSTRACT

If the traditional political institutions are needed to organise society and to ensure the proper functioning of the State, the centralised and pyramidal means to govern that they imply are found not sufficient to support in a fully democratic manner the new societal challenges which sustainable development aims to address. These challenges, which are at the same time social, environmental and economic, highlight the link existing between the socio-economic sphere and the ecosystem, at the level of particular territories which are emerging and structuring each other without regard to existing administrative boundaries. It is therefore by considering the actors of these new territories – through networks and meeting places in which their voices can mingle with those of politicians, experts and business leaders – that we can get the opportunity to foresee an arbitration more engaged with the ground realities. Governance – ambiguous, plural, even paradoxical notion – is the name we can give to this flexible and rhizomic way of making decisions grounded on actual places and better able to handle the issues of sustainable development.

Keywords: Governance, territory, sustainable development, expert, philosophy

INTRODUCTION

Can the values, standards, representations related to sustainable development still be supported by the traditional structures of decision-making: company management, local and regional institutions with territorial limited

liability, nation-state? Or are not we attending to the slow rise of a restructuring of the decision-making bodies, a modification of the process of deliberation and of decisions making (participatory and deliberative democracy) within a governance's logic, a reorganisation and a redistribution of the geographical, political and legal usual boundaries?

The concept of governance has often been treated previously with its ability to invent new procedures for forecasting and decision, with the emergence of a complex rationality, the transition from pyramid to network (from the exercise of power pyramidal arrangements to negotiated exercises), or even the question of the contribution and limitations of expertise in fields invaded by technology. However matters of space for the exercise of governance, implementation of measures, mobilisation of stakeholders by sustainable development, and reconfiguration of this space compared to the current traditional or institutional divisions have been hardly addressed. It is these aspects that interest us here.

GOVERNMENT OR GOVERNANCE: THE END OF POLITICS?

If political philosophy is familiar with the concepts of government and governmentality, it was unaware until recently of the notion of governance. If the word 'governance' is an old word – it is used in the twelfth century as a technical concept defining the administration of bailiwicks – it is only very recently that it has entered the vocabulary of political philosophy, meanwhile passing by the field of business. Governance thus operates a semantic renovation of a former political theme: to co-act, to decide together about realities that are committing the common world without loss of legitimacy and sovereignty. There are questioned the weakening of symbolic forms of expression of sovereignty (political representation) and the technical details of its implementation. De facto, governance arises out of a crisis of representativeness. It befalls by de-politicising the treatment of public issues. A shift from the idea of the sovereign people to that of civil society occurs then. This shift weakens the idea of representation, or rather tries to find other ways of expression. Hence governance puts oneself at the heart of the native weakness of democracy, conceived not as *"the worst regimes with the exception of all others"* but, for Claude Lefort, as a political system necessarily marked by the instability of its principle of legitimacy. And this crisis *"is the essence of democracy"* inasmuch as it is *"a regime based on the legitimacy of a debate on the legitimacy and illegitimacy"* (Lefort, 1981). This native weakness permanently

induces the risk of a capture of sovereignty either by expertise (technocracy), or by the emotion (political compassion), or by the network of influence (lobbying), or by electoral competition (a politics of parties called politics of the government). Indeed, since democracy is a political regime which creates a representation of power by 'an empty space' that belongs to no one, one understands that it calls for vigilance, at the risk of a capture of sovereignty, but also for a work on governance. This latter concept, as a semantic innovation, then records a series of shifts: governance is the government without its authoritarian dimension. In other words, a fixed and stable definition of the place where the decision and executive power focus – that is to say the government – is replaced by a more flexible, relational and rhizomatic conception of decision: governance. "*At the age of government, the State, severe guardian of unity, is an ideological guide, broadcaster of the national faith. In the era of governance, politics, drained of any finality, only serves to monitor the social game is not going too badly*" (Philippe Moreau-Defarges, 2008).

Governance would be revealing a new way of thinking public decision related to a new cultural framework and context: globalisation, risk society (Beck, 1986), the precariousness of the surrounding environment and the concern for recognition of natural and cultural diversities. Governance, before being a concept, indicates a feature of this time: the disenchantment with the traditional position of politics – waning of concepts such as sovereignty or representative democracy, government's failure – but also the expectation of a form of public decision-making which could be more plastic. Governance would thus be an appropriate category that would fill a void but would also be a blind spot: it federates especially since one does not define its content. Governance brings together the idea that it would be necessary to rethink our way of public decision-making because the context and realities it must deal with have quantitatively (scale change with globalisation) and qualitatively (extension of the responsibility with the technological risk and the complexity of situations that invalidate the fact of leaning upon an individualistic conception of the decision) evolved. This notion thus gives less to think about the essence of politics – seeking a common good – than to deal with the exercise of politics, that is to say the technical details of the decision, at the risk of a technicisation of politics. The emergence of the concept of governance in the context of a consideration given to sustainable policy of territories is therefore recent, suspect and promising at the same time.

Recent – it has appeared around twenty years ago – this concept marks the entrance into the vocabulary of political philosophy of what seems to be, at a first sight, less a concept than an opportunist term. Political philosophy in its thinking on power knows the ideas of executive power, of government and that of governmentality, but in its long tradition it ignores the idea of governance. One thinks here of the famous passage of the *Social Contract* (Book III, chap. 1) in which Rousseau defines the government as follows: "*An agent who meet* [the public strength] *and implement the directions of the general will, which serves the submission of the State and the Sovereign, which somehow makes in the public person what is in man the union of soul and body. [...] An intermediate body established between the subjects and the Sovereign for their mutual correspondence, charged with the enforcement of laws and the maintenance of liberty, both civil and political*" (Rousseau, 1762). In sum the renovation of the semantic question of the exercise of power is primarily a symptom: how to think the political decision-making and co-action when conventional models of political decision have proved to be weak. After the medical paradigm – the politician doctor and the idea of a political system that thinks the common world in terms of balance –, or the family paradigm – the political figure of the father who thinks the world as a common initial and native unit (Nation) – here is a new paradigm: the politician turned into an entrepreneur. Indeed, the idea of governance is inherited from the world of business and corporate social responsibility – the unity of the common body would come from non-hierarchical and non-centralised modes of decision within the realm of a network. But is this analogy fruitful, or is it misleading? To what extent may the corporate governance serve as a model to drive politics? Doubtlessly the category of governance is used at many levels, from local to global, as well as in countless sites. But one uses it as a political category while it is apolitical.

The category of governance is also a suspect category because the multiplication of its occurrences – political, diplomatic, and associative, etc. – indicates a passion for new organisational models of decisions related to the transformation occasioned by the technological civilisation (roles of the expert, integration of the long time in the consequences of our decisions, subsidiarity). But one will notice that this category is even more mentioned although it is little or not defined. Governance is a variable category that deliberately blurs the place of the decision. The development of this concept as a political category is all the more intriguing as it is apolitical, having started its contemporary path in the market sphere. Governance is used for coordina-

tion and bargaining, as well as in the management of large companies. It stems from a technocratic logic focused on efficiency. It is considered as a democratic innovation, while its political legitimacy is uncertain and while it is decoupled from popular sovereignty and citizenship. "*Governance is below politics and results from social interactions. It does not take into account the specificity of political power and operates in a very little transparent way. It is responsible for the organised interests who participate to it. [...] Governance is an auxiliary tool of the government and certainly not a term interchangeable with it. However, it could be used to assist the government in some of its functions, such as coordination of private interests and resolving conflicts between them in public spaces*" (Kazancigil, 2010).

A risk is therefore watching out for a too great promotion of governance that would like to replace the idea of government. This risk consists in the belief that dispensing with the idea of representative democracy in order to pass to post-democracy would lead to direct democracy with not a single loss of sovereignty and legitimacy. This problem is the quintessential political problem: that of the questioning of the institution as a set of structures which have been established in order to organise society and to ensure the proper functioning of the democratic State (Savadogo, 2003). Rousseau was already familiar with the problem of the adequate size required for the democracy to operate in a country: what must we do for facing the quantitative growth of large cities or countries and the qualitative increase of the complexity of transnational issues? Four difficulties then: the confiscation of popular sovereignty by the authority of the experts knowledge opposing instrumental interests which are characteristics of the positivist approach in which subjects are treated as objects, and interests of emancipation, prevailing under a communication without domination and leading to autonomy (Habermas, 1968); the intervention of new forms of mediation between people and public decision making (lobbies, think-tank) that divert the initiative and legitimacy; the promotion of emotion as direct and immediate form of popular will in a culture of compassionate, believing one could dispense with the need to establish just institutions; and, finally, the over accountability of the individuals, based on the promotion of their importance in decision-making, which leads governance to a technique of neoliberal governmentality.

Reservations made and precautions taken, in what sense then a government by governance can be relevant in the management of ethics and policy for sustainable development?

Restored to its rightful place, governance is also promising. As part of a technological civilisation, the concept of responsibility has grown considerably trough ages and spaces. It renders an account of the expansion of the gap between the desired action and the unintended effects (GMOs, nuclear waste, nanotechnology, environmental crisis, etc.) which one euphemistically calls the collateral damages. Given this, it is necessary to invent new ways to address collectively these issues. In this sense, the idea of governance is picking up the gauntlet of practical innovation in a globalised context. Precautionary principle in moral philosophy and governance in political philosophy are, from this angle, the two major conceptual innovations that have emerged in the late twentieth century. De facto, and one need to be surprised about it, if the West did not miss inventiveness in terms of deployment of technical material, it was very poor in developing techniques for decision or for groups facilitation. The fact is that, as an attempt to give speech to everyone in order to think and to act together around a shared project, governance seeks to present other ways in which to decide together. It does this by giving heed to the empirical descriptions of political practice instead of leaning upon speculative elaborations. To do this requires rethinking the concept of power. Governance rehabilitates the notion of *potentia*, where the government focused on that of *potestas*. The classical political tradition has, de facto, highly invested the idea of power understood as *potestas*: the "power-on" establishes a vertical relationship of domination understood as a way to make the other do what they would not spontaneously do. The idea of *potentia*, as to it, has invented a horizontal relationship of co-action, waking up and spurring on each actor his potentialities, inviting to upgrade the capacity of actors in the fact of "being able to act with others". American English translates it by the idea of 'empowerment'. The risk of course would be to see this technique of awaking potentialities reduced, by a mechanistic application, to an instrument of power, a legal constraint, a realpolitik that assures that it prefers an effective decision to a collective decision.

CONSIDERING GOVERNANCE FROM THE CONCEPT OF TERRITORY

Let us address the question of the relationship between capacities to act collectively in order to meet the challenges one faces today and the way potentialities of action are becoming a reality at the level of the territory by the evocation of a landscape which may raise some questions within the walker.

Why this bridge with its apparent steel framework prolonged by the birth of a road which dies at the edge of the forest? Behind the strange scene of a site in a state of neglect there are plans, measurements, actions, decisions made and conflicts between actors, contradictory approaches, political divisions and, especially, a long time not sufficiently considered in the technical specifications of the project. There are, particularly in large infrastructure projects, the obligations to connect together different decision-making bodies and to take into account the point of views of various stakeholders. This obligation is seen as a constraint in the eyes of experts who think the space and shape it according to an essentially technical and economic logic.

However, to make possible a life together at different scales should we not consider the connection between several decision-making bodies, whether they are institutional, associative or whether they are businesses, not as an obligation *de facto* but more as a necessity *de jure*? This democratic conception isn't it at the heart of sustainable development as it seeks to enable everyone to meet one's needs without compromising the ability of future generations to meet their own needs (Brundtland, 1987)? And does not this new connection require us to reconsider the existing divisions of space, the 'habitus' associated with it, and the prerogatives of each one, in order to question the functional administrative supervisions, which are not adapted to the handling of issues that transcend the traditional spaces for exerting power of decision.

One would hence distinguish, drawing on theories of Augustine Berque, two forms of governance of space, one which consists in abstracting the geography from the temporal dimension of human affairs and one which pertains to the territory or to the 'environment'. Thinking in terms of environment and territory would involve taking a greater account of the relationship between humans and their surroundings through the necessity for consultation and for the identification of the different forms that such a relationship takes. Therefore the point is not to 'geometrise the earth' (Berque, 1987) because to look at it, with Descartes, as an extended substance which can be divided and reported to proportions leads to a decision-making which comes only from higher decision-making bodies. But it is necessary to identify the diverse modes of appropriation of land by the different actors. There is thus a challenge to support the emergence of new areas requiring a governance transverse to several decision-making bodies and, often, transverse to multiple administrative territories.

However, does not a conception of the earth in terms of space allow a liberating, universal, point of view compared with the possible disintegration of the social fabric in as many worlds as there are actors? It seems that one needs to articulate the spatialising perspective, in apprehending it just as a perspective, with the perspective of the territory which includes the time dimension through the consideration given to heritage issues, and the transmission to future generations. Or can we subject the spatial perspective, as a means, to a regional project based on a dialogue between interested parties? These are also new areas that are created around constraints to overcome, and networks to invent. With these territories, names of vales or valleys, to remain in the local geography, are reacquiring a concrete character by using a governance requiring coordination between several policies. The Valley of chemistry, for example, brings together some municipalities of the Grand Lyon around a dynamic of development relied on the promotion of a territory largely occupied by heavily polluting factories and crossed by road, river and rail transport corridors. This promotion requires the establishment of an agenda 21 integrated into the agenda 21 of the Urban Community (Grand Lyon, 2007) and in constant dialogue with those of municipalities such as the Municipality of Feyzin (Ville Feyzin, 2007) or the Municipality of Saint Fons (Ville de Saint Fons, 2009), in progress. The territory is described, defined, unified and connected to others. Its limitations have become part of a story that the various decision-making bodies choose to direct toward urbanisation more in tune with the environment, in particular by pointing up the ecological treasures hidden at the base of factories. The purpose is to manage, as much as possible, the transformation of constraints into opportunities. Thus an abandoned site can become the starting point for a new project.

One could, similarly, show how the consideration given to inter-regional cross-border territories (countries of the Rhine Franco-German), help to overcome the gaps inherent in territorial frameworks and temporalities of national decisions regarding sustainable development. The administrative and political area is thus no longer the 'good scale' or the appropriate scale to address social and environmental, even economic issues. It is important, in order to address these issues, to deal with historical or cultural approaches, but also with geographical and ecological ones. Regarding the latter approach, the resources depletion at a global level and the increase of their cost put local actors in front of the necessity of finding shorter production cycles through the creation of food processings, for instance, involving trade with

neighbouring areas, independently of any administrative border. "*The territory appears to us not as a geographical area or as an administrative and political unit defining an interior and an exterior but as the place where nodes of relationship of different kinds of nature are overlapping*" (Calame, 2003). Addressing the emergence of governance from the territory by leaning on the description of a landscape was not trivial, as the landscape is *a "piece of territory seen by an observer, where has been written a combination of events and interactions from what one perceives only, at some point, the overall result"* (Deffontaines, 1986). It is by taking the time to read the landscape while considering the different logics and the diverse agents that shaped it that we can understand the territory, as a *"complex system of relationships and exchanges"* (Calame, 2003) that it expresses, beyond a form apparently fossilised. This return to the concrete dimension is necessary to consider the place where may be based a proper governance and to find a way out of this abstract approach of space consistent with a pyramidal structure and a rigid division, on which the local actor seems to have very little control.

SUSTAINABLE DEVELOPMENT: VECTOR OF THE GOVERNANCE OF THE TERRITORY

Why is sustainable development particularly akin to a return to the territory and to the deployment of a governance built on the territory? We use the term "return" because local communities had already, within societies, before the French Revolution and the beginning of the industrial era, a holistic perception of the territory they lived as a complex reality. Always according to Pierre Calame in "*The Shattered Democracy*" there was, in traditional societies, a stronger relationship between socio-political and economic system and ecosystems, "*the bond of community with its ecosystem had an immediate sense*" (Calame, 2003). As soon as a gap appeared between the socio-economic sphere and the capacity of the ecosystems to meet the needs and expectations of this sphere, society was faced with the need to respond by finding technical (inventions of new farming techniques) or socio-economic (migration, conquest, creation of partnerships with other territories) solutions.

Currently the problems to which sustainable development claims to offer solutions are bringing a new light on the link between socio-economic sphere and the ecosystem. The individual, particularly the western individual, may have had the impression to gain some independence from its environment, notably thanks to the availability of abundant fossil energy from various plac-

es on the planet. But facing the scarcity of resources, the increase of their cost, facing also the significant degradation of many natural environments which alters the conditions of human life, the link between "econosphere" and biosphere has recalled itself to the good memory of our societies: "*econosphere is not a closed system: the sphere of human activity is indeed open on the biosphere, from which it is actually one of the subsystems*" (Boutaud & Gondran, 2009). However, as the authors of "*The ecological footprint*" pointed it out, econosphere mobilises nowadays the biosphere beyond its capacity of production and regeneration, in the same way as it pumps until exhaustion into non-renewable resources. All actors in society, institutional, social or economic, are challenged by this situation which is not sustainable over time. Some technical solutions more environmentally friendly are appearing although they are never completely satisfactory if they are not accompanied by a change in lifestyle, by regulatory, standards, labels, but also by guides, testimonials, or alternative trends of thought inviting everyone to come off the consumerist model and to live differently, in a 'happy sobriety' (Rabhi, 2010).

In correlation with the environmental degradation of the planet one can notice, especially since the end of '30 glorious years', a weakening and a decline of politics in front of the economy. State sovereignty is fading in front of a globalisation without regulation, made possible by the hegemony of neo-liberal ideology. Such an ideology is based on a principle like *'the immanent self-regulatory capacity of the market'* (Freyss, 2004). But this leads to a commodification of areas previously not considered as saleable: the life, the health, the culture or the education. The submission of the State and the deregulation give way to the commodification of public goods and inevitably lead to the raise of inequality and to the marginalisation of vulnerable groups increasingly important. This change is, in an apparently paradoxical way, reinforced by decentralisation policies. "*The liberal vision of 'less government' is consistent with the assertion that local public management is in itself a progress*" (Freyss, 2004). This does not mean citizens have to reject the local public management to protect them behind a centralisation of power involving decisions which will be missing the voices of local actors. But the socio-political crisis, as the environmental crisis, calls for a new arbitration of societal questions.

At the same time as the life cycles of products and services are restricted to new territories that are not the conventional administrative territories or the planet as a whole, the politics is called to bring order in the relationship between socio-economic sphere and the environment and within the sphere of

socio-economic itself, through the establishment of rules and through the openness to new modes of deliberation. In this perspective of a government by the territorial governance, it is therefore necessary to recognise the importance of all the figures of mediation and of all others areas where it is possible to deliberate collectively: groups for the analysis of practices, focus groups, consensus conferences, participatory democracy, etc. Singularly, the role of the expert is here to point out, as far as one acknowledges that his role of mediator has the possibility to differ from the ideology of expertise. Faced with decisions relating to applications of science and technology – biotechnology, nanotechnology, etc. – the challenge for governance is to give citizens a place alongside the experts, not to see the expertise play the role of a new argument of authority by legitimising a decision of power by the authority of knowledge. It is therefore important, in the framework of governance, to organise upstream and not downstream of the expert knowledge a pluralism of expertise so that contradictories expert opinions can emerge and express themselves publicly, since the "responsibility of elected officials can not be built on the irresponsibility global citizens "(Viveret, 2002). One could seek to analyse here examples of practices such as the general states of bioethics in France regarding cloning and the status of the preimplantation diagnosis. One could also mention the theoretical model of the type of communication which leads to involvement and institution, as it exists in the framework of the concern of local communities to change behaviours, to improve the quality of products used in catering or to reduce the impact of small collective structures (child care centres) on the environment (Weiss & Girandola, 2010). One could include, with the other examples, consensus conferences organised by Dominique Bourg and based on observation of the psychological or socio-psychological impulses which profoundly alter interpersonal relationships involving, beyond affinity groups – the political link is not elective –, a form of sustainable social networks. In the same vein the idea of 'citizens' conference,' breaking with the idea of representative democracy and against the ideology of expertise, invents a device requiring citizens to receive a technical training in order to be able to question scientists in a relevant way and requiring scientists to agree to be interviewed by lay (Boy, *et al.*, 2000).

A sustainable development project introduces into the public sphere more 'reflexivity' (Rumpala, 2008), by bringing citizens to get involved in a collective work territorialised through exchange places or areas dedicated for democratic action. Two challenges are then arising. The first, according to

Yannick Rumpala is, *"the question of articulating these spaces [for democratic action], of making them converge, especially for a comprehensive project such as sustainable development."* But we have seen, through the example of the Chemical Valley located in the Urban Community of the Grand Lyon, that the new form of governance, emerging from territories which were not clearly identified recently as entities likely to carry a political project, was associated with an articulation between different levels of sustainable development policies. The notion of territory, as an interface and as a dynamic place for exchanges, is faced with the need to consider the articulations between territories and between local actors and more global decision-making bodies. The other challenge is to remain vigilant concerning a return of the ideology of expertise, not in the content of the scientific discourse delivered to the population, but at the level of the formalisation of a sustainable development approach through an 'engineering involvement'. The management of places of exchange between different actors is, for decision-making bodies, an information source and a means of estimating the degree of development of the society compared with the objectives to reach. It aims to provide solutions to the question of how to get people change their behaviour without using force? (Rumpala, 2008). The fact that the concept of governance is an apolitical concept, emptied of its contents and which federates by inviting us to rethink our ways of decision-making, can lead to the instrumentalisation of democracy which becomes, at the same time, the end referred to and all the means used to achieve the objectives. But the reflexive dimension of governance conduces to keep a critical eye on the political choices made and on the way to take them. This reflexive dimension leads to always seek the most authentic way to invest in collective projects, even if one has to change several times of causes and of ways of getting involved. Such a dimension is a guarantee of constant displacement of places and of creative forms of politics, without a total instrumentalisation can happen.

CONCLUSION

Such a progression through the concepts of governance and of territory has allowed us to assess to what extent the inclusion of sustainable development goals has imperceptibly cast doubt upon the administrative, legal and political structures in a way perhaps more profound and irreversible than it would have been by institutional reforms initiatives from above by State authorities.

The environmental, social and economic stakes of sustainable develop-

ment aim to lead the different actors of the society to reinvest in the territory as a complex reality shaped by trade and transformed by the encounter of logics and sometimes contradictions. Facing the submission of politics to economy and the failure of a pyramidal government, unsuited in its operations to the needs to develop networks and local channels, a new form of governance emerges, supported by actors representing the different stakeholders involved. Such governance can be deployed in places that make possible the dialogue between economic and political leaders, experts and citizens. The latters are not mere extras in a political showmanship, but have the opportunity to make their voices heard to the other actors in decision making.

Following this path we can go back one last time on the concept of governance. We have underlined the ambiguity of its introduction into the political arena as it is from the commercial sphere and from the corporate world. Although experts, businesses and citizens can deliberate together through networks or platforms for the creation of collaborative knowledge, still looms the danger of a recovery of this knowledge for the benefit of an economical logic. We are therefore facing a somewhat paradoxical concept since it is derived from the business world but also advocates the creation of places of exchange that can serve the common good and not the interests of a minority. That would be the place given to the citizen, and to the various stakeholder groups, through a territorial approach, that would allow governance to achieve its mission. Having taken precedence over other decision-making bodies, threatened with bankruptcy by problems that aims to solve a sustainable development, companies have contributed heavily to bring back the concept of governance and then to reinstate the stakeholders they had evicted, thereby joining the concerns of civil society. In a delicate and still mobile balance, but relied on very concrete realities, the establishment of genuine governance is a guarantee to enable actors and decision-making bodies which have neither the same goals nor the same expectations to arrive at solutions to the service of the improvement of living together.

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2

A New Governance of Natural Hazards Areas

Philippe Billet

ABSTRACT

If the territory is envisaged as support for measures intended to prevent natural hazards, the confinement of the risk to a specified area creates many difficulties. Natural hazard areas are superimposed on other areas (administrative areas, urban areas...), and the definition of their boundaries is subject to caution: there are many difficulties associated with enclosing a dynamic natural process within static legal borders. The inadequacy of the administrative boundaries of hazard areas is an answer to the territorialisation approach to natural hazards and it invites the exploration of the ability to reconfigure these territories. It also questions the appropriateness of risk management measures in a predefined area.

Keywords: natural hazards, prevention, governance, environmental law, territory

INTRODUCTION

The law has taken hold of the territory, inventing it by writing its frontiers, manifesting its hold through partitions, allocations and norms. If the territorialisation approach must be understood as a cutting of space from a utilitarian standpoint, the resulting territory is functional: this territory is envisaged as support for measures intended to attain objectives of this individualisation (area, sector, basin, circumscription....). The territory is thus a relative concept, a surface with a specific purpose. Theoretical space, the territory also constitutes a physical basis for human activities and occupations, which are in line with prevailing geographic and climatic constraints and

more or less associated with natural hazards. In such cases, the legal instruments act to make these activities and occupations compatible with the territorial contingencies. Binding and determined in accordance with the natural phenomenon which provides the basis of its existence, the legal norm must be appropriate to the different situations. For those reasons, the risk areas need to be identified in advance. The difficulty is that there is not one but many risk areas, with variable scope according to the level of risk, and each can be divided into several zones, according to the type and degree of risk. The spatial variability of the natural hazards complicates it legal treatment: its area is superimposed over areas (administrative area, urban area...) and the definition of its boundaries is still subject to caution.

We could question the relevance and value of the definition of a territory of natural hazard. The prevention of natural risks depends on its area (I) but the confinement of the risk in a specified area creates many difficulties. The result can be an inadequacy between rules and facts and put into question the validity of the rules (II). The legal requirements and constraints affecting this territory may be discussed, but the resolution of any problems encountered leave unanswered the fundamental question of the territorialisation approach to natural hazards. It is necessary to explore the ability to reconfigure the territories which are exposed to natural hazards and to call into question the appropriateness of the risk management measures in a predefinited area (III).

THE GEOGRAPHICAL AREA OF THE PREVENTION OF NATURAL HAZARDS

According to Patrick Janin, *"Any legal rule has a specific spatial domain of validity"*. Janin defends the existence of a 'territorial determinism': *"being located at such and such a place, the individual is subject to the rule in force at that place"* ([1]). The rules of risk management may be different from one place to another, because the recognition of territorial specificities justifies a different legal regime based on location.

The law of natural risks prevention is no exception to this rule, being affected by the historical roots the norm has in the area: it presupposes a necessary territorialisation of the rule applicable to this question, when the risks are not the same everywhere and the constraints will vary from place to place and

1 P. JANIN, L'espace en droit public interne, typed thesis, Lyon II, 1996, p. 7.

from one risk to another, according to their characteristics and features in the place in which they occurred. This territorialisation is necessary because risk prevention measures can be analysed as 'measures of policing', whose legality is founded on the territory: the principle of 'territorial speciality' that identifies precisely the authority competent to act; and the principle of 'territorial adaptation', which implies that proportionate measures must be proposed.

This requirement implies that the features that characterise the area are identified in advance and limited in geographical scope to be legally translated and that the limits of this territory are valid. Otherwise, the manifest error in assessing the geographic impact of the natural phenomenon and its potential intensity, will affect the legality of all measures which have had - or taken - it as a basis.

The Principle of 'Territorial Speciality' and Restrictions on the Exercise of Regulation Jurisdiction

The territorial jurisdiction determines the territorial scope of the administrative police authorities and confines them within strict limits. These authorities are numerous and this plurality implies many jurisdictions, whether at the national, departmental or municipal levels. Each authority may be requested to exercise its powers in a specific geographical area: any overstepping of these limits constitutes an illegality.

Regarding the prevention of natural hazards, if the Mayor wishes to exercise his authority in that area, he can only do that on the territory of the municipality. The Prefect cannot act beyond the boundaries of the 'département' (French administrative sub-division): when he has to replace the Mayor, this can only be done within the municipalities of his département.

Emergency situations warrant exceptions that justify the legality of the preventive measures adopted. But the exception only applies, however, to the content of measures, not to their territorial scope. Failing such circumstances, only a joint order overcomes these limitations: thus, the police must be used jointly by the mayors of the municipalities concerned and regulations should be enacted as orders signed by each of them or single orders signed by both Mayors. There may also be designated as a coordinating authority, as the Basin Coordinator Prefect under the auspices of the Master Plan for Water Development and Management (SDAGE).

In special cases, the principle of 'territorial speciality' is nonetheless undergoing an erosion which could lead to implementing policing of natural

hazards in order to prevent them. According to the case law, a municipality can expropriate land, outside its borders, which is required for the implementation of public infrastructures outside its territory: this procedure is legal where the expropriating municipality could not find land with the same ability to receive the infrastructure on its own territory. This permeability of frontiers should allow a municipality exposed to natural hazards which are rooted in the territory of another municipality to prevent the effects on its own territory by building facilities in the territory of the neighbouring one (storm overflows, avalanche barriers...). The measure adopted on a territory can thus be applied in another territory.

However, the basic principle is the principle of 'territorial speciality', and this necessarily requires the prior definition of an area of jurisdiction.

The Necessary Prior Establishment of Areas Exposed to Natural Hazards

The application of the law on prevention of natural hazards is based on a prior territorial delimitation, on a location of potential entry points of the natural phenomenon involved: this identifies the authority which is territorially competent to manage them. As the police authority must prevent these risks, its intervention requires appropriate designation of sensitive areas: this delimitation constitutes an obligation and may engage the responsibility of the authority which does not proceed upon it, proceeds with delay or proceeds without efficiency. This delimitation is also the basis for the restrictions on land use defined within the area, constituting violations of public liberties or the use of property. The legality of this boundary is thus governed by its necessity and its appropriateness.

In some cases, planning law allows for the limitation of the occupation or use of the land because of the location of a project, without delimitation of an area, because of the risks affecting this area. However, the principle of legal certainty means that the preventive measure is identified and known in advance, like its geographical scope, and benefits from a minimum level of stability within its boundaries.

The law does not favour one delimitation method over another: it notes that the delimitation of the area shall be scientifically established and produces legal effects for one technique or another by making it compulsory. It can also allow free choice of method and merely gives some guidelines: thus, the plans for the prevention of foreseeable natural disasters have to de-

limit the zones exposed to the risks by taking into account 'the nature and intensity of the risk'. For its part, the expropriation process to safeguard the populations threatened by certain major natural risks must take all the relevant circumstances in each particular case into account. Proceeding with caution, however, because of the hazard that affects the existence of the phenomenon and the territorial boundaries of its effects, the law sometimes extends the area of risk and authorises the creation of areas *"which are not directly exposed to the risks but where constructions, structures, facilities or farming, forestry, artisan, commercial or industrial operations could aggravate the risks or cause new ones, and to provide measures of prohibition or stipulations"*. The recognition of a buffer zone corrects the defects of a boundary which is sometimes as uncertain as the phenomenon it purports to limit in space. It also reflects the difficulties of this territorialisation, which presents numerous drawbacks.

THE CONSTRAINTS AFFECTING THE TERRITORIALISATION OF NATURAL HAZARDS

The reality of risk is not always easy to determine and territorial individualisation of the rule is quickly demonstrated as being limited. These limits are related to the difficulties of enclosing a dynamic natural process within static legal borders. Traditional administrative boundaries appear unsuited to the reality of the situation that needs managing. These limits are also related to uncertainties in the results of scientific and technical studies, contingencies-with which the law must deal.

The Inadequacy of the Administrative Boundaries of Areas of Risk

Risk knows no borders between administrative districts and, consequently, between jurisdictions. This complicates the definition of suitable zoning and disrupts the administrative reaction.

The existence of risk areas covering two communes substantiates the intervention of each town council to set up an urban zoning system which is unique to each commune, without there necessarily being zonal identities on both sides of the communes' borders. This limitation of competence is all the more regrettable on account of the fact that there is no obligation for coordination between zoning of juxtaposed communes: urban planning law stipulates that only the mayors of juxtaposed communes shall be consulted, at their request. This situation may also lead to a different treatment of the same

risk and to make a commune the simple spectator of the development projects liable to have effects on its territory, such as the opening to urbanisation of an area situated on the territory of a commune, leading in the long run to land sealing causing run-offs into the territory of a neighboring commune. It is only when the commune which adopts its local urbanisation plan is not covered by a territorial coherence scheme that the prefect of police of the Department can delay the coming into force of this document by specifying the modifications to be made in the event of blatent incompatibilities with the use or affectation of the land of neighbouring communes. This absence of harmonisation between territories is of even greater concern since the delineation of risk areas is not always adapted to the reality of the situation on account of the uncertainties which affect it.

The Uncertainties Concerning
the Scientific Delineation of Risk Areas

The definition of zones exposed to a natural risk is a scientific operation which cannot be indifferent to the legal considerations on account of the impacts on the legality of the norm stemming from it or the legal consequences of a factual error or manifest error of appreciation. These areas are however not always easy to determine and it is necessary to be content with 'reasonably reliable' frontiers, in the absence of fixed certain boundaries, based on current scientific and technical knowledge. The definition of risk areas as a legal framework cannot thus depend on a sole basis: for floods it is a combination of hydrological, rainfall, geomorphological and statistical studies which act to correct the field surveys and the loss of initial references brought about by the carrying out of civil security works.

In other cases, the boundaries under consideration do not always overlap, although the same natural phenomenon is being looked at. Multiple types of map may thus exist together and can be confused even though they are distinctly different: the hazard map, whose object is to determine the level of risk according to a reference hazard corresponding to a given return period; the vulnerability to risks map which is based on the occupations and uses of the land. The documents make it possible to determine foreseeable effects on human occupation in accordance with the nature and the level of the risk involved, with this pluralism having to be combined with a possible replication in the urban planning documents. The difficulty is that each map is based on differing logics and final objectives: therefore, independent perime-

ters could be envisaged and a single territory may be concerned by two risk areas with distinct boundaries. This may introduce confusion.

Also, the geographical lessons of history rapidly attain their limits:historical data makes it possible to trace with more or less exactitude the single map of the areas that have already been affected by a natural phenomenon, and not those which are only likely to be affected If the observation that, 'that which has already happened is likely to happen again', makes it possible to legitimise the qualification of 'exposed area' applied to an area which has already been affected by a natural phenomenon, the evolution of the physical data on the ground over time often confuses the issue and the useful memory is reduced.

Finally, the sociological constraints often weaken the outlines of the risk areas, disrupt the decision-making process and reconfigure the territory in question according to informal criteria. Everything happens as if the boundaries defined scientifically only represent a basis for negotiation with the population and the delineation gives rise to the results of an administrative arbitration based no longer on the reality of the risk but on its social acceptability. Yet it is still necessary that the acceptance is based on full awareness of the risks undertaken, without this being altered by excessive confidence in scientific expertise or physical corrections on the ground in the form of avalanche barriers, dykes, flood retention dams, or other examples.

Whatever the reliability of the scientific data, finally, territorial organisation of the constraint will be all the more acceptable in that it has been negotiated, leading to the lowest common denominator. Without ruining the scientific approach, this situation weakens its reach and fosters even greater uncertainty on the relevance of risk territory. Questions could thus validly be asked about a possible reconfiguration of this territory.

THE RECONFIGURATION OF TERRITORIES EXPOSED TO A NATURAL RISK

What legal territory should be given to risk? What formatting of space should there be to look at the administrative management of natural phenomena? Everything happens at the moment as if it was not the risk that affects a territory, but the law that gives a territory to the risk. Whatever solution is envisaged to remedy this tendency, it leaves the problem of lack of coincidence between risk territory and administrative areas. Unless the setting-up of an administrative action territory is proposed, strictly based on risk, a risk basin

which would lead to the superimposition of a new area on the existing areas, without however solving the problems.

Two options may be envisaged: defining a risk territory on other bases than those considered up until now, or, on the contrary, leaving the natural phenomenon to define its own territory, and the law only intervening to record it and draw functional conclusions, thus leading to the admission of a certain deterritorialisation of risk.

The Deterritorialisation of Risk

This is about functionalisation of space and defining a territory according to the coherence of a given action and not defining it as an element of the administrative organisation of the state. This solution is however in opposition to the solution which seeks at all costs to have influence over the dynamic phenomenon by assigning it a territory and adapting this to its evolution. This is the case, for example, for the delimitation of the public fluvial domain: the administration merely records the existence of a physical phenomenon and the limits reached by this whenever it is necessary in the event of inventory changes. The legal territory thus defined has only cyclical stability and evolves with the phenomenon which it shadows closely, since its delimitation depends on the establishment of a factual situation at a determined moment and on the premise that the facts are liable to modify later on.

Deterritorialisation consists, on the contrary, in changing the conception of risk territory, in giving to the natural phenomenon its full expression without enclosing it in a predefined territory. Risk territory would thus no longer be presented as a closed space, as a space necessarily circumscribed by a rule, but as an open space without predetermined borders. Case law has admitted on several occasions that the application of preventative measures can free itself of this prior territorialisation of natural risk. It thus creates informal territories. That the zone is exposed to a risk is one thing, that it is formally a 'zone at risk' is another. By validating the administrative decision, the judge characterises the zone as being exposed to risk but does not condition its existence to an administrative operation of prior delimitation. The space thus created only exists as long as the decision does, and is not instrumentalised on a long-term basis. This procedure thus makes it possible to validate the refusal of a building permit in a zone exposed to high avalanche risk, even though the ground for implantation of the project was not included in a de-

limited avalanche risk zone. It is ensuring that the risk had a certain consistency and is not reasonably uncertain.

Is it possible to go further in this 'a-territorial' approach to natural risks? *A priori*, this solution is not incompatible with the principle of territorial speciality, inasmuch as the administrative authority remains confined within its area of competence. It is not however perfectly operational; if it is clearly preventative where it is a case of preventing a particular land occupation being subject to prior administrative monitoring, this is no longer the case as soon as, where no territory is identified, it no longer allows the existence of risk to be taken into account. It also calls into question the legal security of owners, who can no longer anticipate this risk and can be the subject of measures whose legal basis will be especially debatable since their adoption will have been made without indication of their possible enactment. Such a disaffectation of the territory can thus only be temporary and limited to specific situations and measures, the simple legal correction of a delimitation which has not been carried out, or has been carried out badly. Since there must be territory, and given that territorialisation of risks as it is understood currently is subject to discussion, it is doubtless necessary to envisage its reconstruction.

The Reconstruction of Risk Territory

For the reasons which have already been examined - infringement of certain public liberties, appropriateness of police measures and sociological constraints - the definition of territories exposed to a natural risk must take into account the geographical reality of the natural phenomenon, which imposes a precise definition of the territorial limits. This conception is nonetheless simplistic in two ways. On the one hand, it only gives relative flexibility to administrative authorities who are limited to being able to draw up the perimeters of the areas only after long and in-depth analysis. On the other hand it only allows for the settlement of post-territorialisation situations and the occupation constraints whose imposition it authorises, whilst at the same time partly concealing the dynamics of the natural phenomenon. It nevertheless seems possible to go beyond this conception and to renew the risk territory approach, either by correcting the definition of its borders or, on the contrary, by 'liberating' the natural phenomenon of certain territorial constraints adopted for preventative objectives, by giving it its own territory.

First of all, the risk territory is generally confined to a single clearly exposed area and its delineation is naturally based on the analysis of the zone of

influence of the natural phenomenon. These restricted borders only allow however for limited manoeuvring by their definition and the difference between exposed and non-exposed area is very small although the nature of risk would normally allow for a certain margin of error, if it does not constitute a manifest error. This situation would be a justification for the wider development of the notion of 'risk basin', which for the moment is used informally. It would be a case of keeping the risk territory as a homogenous geographical space taking into account all the existing risks in a single sector and their potential interactions.

In this context the territorial conception of plans for risk prevention of article L.562-1 of the Environment Code would deserve to be extended, insofar as it makes it possible to define a more coherent geographical entity.

The nature and intensity of the risk or risks encountered are obviously taken into account in this definition. However, the borders of the territory are extended beyond the directly exposed zones to include areas alluded to as 'precaution areas'. The latter are not directly exposed and should not have been taken into account, but their characteristics contribute to the formation or expression of the exposed risk area and justify this territorial integration. This broad conception allows for the adoption of much wider preventative measures, thus containing a possible amplification of the natural phenomenon and creating above all the necessary territorial solidarity which is often lacking in this domain.

The search for a new territorial configuration may, secondly, be directed towards a path which is no longer centrifugal but centripetal, through a return to the territory or, more specifically, to the function of the territory. Concerning risks, the natural function of the territory should be able to take precedence over its administrative function, the space being taken as a basis for administrative measures which have to make way for expression space of the natural phenomenon. In other words, it is no longer to constitute the risk territory but to come to terms with this risk territory.

The sectors at risk of urban planning law or the implementation of Article R.111-2 of the Town planning Code[2] prefigure this possibility of adapting human occupation to the risks but, above all, of giving over a territory to

2 This Article stipulates that, "the project may only be refused or not accepted subject to the observance of special conditions if it has the capacity to infringe public health requirements or public security on account of its situation, characteristics, importance or implantation near other installations".

natural phenomena, even if this means limiting or forbidding all human occupation. This option was chosen with the natural hazards prevention plan, which makes it possible to ban or do away with all elements situated outside the public domain likely to obstruct the drainage of waters, or to restrict flooding areas in a prejudicial way. This is also the case for expropriation in the event of major natural risk in Article L.561-1 of the Environment Code, which stipulates that the protection of populations may be carried out by distancing them definitively from the zone exposed to certain risks if safeguarding and protection of the populations are more costly than the compensation for expropriation. This effectively hands over the territory to risk.

This new policy for the territorial management of risks may also be in evidence with the setting-up of 'temporary retention areas for flooding or run-off' aimed at allowing for periodical flooding of land situated in these areas in order to limit flooding in urban sectors situated downstream, and 'areas of mobility for waterways' whose aim is to allow the natural displacement of a minor river bed of a waterway, with a view to preserving or restoring its essential hydrological, rainfall, geomorphological and ecological characteristics. The aim of these easements is to develop a space for liberty and to make human occupation compatible with natural phenomena, and no longer to adapt the zones which are exposed to a natural risk to this occupation.

This abrupt change in perspective does not however incorporate the desired universalism and can only concern certain risks with territorial characteristics which can be determined with a certain exactitude. Its underlying philosophy is nonetheless transferable to most natural risks: the abandoning of an anthropocentric vision of the dynamics of natural phenomena, based on a productivist conception of space and on a compromise between the occupation of land and exposure which is socially acceptable to their effects. Natural risk does not exist in the state of nature: it is human occupation which, basically, creates risk and transforms into danger events which are more or less natural through exposure which is more or less subject to their effects.

If the area of risk is still seen as a space of competition, a sustainable land use planning would mean the abandonment of the subjection of land to human occupation 'at any price'. This would involve the need to admit that the management of prevention can also come about through the effective handing over of a territory to certain natural phenomena and adapting the occupation of this accordingly.

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3

Water Management Catalysing the Participative Definition of Climate Adaptation Strategies on the Level of Coastal Communities

Thomas Klenke - Frank Ahlhorn
Helge Bormann

ABSTRACT

This paper presents results of an integrative and participatory study of community approaches to regional adaptation to climate change. For the Wesermarsch county (Northwest Germany) a group of regional decision makers developed the framework of an adaptation strategy to climate driven regional changes. The focus is on water management. Based on information on expected regional climate and hydrological change (provided by scientists), the stakeholders sketched a vision how the Wesermarsch county should look like in the year 2050. Adaptation in terms of adapting land use was not proposed. The stakeholders involved in this process preferred improvements of the present technical infrastructure and avoided consideration of promising alternatives in water management. However, all the stakeholders took actively part in a participatory learning process which is a necessity for successful regional climate adaptation management. This example of regional governance is one pilot study in a set of similar approaches within the North Sea area.

Keywords: Climate change adaptation, water management, participation, social learning process, North Sea region

INTRODUCTION

Climate change challenges societies in respect to their normative settings and approaches in decision making. The challenge asks for managing complexity, uncertainty, interactions and multi-sectoral phenomena. Traditional governmental acting has been argued to be incapable of defining strat-

egies and schemes in climate adaptation in an adequate way for several reasons (Jessop, 2004). Recently, additional ways in societal decision making have been proposed or developed in a set of local to even global settings. This governance driven by individuals or groups of stakeholders is in an exploratory phase. Various exercises have provided guiding examples all of them having one common ground in letting the broad society become responsible for setting the course for sustainable development (Voß *et al.* 2009).

Adaptation to climate change has raised public interest in the past years and become the focus of informal participative decision making (Ahlhorn, 2009, Krysanova *et al.*, 2010) in the context of regional governance according to Fürst (2001). As a consequence, preliminary national concepts have been set-up towards the development of national adaptation strategies (Bundesregierung, 2008). Several authors introduced general concepts and approaches for adaptation planning and analysed regional possibilities (de Bruin *et al.*, 2009; Kabat *et al.*, 2005). Adaptation strategies were compared among different regions (Krysanova *et al.*, 2010) as well as their recent status in adaptation planning (Huntjes *et al.*, 2010). Water management in certain river basins and spatial climate adaptation overlap on a local and a regional scale (Wesselink *et al.*, 2009) and ask to consider different sectors (Veraart *et al.*, 2010) of the natural and the societal systems.

The North Sea region provides an ideal example of a shallow marine basin with flat coastal areas which are threatened by the effects of climate change (Ahlhorn, 2009). Several coastal communities have started recently to discuss how the frequency and impact of natural disasters such as storm surges and floods will increase in the future while also increased levels of rainfall and higher water levels in rivers are expected. This study analyses an ongoing process of regional governance embedded in the German Wesermarsch region focussing on the interaction of water management and the definition of local climate adaptation strategies. We also look for similarities as provided in parallel processes in other coastal regions of the North Sea area.

SITES AND METHODS

Stakeholders within the community of the coastal Wesermarsch county (Landkreis Wesermarsch, Lower Saxony, Germany) have started a process to define a comprehensive strategy and related measures of regional climate adaptation. This participative process is directed to a sustainable development of this rural area. This process is stimulated and embedded in a European exer-

cise in the framework of the Climate Proof Areas (CPA) project (EU Interreg IVB North Sea Region). The Wesermarsch County (822 km^2 in size) is located in Northwest Germany (**Figure 1**). The county has a population of about 92 000 people (year 2009) and has a rural character except for four small port cities alongside the Weser Estuary. 95% of the area is used for agriculture (90% grassland). The topography is predominantly flat (elevations between -2 m and 5 m above sea level). In order to protect the region against storm tides to reduce the risk of being flooded, dikes have been constructed for centuries and heightened by and by. In order to regulate water surplus and deficits, a traditional water management system has been developed in the last centuries. In winter time, water needs to be drained from the area in order to avoid flooding, while in summer time the region suffers from a water deficit which needs to be compensated to avoid drying out of marsh water bodies. Due to the peninsula-like situation and the intense drainage of low-lying areas, salinisation of surface and groundwater bodies is an increasing problem. These problems are expected to become more severe in the course of the likely impacts of climate change in the decades to come. Water management played and still plays an important role to guarantee the usability of the land for agricultural and industrial purposes as well as for habitation.

An informal group of decision makers (regional forum) representing the relevant sectors, interest and administrative levels has formed to run the process (**Table 1**). Therefore, all members of the regional forum worked together on a jointly developed overall community adaptation strategy for a period until 2050. Local projections for hydrological key factors were derived from statistical data analysis and regional climate scenarios and communicated to the regional forum (Bormann, 2010). Focus groups for (i) urban and (ii) rural areas discussed current water management problems and developed ideas for alternative future water management solutions.

This participative process can be considered as a pilot for similar science-driven processes of regional governance to be initiated in other coastal communities as well. Within such a participatory process an adaptation strategy for regional scale water management has been developed by a group of stakeholders. Given the lack of real experience in actual (innovative and politically sensitive) adaptation measures, local partnerships must establish themselves in order to define and to govern climate adaption in accordance with the coastal ecosystems and the socio-economic needs. In the European context of the Climate Proof Areas project, we analysed the example of the

FIGURE 1
Wesermarsch County: Elevation Above Sea Level

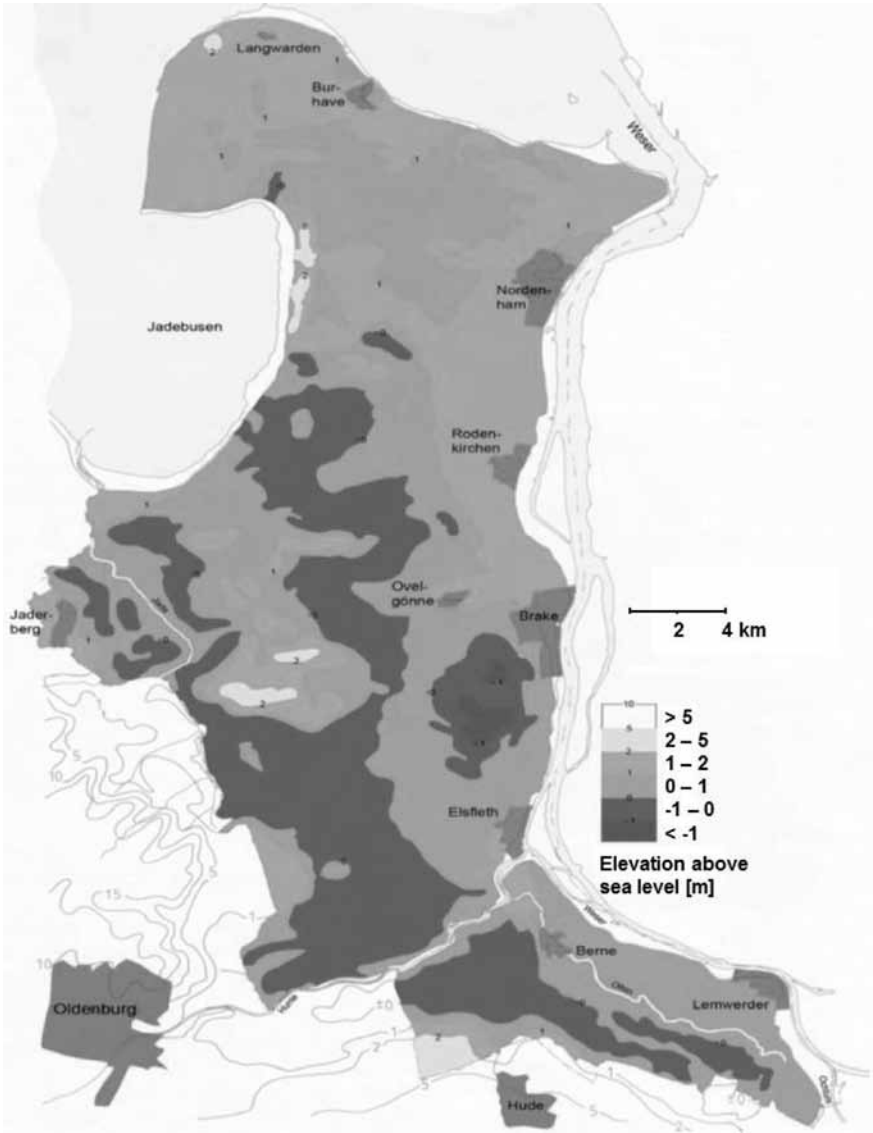

TABLE 1
Stakeholder (Representative Organisations), Integrated in the Participatory Process of Developing an Adaptation Strategy for the Regional Water Management

Sector	Participating organisations
Administration	County Wesermarsch Municipality Butjadingen City of Brake
Agriculture	Chamber of agriculture Peasantry
Coastal protection	Dike boards NLWKN (State Agency)
Nature conservation	NGO: BUND (Friends of the Earth) National park authority NLWKN (State Agency)
Water management	OOWV Drinking water supplier and sewerage operator Water boards NLWKN (State Agency)

Wesermarsch county with respect to its relevance and implication for other North Sea coastal communities in the Netherlands, Sweden and the U.K. (England).

RESULTS

In order to consider the different sector specific views on the future, all members of the regional forum compiled a common 'Wesermarsch vision 2050' (**Table 2**). During a subsequent workshop all participants of the regional forum identified water management to be the foundation of all the societal activities and needs in the Wesermarsch area. Some crucial aspects in that respect are

(i) Coastal flood protection (innovations to protect the vulnerable areas partially lying below the mean sea level)
(ii) Flood protection in cases of intense precipitation and run-off events (innovations to present infrastructure and governance systems)
(iii) Drainage (autumn to spring) and watering (summer) in the widespread agricultural parts and urban areas
(iv) Water management in urban areas (design of urban landscapes

TABLE 2
Crucial Sectors of the Stakeholders' Vision of How the Wesermarsch Should Look Like in Year 2050

Sector	Vision
Landscape	Preservation of the current state of the landscape (open, grassland dominated, dairy cattle)
Agriculture	Intensive agriculture should be possible as it is now. In parallel, less intensive schemes are are proposed as well.
Job market	Jobs should be safe in future; focus is set on agriculture, tourism and harbour related economy.
Coastal protection	Future life behind the dike should be as safe as it is now. Reduction of compensation requirements of coastal protection measures.

capable to increase the ability to store and handle water in urban settings).

Throughout the regional forum, different land uses as nature conservation, urban/built-up areas (along the coast and inland) and agriculture were considered and represented. Although all the sectors had different emphases in land use, still an integrated approach is needed in order to achieve a sustainable adaptation strategy (for instance, combining safety issues with nature development, tourism or urban development). For this purpose, the members of the regional confirmed the results of the more detailed studies of crucial locations and processes (**Table 3**) which were developed by the two focus groups.

Given the fact that local partnerships have establish themselves in order to define and to govern climate adaption in other regions around the North Sea, we considered similar processes in coastal communities in the Netherland, U.K. and Sweden. We found

(i) Although expected impacts and scenarios used for climate adaptation on the national level do not differ significantly, regional and local information, data and scenarios have limited overlap in the coastal regions examined.
(ii) The practical experience on the community level can be used for recommendations to national and regional adaptation strategies and to a certain extent also feed into climate change adaptation

TABLE 3
Portfolio of Possible Water Management Adaptation Measures

	Rural pilot area	Urban pilot area
Increase in water storage capacity	Heightening of inland dikes Deepening inland channels Sediment removement	'city as a sponge' schemes (green roofs, multifunctional use of parking areas, lakes) Retention in the Hinterland: additional polders
Improved drainage capacity	Heightening of inland dikes	Establishment of flood ways Additional sluice
Storm flood protection	Heightening of dikes Storm barriers (Weser, Jade)	Storm barriers (Weser, Jade)
Maintaining watering	Installation of a freshwater polder Installation of an additional drinking water system for agriculture Freshwater system Jade bay Extension of the historic watering channel	
General	Improved co-operation among water boards Drainage and watering considering topography	

recommendations for a region on a European level. The practical pilot experience enables to make recommendations to the existing regional and national adaptation strategies from an integrated point of view where issues of safety, nature, agriculture, tourism and urban development are considered and combined.

Experience and expertise in designing effective adaptation strategies and especially designing and implementing concrete adaptation measures is still very limited as demonstrated by the Climate Proof Area project. In low lying coastal areas such as Netherlands and Northwest Germany, water management is crucial due to the interactions between freshwater and salt water, storm tides and river floods as well as seasonal variations in freshwater availability. Climate adaptation is in different phases of the policy cycle within the various regions: communities in Sweden, Germany and the Netherlands are in the process of developing adaptation policies together with testing potential adaptation measures, while the U.K. communities have partly started the process of policy implementation already.

DISCUSSION

The study demonstrates that current shortcomings in present water management which are likely to become more difficult and expensive to handle in the course to expected climate change are promoting regional action taking on the development of a more comprehensive climate adaptation strategy. This initiative is rooted in the regional society whose decision makers have established an informal group in the light of regional governance (sensu Fürst, 2001).

The water sector has already served as catalyst for climate adaptation studies and for approaches to climate adaptation schemes as well (Huntjes *et al*., 2010; Krysanova *et al*., 2010; Veraart *et al*., 2010; de Bruin *et al*., 2009; Lopez *et al*., 2009; Wesselink *et al*., 2009; Woltjer and Al, 2007) although others counter that climate change will transform boundary conditions for water managers only (e.g., van Beek, 2009). Many stakeholders as well as experts perceive water related risks (e.g., floods, droughts) as most serious impact of climate change (Veraart *et al*., 2010). This is confirmed by the steps within the Wesermarsch county.

Many studies conclude that a closer integration of water management and spatial planning is required (Veraart *et al*., 2010; Aerts and Droogers, 2009; Woltjer *et al*, 2007). Spatial planning, however, turned to be an exercise which has to involve participatory elements (Ahlhorn, 2009). This results in a regional governance process driven by relevant stakeholders. Many studies are agreed that stakeholders are an indispensable part for the process of developing regional adaptation strategies (Huntjes *et al*., 2010; Krysanova *et al*., 2010; de Bruin *et al*., 2009; Cohen *et al*., 2006; Füssel, 2007).

Adaptation will require (huge) spatial investments and innovative solutions which are politically sensitive. They have to be realised on the regional and local level. Therefore, coastal communities have the common challenge of working on climate change adaptation strategies and innovative measures that will enable communities to deal with the problems caused by climate change. Social learning processes in actor networks have been proposed of being powerful in water management (Walker *et al*., 2002; Berkhout *et al*., 2006; Pahl-Wostl *et al*. 2007).

Climate adaptation management with an associated a paradigm shift in regional decision making and acting taking is a long lasting societal endeavour. Governance is promoted by partnership and alliances of groups within a certain society (Jessop, 2004). This study has shown that a partici-

patory process to adaptation is a suitable approach to initiate a regional transformation process which, however, is still questionable to be capable in mastering the needs of regional climate adaption (Kemp & Rothmans, 2009, Voß *et al*., 2009).

CONCLUSION

Successful regional climate adaptation requires a participatory learning process. This study showed that regional stakeholders are interested to actively participate in such a process of regional governance. They provide the necessary knowledge on their region while specific information on regional climate change projections must be delivered by science. The resulting adaptation options strongly depend on the vision how the region should look like in the future.

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4

Are Protected Areas Really Sustainable? How to Develop Sustainability within Nature Conservation

Samuel Depraz

ABSTRACT

The management of Protected Areas, once mainly devoted to ecosystems conservation and driven by a rather radical ecologic approach, has been significantly unsettled by the paradigm of sustainable development for a decade or two. The sector of Nature Conservation has now to be socially responsible and shall take in account, in its policy, the ecological, economical and cultural fields at the same time. However, the global shift towards sustainability in the management practices of Protected Areas is not always obvious, and several examples of this reservation will be developed here, in the three above mentioned fields. Therefore a comprehensive assessment of Protected Areas effectiveness is needed in order to legitimate the role of nature conservation in the local development prospects, with the broader aim to foster a more integrated territorial governance at the local level.

Keywords: Protected areas, nature conservation, integrated management, territorial governance

INTRODUCTION

The sustainability of Protected Areas has not really been questioned before recent times: as long as protected areas have been solely considered from an ecological point of view, there was no point in asking whether they were carrying any socio-economic added value, or were at least socially and financially bearable for human societies. They were but considered as a necessary expense in the eyes of Nature Conservation, as they were the most obvious and proud evidence of the achievement of public policies in the matter of environ-

mental action.[1] Moreover, it was not questioned whether they were a good way of protecting nature or not, even from an ecological point of view: based on an inherited conception of Nature Conservation that protected the most remarkable places and species, and embedded with many representations on wilderness, natural landscapes and aesthetic sites (Larrère, 1997), they were far beyond any rational criticism regarding their scientific legitimacy.

However, sustainability does not only mean nature conservation; neither is it a pure aesthetic and emotional approach of environmental questions in our contemporary world. At least, the paradigm of sustainability – if one refers to the most widely acknowledged definition of the term after Brundtland (1987) – leads to consider that any environmental action has also to be assessed in the scope of its social and economic function. In other words, conservation policies have to be scrutinised under a more integrated, socio-economic approach. In return, a more comprehensive planning of territorial development and regional governance, that includes environmental protection, will help conservation projects to gain more efficiency and legitimacy. This new paradigm of sustainability is consequently re-defining the way how nature protection has to be lead in the three fields of a sustainable management – environment, economy and society – in order to reach a difficult optimal balance between a higher social acceptance without compromising the initial ecological goals.

Are Protected Areas Really Protecting Nature?

From an ecological point of view, the answer to that first question is not obvious anymore. If one refers, in the history of nature sciences (Acot, 1988; Deléage, 1991; Drouin, 1993) to the fundamentals of ecology (Odum & Odum, 1953), the analysis of natural areas seems to be mainly based on static principles that show the homeostasis of ecosystems, fighting against changes in order to maintain or re-reach their idealistic state, the *climax* (after Clements, 1916). This nature is mainly considered apart from the – necessarily bad – influence of human societies. Protected areas are thus a spatial response to this theoretic dichotomy, since they draw a clear line between human and natural areas, so as to protect the most exceptional species from any destruction. The very strict level of protection in many National Parks or Reserves in

1 For a broader analysis of the historical and geographic context of Protected Areas, as well as more developed explanations about the main concepts that are mentioned throughout this chapter, see more generally Depraz, 2008.

the world has indeed to do with this inherited radical approach in the history of the scientific ecology.

However, the introduction of the key-concept of biodiversity in the 80's (Soule & Wilcox, 1980; Pickett & White, 1985) has had unexpected side-effects on the way to protect nature. First of all, a more dynamic vision of natural areas has developed, focusing on the capacity of adaptation of ecosystems, regardless to their initial state. Moreover, the climax theory has been criticised, in so far as biodiversity is not always at the highest level in quasi-natural areas – if not a myth, since there are no more "natural areas", but always different evolutions of secondary vegetations because of permanent disturbances on every ecosystem. Therefore, human influence can sometimes even increase the scope of species, since some agricultural practices, such as the selective cutting of woods, the maintenance of natural hedges or terraced cultures for instance, create specific transitional areas that constitute unexpected resources for pioneer species, heliophytes, etc.

Most of all, biodiversity is not only a question of protecting the most valuable areas and species; it is also including an 'ordinary nature' (Mougenot, 2003), made of small, common species for which a lack of recognition has long existed, but which appear to have a key-role in the functioning of nature. Those species are identified as 'target species' and can serve as strong indicators of the state of conservation for a whole ecologic series. Conservation is therefore not that much a question of spaces anymore, but rather a question of species: a global protection, considering groups of species, their distribution and their symbiotic relationships. In other words ecological processes have become more important than the current location of valuable items/species, this is making protection of habitats beyond protected areas also very important.

In this regard, protected areas cannot work as a closed laboratory, sealing the most valuable ecosystems behind a tight wall: they need to be included in a more global approach, they have to be interconnected in order to constitute a coherent network, with biological corridors, buffer zones or even areas of sustainable human activities (Langhammer & al., 2007). They are not protecting necessarily a nice nature, but mostly a significant level of biodiversity. There is also not a single type of protected area, but different degrees and ways of protection, with specific management levels, sometimes tolerating adapted human activities, or even asking for specific intervention on ecosystems: monitoring, measures for the restoration of degraded milieus, management or regulation of species, etc. (Larrère & Larrère, 2009). However, this new integrative

approach of conservation management in protected areas is not always easy to develop, especially when management authorities have been built for decades in a radical state of mind, only with biologists and without specific considerations for local development and neighbouring societies – if not in opposition with the latter. One has to take in account the weight of institutional routines that makes changes in the field of conservation policies even harder.

Protected Areas, up to Which Financial Expense?

The integration of nature conservation in a broader approach of human territories and spatial planning, mainly based on sustainable development, has also raised new economic challenges in the management of protected areas. The shrinking of public financing in a global neo-liberal context, added to a new contractual and co-operative approach in regional and rural planning, has also impacted on the way protected areas are managed. Those structures have now to justify their ecological action and to struggle for financial means by establishing projects and explaining their management – in a word, by proving their legitimacy in the field of the 'economics of sustainable development' (Bürgenmeier, 2004).

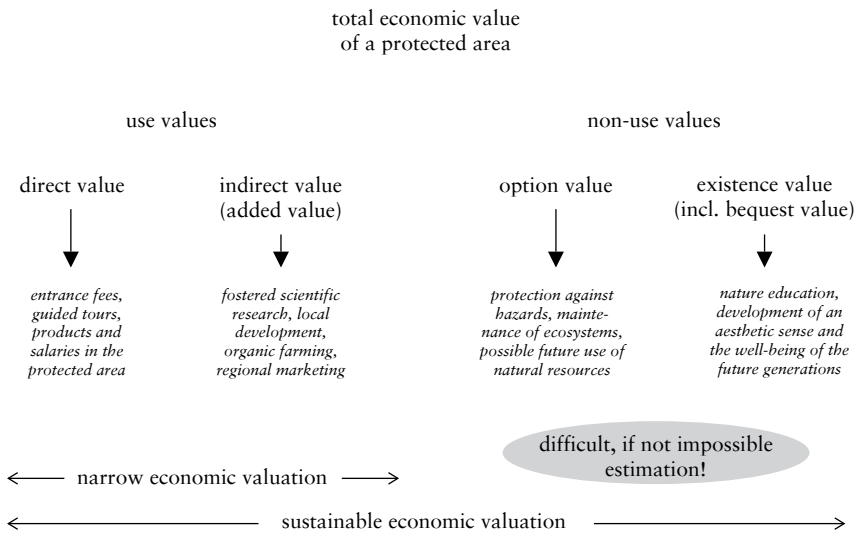
However, this legitimacy, if transformed in raw financial data and pure economic considerations, can be seriously questioned. In a narrow sense indeed, a costs-benefits analysis will always show that the costs for establishing, managing or developing a protected area are always much higher that the socio-economic benefits of it, since the expenses for a protected area are precisely located in the budget of the Authority in charge of the protected area – often a public institution, with a specific budget – and will mostly account as direct expenses. In contrary, the benefits are spatially and socially diluted, shared among a broad number of stakeholders (Authority, private enterprises living from tourism around the protected area, etc.), that is, they mostly account as indirect expenses. This spatial and social dilution of the economic benefits generated by protected areas makes their evaluation uneasy. How far does the influence of the protected areas go, and what share of the benefits can be explained by the protected areas? There is indeed a large span in the possible answers, and consequently in the financial assessment of the impact of the protected areas on the local economy. The balance often appears to be negative, making economic criticism against the cost of Nature protection easier.

In a broader sense, the principle itself of the economic valuation of protected areas appears however to be highly questionable, since the added

socio-economic value of a protected area is not only a monetary one (see **Figure 1**). The 'optional' costs and benefits caused by protected areas have also to be assessed (costs: diminution of economic opportunities in the protected areas; benefits: increase of biodiversity and future natural resources, protection against some pollutants and risks, etc.), which is a difficult exercise since one has to measure virtual data that have not occurred yet (Dixon & Sherman, 1990; Balmford *et al*., 2002).

Last, but not least, there is also a strictly social value of protected areas, that is the increase of knowledge, of well-being and the legacy that will be maintained for future generation. This is the key answer to economic criticism against protected areas, but the evaluation is again very difficult, not to say impossible. Many economic models are trying to convert this non-monetary, non-use value into a financial equivalent, such as the hedonic prices method, the cost of travel method, the renouncement cost method, or the most recent choice experiment or contingent valuation methods (Hanley & al., 1998; Hanemann, 1994). But, fundamentally, this 'existence value', mostly based on moral and ideological considerations, is turning every macro-economic analysis into a nonsense: indeed, if one considers

FIGURE 1
The Economic Valuation of the Spatial Impact of Protected Areas (Depraz, 2008)



that the preservation of ecosystems and biodiversity is a key action for the perpetuation of humanity itself, then the economic value of protected areas will tend to infinite.

In this regard, the economic sustainability of protected areas cannot be correctly assessed in a sole macro-economic valuation of costs and benefits. The question has to be laid on the political field; the cost of nature protection is rather a question of socio-economic priorities, and a relevant assessment of protected areas would rather consist in a 'costs-efficiency' analysis (Hockings, 1998; Hockings *et al*, 2006): are the financial investments put in protected areas correctly translated into ecological improvements? Are the ecological goals of the protected areas socially relevant? Are the results reflecting properly the initial goals of the protected areas? Many NonGovernmental Organisations (NGOs) working in the field of nature conservation have thus introduced new tools for the evaluation of the stage of nature conservation and the assessment of the efficiency of nature protection institutions. For instance, the Rapid Assessment and Prioritisation of Protected Areas Management (RAPPAM) methodology introduced by the WWF (2003) for tropical forests; the Forest Management Effectiveness Tracking Tool, by the WWF and the World Bank; or the Threat-Ranking System by TNC (2007). As a consequence, protected areas managers are now developing a new professional culture, clearly deriving from the private sector field.

Such questions were actually raised during the world commission of protected areas congress of the IUCN in Caracas (1992), where a task force about conservation effectiveness assessment had been launched at an international level. The Convention on Biological Diversity (CBD), in a 2004 meeting, also asked all Member States to act for a better management in existing protected areas. On a socio-economic point of view, it would be indeed irrelevant to raise the number of protected areas without securing the existing ones, and checking their action in regard to the new ecological objectives of the planet. Thus, 30% of protected areas had to be endowed with a management plan before 2010, and should strive for new financial resources by making the best possible projects, or even raising funds with public-private partnership, as any other territorial development project (Emerton & al., 2006; Stolton & Dudley, 1999). Developing the economic sustainability of protected areas has definitely turned them towards managerial considerations.

The Social Disservices of Protected Areas

On the social point of view, one can consider that there is a rather broad acceptance of the idea of protected areas, since it is easily bound to the contemporaneous 'categorical imperative' that triggers modern societies to protect nature. Many NGOs are now acting in the field of nature protection, especially in English-speaking countries, and their action is considered as a charity one, since the well-being of the future generations is at stake. However, are protected areas, and the action of their promoters, always socially sustainable? There is actually a strong debate in the conservation field between rather radical approaches that claim that nature conservation should be considered above any individual interests, since it is a universal priority – and that the general interest has to take priority over any local consideration. But other conservationist circles will point out the social cost of establishing protected areas, especially in poor or developing countries. Is the ecological expense socially bearable, when compared to the question of reducing poverty or fighting against hunger (Brunel, 2008)? Shall most vulnerable people pay for others, when a protected area is created on their usual hunting territory, depriving them from natural resources? Environmental NGOs have now enough power to secure land by purchasing lots in poor countries, or intervene on national policies by the "debt or nature swap" method, making them a real global stakeholder of conservation (Dumoulin & Rodary, 2005).

In the 80's, political contests have arisen among local societies in eastern Africa, in South America or South-Eastern Asia against the 'green imperialism' of western NGOs and their ecologic influence on poor countries (Crosby, 2004; Rossi, 2000). The social impact of protected areas has now been taken into consideration at an international level. The IUCN, after the Nairobi summit on protected areas, has developed a more participative approach of nature conservation (Kamstra, 1994; Borrini-Feyerabend *et al.*, 2004), followed by most of the biggest NGOs since it was the best way to get more social acceptance of nature conservation. In Australia for instance, the establishment of Indigenous Protected Areas in the 80's was the first tangible experience of a real devolution of nature conservation on a voluntary and contractual basis. Other co-management programmes are currently implemented in most protected areas, with the idea of linking nature protection and local development by a promotion of sustainable tourism or new local resources (Scherl *et al.*, 2004).

However, such a policy needs strong local communities and the recognition of their collective rights to be successful. In many cases, the implemen-

tation of conservation policies remain actually very conflicting on the field. In India for instance, a very radical approach of nature conservation is still applied. Living in a National Park is forbidden, as is the hunting or the use of any natural resource. However, the strong social pressure for firewood, for game or even for place to stay make these rules difficult to observe. The situation around National Parks leads to a 'shoot on sight' policy against poaching, and forced evictions occur, concerning not only informal housing, but also against the Adivasis, which are the indigenous people traditionally living in mostly natural areas (Mathews, 2005; Zérah, 2007). Violent cases of forced evictions are also frequently recorded in Africa (Brockington & Schmidt-Soltau, 2007; Brockington & Igoe, 2006). After Geisler (2003), this could be the case of 14 million people around the world, creating a new category of 'conservation refugees'. Even if this number remains highly questionable, and has even been attacked by some NGOs that raised severe doubts about the scientific value of those calculations (Redford & Fearn, 2007), the case has to be at least taken in account, as some programs financed by the World Environmental Fund of the World Bank are still openly planning some 'voluntary resettlement' or 'soft evictions' policies. The case of forced evictions is the most evident case of the possible gap between protected areas and sustainability, making the need for participatory and socially policies even more urgent.

CONCLUSION

A French defender of nature protection in the Northern Alps, Jean Eyerhalde, had these words, as he campaigned for the creation of Nature reserves in the 60's in Savoyen: *"Nature reserves are conceived to disappear"* (quoted in Mauz, 2009). He was right in a certain way, for protected areas, since their creation at the end of the 19th Century, are carrying some principles that might go in the reverse direction of sustainability. If they still depend on a radical vision of a preserved wilderness, especially in populated areas, they create economic, social disservices and might even have no grasp on biodiversity losses at a broader scale; however, if they are cleverly managed in a way that makes their goals merge into local development prospects, they can contribute to a better understanding of the goals of nature conservation, and bring an improvement of nature management even beyond their borders, so that the principles of nature conservation could apply without differences in and out of protected areas.

But as long as protected areas are necessary, they will surprisingly enough prove that a sustainable development has not been reached yet, since

human societies have not been able to completely integrate the ecological imperatives in their management of territories.

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5

Relocation and Ethics

CATHERINE MERCIER-SUISSA

ABSTRACT

The relocations, as a well-known phenomenon, are carried out with the perspective to improve the profit of the enterprise. If the reasons for relocation are various, the enterprises dominated by the cost strategy would seek to settle in those countries with low salary and social cost. In this paper, we will focus on the role of the stakeholders, particularly on the impact of these stakeholders on the decision of relocation.

Our study presents, first of all, the determinants of the relocation. Then the relocation will be studied in an environmental context in favour of sustainable development. We put in advance the social responsibility of the enterprise and the respect to ethics in order to justify its legitimacy in international activities. Facing two groups of stakeholders from a divergent vision in terms of ethics, the enterprise must protect its image with the concern of being severely punished by the consumers. In fact, the latter are the major issue of the conflicts between the stakeholders. Without the capability and the interest to understand the production process and the working conditions, they adhere themselves implicitly to relocation. The importance for the enterprise to achieve an ethical reflection is to find a balance between the interests of different actors located in the home country or host countries.

Keywords: relocation, stakeholders, low-cost country, social responsibility, ethics

INTRODUCTION

Today, outsourcing is increasingly attracting the focus of the media and calls for the protection of companies by local authorities, as well as the promotion of the territory to attract new investors. Yet, several companies have been returning to their home territory. This trend is generally identified under the term 'relocation'. We are trying to determine the impact of the stakeholders in the relocation process as well as the role of ethics in this decision.

The relocation process is a well-known phenomenon (Mercier-Suissa and Bouveret-Rivat, 2010). The incentives for a company to expatriate its activities are diverse: the search for competitive advantages does not merely translate into the reduction of wages and social costs. The reduction of transportation costs and delivery time also push the company to get closer to the consumer markets. The growing competition for foreign direct investment (FDI) also leads companies to take advantage of the fiscal and monetary dumping set up by some governments. By playing on the transfer pricing and relying on taxation differentials, companies can increase their benefits. The search for new markets and the growth of international market share justify the outsourcing operations. The reduction of market uncertainty and risks also encouraged companies to set up their productive and commercial activities in foreign countries. However, when companies are subjected to a productive strategy (in Mercier-Suissa and Bouveret-Rivat, 2007), outsourcing decisions can be made solely regarding the reduction of production costs (Arthuis, 1993). The company is therefore under a general strategy dominated by cost (Porter, 1982). In that scenario, companies will expatriate their productive activities by taking advantage of regions where the labour force is cheap and social costs are low. Our research focuses on companies which adopted this strategy.The outsourcing process allows for the exclusive pursuit of economic interests - lowering the cost of labour - regardless of the outcomes for local stakeholders, which in our study is France or the host country. The notion of 'stakeholder' was defined by Freeman in 1984 as *"a group or an individual that can influence or be influenced by the actions of the organisation"*. Hence, companies must take into account individuals' expectations, thus, different interests. Therefore, the decision to outsource can, on one hand, trigger strong tensions in the home country given the perspective of massive unemployment. On the other hand, the expatriation of the productive device can also provoke favourable reactions of stakeholders in the host country.

A company is not a detached entity from its environment. The stakeholders (NGOs for instance) can exert pressures on the company through boycott, among other means (Grolleau *et al.,* 2004). This may bring companies to reconsider the stakeholders' expectations, whose satisfaction is a key factor of success, which value equals or exceeds that of the reduction of the production cost induced by outsourcing. Consequently, by failing to improve the conditions of production abroad and its reputation, a company may decide to come back to its home country. In this regard, we are going to study the determinants of the relocation process.

First, we will review the main incentives for relocation, and introduce some key notions such as sustainable development, corporate social responsibility and ethics (I). From there, we will present the responsibilities assumed by companies (social responsibility), which are highly subjective (ethics) and depend on the value the company grants the community (II). The stakeholders influence the importance given to different values and consequently weigh upon the companies' decisions to relocate through the signing of binding legal agreements.

We will finally present the position of those stakeholders in favour of outsourcing in countries with low labour costs, as well as the ethical concerns this process may bring up (III.1). Then we will analyse the behaviour of stakeholders who value the respect of ethics, through the analysis of their means of pressure over a company's strategy (III.2).

WHAT INCENTIVES DO COMPANIES HAVE TO RELOCATE?

In order to determine what leads companies to relocate, we conducted a series of interviews, and compiled press articles on the issue (Mercier-Suissa, 2008; Mercier-Suissa and Bouveret-Rivat, 2010). Most of the time, companies underestimate both the cost of outsourcing and of production management abroad. Moreover, piracy risks are high where the cost of labour is low and the quality is far from optimum, which eventually induce a rise of the supervising costs. Whereas the company used to be highly reactive in its home country, the distance also causes poor flexibility. We list below a series of incentives for companies to relocate their production:

– Industrial development occurring in most of the host countries leads to the increase of local wages,

- Labour productivity in France surpasses that of countries with cheap labour forces, where more time is spent producing the same good,
- Low wages may come along with very necessary and costly training, weak productivity and consequent turnover of the personnel,
- With the increasing mechanisation of production, the share of labour costs have been significantly reduced in the cost price,
- Consumer's versatility and just-in-time production circuits require companies to be highly reactive, which may be incompatible with increased production deadlines,
- Distance constrains creativity
- Distance fosters complications that are harder to manage from abroad,
- Risks of loss or stealing, capital immobilisation, customs duties, anti-dumping taxes, increased transportation costs, outstanding products over long periods of time (3-9 months) all weigh heavily on cost price.

Henceforth, the costs of outsourcing operations may exceed their benefits, with the exception of fields requiring lots of unskilled labour (e.g. textile industry), where low wages highly increase competitiveness. Indeed, when accounting for wage differentials, productivity differentials, and coordination costs for remote activities (transportation costs and deadlines, quality problems, untrustworthy contractors, insurance costs, judicial insecurity costs, etc), several small and medium enterprises (SMEs) came to the conclusion that it was more profitable to stay in France rather than to engage in outsourcing operations. The underestimation of distance-related difficulties increases the supervision costs. However, these costs are measurable, and today, companies include in their calculation a new element regarding their corporate social responsibility.

By taking into account this new dimension and by analysing the role of stakeholders following an outsourcing operation, we wish to enhance our understanding of the relocation phenomenon.

We have already shown that it is necessary to think in terms of overall cost in order to fully assess the benefits, or lack of, outsourcing operations (Mercier-Suissa, 2008), but also because consolidating other factors than costs leads to an improvement of the company's competitiveness. Stakehold-

ers exert a strong pressure on the company in its operations abroad, for it to comply with the company's ethics. Ethics is an arena of tensions, situated between the company's interest, collective interest and the others' interests (Mercier, 2004). The main issue for the company is to reach equilibrium between those different actors' interests, both at home and in the host country.

IN WHAT KIND OF ENVIRONMENT DO RELOCATIONS OCCUR?

Companies have to operate in a global and highly competitive environment. In addition to those constraints, they ought to take into account the environment, that is to say, the different actors' interests. Because individuals, such as employees, or groups of individuals (unions, consumers, NGOs, etc) are affected by the company's activities, we can ask ourselves whether those groups may affect the company in return.

Through the rationalisation of their production device, companies focus on the most profitable localisations, which are countries with cheap labour force, and adequate productive facilities (energy, communications, transportation, etc), in Eastern Europe (Poland, Czech Republic, Hungary, Romania), Latin America (Mexico, Brazil), and most of Asia (China, Thailand, Malaysia, Philippines), where the productive process can be outsourced, or executed by subcontractors. The increase in the number of subcontractors, and contract manufacturing in general in the world, makes it more and more complex for the prime manufacturer to control its production device (Mercier-Suissa, 2009), and for unethical management behaviours to thrive. Unethical management practices are to be understood as any endangering practices (because of the products used or the productive process itself) for human health and security. Those practices, once known, are subjected to public denunciations, which effects are highly negative for the company. Therefore, whenever there are ethical questioning on the impacts of the company's activities on others, the notion of corporate social responsibility (CSR) comes to the forefront.

Bowen (1953), who is considered by Carroll (1999) to be the founder of societal responsibility, indicates that the latter *"calls for the businessmen's duty to make decisions and follow guidelines in compliance with objectives and values that are considered to be desirable by the society"*. CSR accounts as an element of companies' legitimacy. Laufer (1993, p.78) highlights that *"being profitable does not provide enough legitimacy anymore, but it is nec-*

essary for the company to show that it takes on its societal responsibility and is aware of its new ethics". Pasquero (2002, p.42) indicates that 'societal performance has become key for the company's legitimacy'. Therefore, a strategy in which the company only seeks immediate benefit might lead to immoral, unethical, and sometimes illegal activities (Andrews, 1987).

Liberals argue that the companies' ultimate goal is to be profitable, an idea which is supported by the neoclassic theories, which state that the maximisation of the company's wealth will lead to the maximisation of collective welfare. However, Drucker (1954) nuances these stances, as he considers that if the prime responsibility of a company is to be profitable, it also has to envision the impact and consequences of each of its actions and policies on the society (p.388): *"It (the management) has to consider whether the action is likely to promote the public good, to advance the basic beliefs of our society, to contribute to its stability, strength, and harmony"*. This idea is engraved in the logic of sustainable development, which the companies' stakeholders have widely endorsed.

THE STAKEHOLDERS' STANCES

It is common to say that companies should be able to broker a compromise between all the stakeholders so as to satisfy everyone. In a simplified scheme, stakeholders fall into two categories when it comes to ethics. The first group is in favour of outsourcing in countries offering low costs, and does not see ethical considerations as a priority when it comes to making profit. However, the second group is directly and negatively impacted by the outsourcing process and the unethical behaviours that may come with it and thus it is opposed to outsourcing. Hence, these two groups have highly divergent interests. They put forward their own particular interests, and perceive management differently. We will examine these different stakeholders, and their own conception of ethics. Which stakeholders are influential in countries with low salary costs? Why do they want to impose, or not, the respect of a certain ethics?

The Stakeholders in Favour of Low-Cost Country Outsourcing

First and foremost, the 'stance of the governments' in these low cost countries needs to be analysed. Foreign direct investment (FDI) is considered to be driving international trade, and is thus a pillar of economic growth and development. FDI is a vector of technological and skill transfers for trading countries.

Therefore, governments strive to make their countries attractive for potential foreign investors by lowering taxes or setting up treatments of favour for those same investors. For instance, foreign companies in Hungary received 92.6% out of the entire country's fiscal cuts in 2000 (Godek-Brunel & Mercier-Suissa, 2009).

Gasmi & Grolleau (2008) highlight the fact that low cost countries, in order not to hinder their competitive advantages in comparison with other developing countries, engage in a fierce 'race to the bottom', explicitly or tacitly. Gorce (2000) defines social dumping as *"any practice consisting, for a state or a company, in violating, going around or degrading, more or less deliberately, social laws in application - whether they are national, communitarian, or international- in order to gain economic advantages, especially in terms of competitiveness"*.

Therefore, governments end up promoting the violation of fundamental rights to attract foreign investors. For instance, Gorce (2000, p.42) denunciates how the state of Yucatan in Mexico advertised on billboards: *"There's no way I can get my labour costs down to $1 an hour; – Yes you can: Yucatan"*. Similarly, Honduras exhibited the following: *"Want to cut your labour costs? Cut here"*. As for Bangladesh, the government promoted that in order to reach the 'optimum profit', the country *"offered the lowest costs yet a productive labour force"*, but also that *"laws forbade the constitution of unions in certain areas"* and that *"going on strike is illegal"*. Moreover, most employees in those countries are willing to endure really harsh working conditions, as long as they are getting paid.

Andreff (2001) explained that in developing countries, *"the outsourcing threat is used as a tool to discipline the labour force in terms of wage and working conditions"*. As a mean of pressure, the threat to outsource or relocate enables companies to nip in the bud any wage claims. The threat of waterfall outsourcing used by multinational companies (MNCs) weighs on low cost countries wages so heavily that the Center for Research on Multinational Corporations (SOMO) read this slogan on a Nike sub-contractor in the Philippines: *"What would I do tomorrow if I lost my job?"*

The Role of Stockholders

The role of stockholders is oftentimes decisive in outsourcing strategies. Rebérioux (2008) identified two types of models concerning stockholders: 'the shareholder model' and 'the governance partnership model'.

- The shareholder model relies on the idea that both corporations' leaders and administrators ought to serve the sole interest of the stockholders. Following this idea, leaders and stockholders engage in an agency relationship, where the principals (stockholders) hire agents (managerial team) to manage the company. The stock market value of the company summarises the stockholders' interest, and represents the best indicator of performance of the company (Tirole, 2001).
- The second model, of governance partnership, takes on the idea that the company's interest trumps that of the stockholders in order to take into account the other close stakeholders' interest, such as the employees'. This partnership model leads companies to grant importance to their corporate social responsibility, and outsourcing operations in low cost countries are oftentimes subject to controversy.

As for consumers, they are also in favour of outsourcing, to the extent that the quality of goods they buy is satisfying enough and that the price is relatively low. However, this consumer's acceptance of outsourcing is limited. Indeed, consumers accept the existence of harsh working conditions as long as they have no idea about it. The consumers archetype according to Grolleau *et al.* (2004) can be defined as following: *"'I really don't want to know that my clothes are made under bad working conditions, but once I know, I want improved conditions so I can enjoy consuming again."*. Among consumers, there is not only a lack of will to oppose unethical practices, but also a lack of information. They often are in a paradoxical situation: both victim and promoter of outsourcing, as their jobs are threatened by it, but it also boosts their buying. Nationalist consumption, which consists in buying products from the home country instead of import goods, is still rather seldom seen.

Whereas governments in low cost countries and stockholders uphold outsourcing upstream, consumers do not impact the decisive process from the start. Ultimately, outsourcing operations are to enhance a company's competitiveness, which can translate into a rise of its benefits, and not necessarily into lower prices for the consumers. For this reason, consumers behaviours weigh more after the company decides to outsource its production, as they can reduce or cut their consumption of goods produced abroad and imported in the home country.

The Stakeholders Opposed to Outsourcing in Low Cost Countries

Those stakeholders can be found among interest groups such as NGOs, unions, Human rights associations, and the media. Whawell (1998) draws upon the interest groups classification made by Finer and Stewart in 1958, and identifies two different categories:

- The first group is composed of 'sectional pressure groups'. It is made of individuals from well-defined constituencies to represent the interests of the constituencies' members. Unions belong to this group for instance, as well as guilds, business groups, or resident associations.
- The second group is made of 'promotional groups'. It is harder to identify this group to the extent that its members' interests are very wide and diverse, such as the fight against fur trade or against the construction of a second highway, etc.

Kimber and Richardson (1974) differentiate these two groups as following: *"sectional pressure groups seek to protect the interests of a particular section of society, while promotional pressure groups seek to promote causes arising from a given set of attitudes"*.

In the first group, unions will start advocating even before the outsourcing operation starts; in order to prevent it from going any further and relocation will be seen as a victory. However, depending on the country, the unions' stances can vary. Vanommeslaghe (2001) showed through the example of Levi's outsourcing of four production units (3 in Belgium and 1 in France), that unionists' behaviours differed by a lot. In Belgium, unions set up a minimum production and rapidly voted for a designed social plan. Yet, in France, unionists, after hearing about the outsourcing decision, decided to show the corporation their commitment to the brand. Then, unions organised street protests and press statements to get the officials' attention. The employees even offered to cut their wages by ten percent in order to keep their jobs. Ultimately, three employee representatives even considered going on a hunger strike on the production site. The French employees' confusion was sharpened by the fact that they believed that Levi's benefits were more than satisfying, that the corporation was the international leader on the denim market, and regarding its' corporate social responsibility, ought not to outsource its production.

As for promotional pressure groups, their members defend the respect of fundamental conventions drafted by the International Labour Organisation (ILO). To Whawell (1998), NGOs managed to be heard: *"... these (promotional form of pressure groups) are now successfully finding and increasing their voice, despite their apparently weak position"*. Whereas the first generation of NGOs reasoned in narrow terms: 'Not in My Backyard', as they advocated for the enhancement of working conditions in their home countries, the second generation broadened its scope of activity and influence by funding its reasoning on universal rights: 'Not in Anyone's Backyard' (Grolleau *et al.*, 2004). Henceforth, along with the pressures these groups can exert on governments, they also directly impact companies, wherever they are. Their intervention capacity has been strengthening as they resorted to new technologies of information and communication, which enable them today to deliver accurate information to consumers at all times. Smith (2003) argued that "*More extensive media reach coupled with advances in information technology (e.g., NGO use of web sites) has allowed rapid and widespread exposure of alleged corporate abuses even in the most remote corners of the world*".

NGOs are to the public an incredible and reliable source of information and action on multinational corporations. This reliability can be explained by the fact that NGOs are trusted to act for the public interest, and not just their own, unlike corporations. Biagiotti (2001) mentions an investigation in several industrialised countries (Australia, France, United Kingdom, Germany and the US), showing that NGOs benefit from a very positive image and are highly trusted by the public opinion, especially with regards to the issues of the environment, health and social policies. Manasian (1998) also indicated that *"over the past 20 years, hundreds of human rights NGOs have been forced to document and publicise abuses, proselytise for legal change, chivvy governments, deliver aid and arouse public opinion. Human rights non governmental organisations now participate directly in policy making and have become highly skilled at media relations"*.

Henceforth, the stakes are high for companies under scrutiny. Activists can resort to different means of pressure, such as boycotts, special certifications to differentiate certain products, website attacks (including hacking, aggressive mailing campaigns, viruses, etc).

Those kinds of pressure are even more effective that the media have gained a strong interest in outsourcing related issues, starting with the Nike case (Kahle *et al.*, 2000). The sports brand has been the object of numerous

negative advertisements, of TV coverage, and of multiple website denunciations with destructive impacts on the company. Starting in 1990, the press released a number of articles based on NGOs reports criticising Nike's unethical practices, as well as those of its sub-contractors. The year 1997 marked the peak of critics against the company, with 159 articles dealing with the issue of 'sweatshops', 79 on child labour and 59 on exploitation. In 1998, Michael Moore shed light on the awful working conditions set up by Nike's subcontractors in his documentary "The Big One".

Those critics were the fruit of the tactical alliance between associations defending social rights and the media, and contributed to the strengthening of the link drawn between the brand and unethical practices. Bartoli (2003) highlights the causal link between the steep fall, by more than 49%, in Nike's benefits between 1997 and 1998, and the inquiries by pressure groups and the press on the disastrous working conditions in the brand's subcontracting units in Asia. The threat of a company's image being destroyed is very concerning, as its reconstruction is incredibly costly. Moreover, it is almost impossible to rebuild an image similar to the first one, before the accusations (Raiborn & Payne, 1990). The shame factor is therefore crucial for any company that operates abroad, and needs to be carefully taken into account by those entities.

More recently, a new generation of activist groups rose and rejected direct confrontation with the companies, promoting cooperation instead. Such situations of cooperation between activists and companies are developing once the latter realise that upholding ethics can be profitable in terms of reputation, of employees' satisfaction and of productivity gains. Working with ethical activists can lead to a net gain rather than a net loss, and reinforce the firm's standing. We can therefore talk about ethical alliances (Grolleau *et al.*, 2004). These relationships pertain to long term strategies and have a very strong impact on the company (Roux, 2005). Green alliances between companies and environmental associations (Hartman & Stafford, 1997) follow this scheme. These partnerships are as beneficial for the companies as for the ethical groups. Therefore, the mere fact of engaging into ethical activities enables companies to enhance their image, while being flexible and efficient, to better their reputation as a socially responsible company, to differentiate themselves from their competitors, and above all, to reduce their likelihood of becoming a target for activist groups.

In France, in order to enhance their image, several companies gathered with NGOs and unions (CFDT) to create the group "*De l'éthique sur*

l'étiquette" (Ethics on the label), as to encourage the food industry companies to encourage the respect of fundamental social rights among their suppliers. Some food retailers, such as Auchan and Carrefour, have provided their buyers with training and have inspected several of their suppliers in order to grant them a social certification. It is, among other things, a means for the company to differentiate itself from its competitors, by fostering the image of a socially responsible corporation. Companies communicate on this aspect by adopting and publishing ethical charters. In order to limit the hindering of their reputation and image, as well as to avoid boycotts or threats of prosecution, companies advocate loudly for their compliance with ethical norms.

Codes of good practice are multiplying. Bartoli (2003) reported that in 1991, Levi's investigated the working conditions at its subcontractors units, following complaints from human rights associations and the opening of an investigation by the State Department on working conditions in the textile industry. The company accounted for its partial responsibility where unethical practices were uncovered, and adopted a code of good practice a year later, according to which its partners ought to uphold ethical standards compatible with those of the jeans brand. In the same way, after being accused of resorting to appalling working conditions in El Salvador by the National Labour Committee, GAP subscribed to a code of good practice in 1995. International non binding norms (ISO 26000 working conditions) have been flourishing in the past decades, and constitute today a framework for the companies' corporate social responsibility.

However, depending on its positioning on the value chain, a company is more or less impacted by those actions. Companies that do not directly sell to the final consumer face lower risks as they are less exposed to boycotts. They are also less known by the broad public, thus benefit from an *omerta* concerning their unethical practices. Yet, such practices are limited to the extent that the main companies can be submitted to pressures from the NGOs, and can exert pressure themselves on their suppliers for them to comply in turn with fundamental social norms. Eventually, the fact that the company can control neither its suppliers nor its production abroad may constrain it to relocate, all or parts of its productive process to its homeland. Henceforth, the respect of ethics within companies now corresponds to a double constraint: they have to meet the stakeholders' expectations, while enhancing their competitiveness by strengthening their image.

CONCLUSION

The idea that companies' prime mission is to be profitable regardless of any other considerations has turned out to be false. We have gone from a situation in which companies had to make as much money as possible to please their stockholders (Friedman, 1962), to a constraining environment in which beyond the bottom line, it is necessary for companies to take into account their social responsibility if they want to be legitimised (Laufer, 1993). Henceforth, the stakeholders' expectations have become pivotal. Stakeholders went from being passive actors to highly conscious and capable entities defending their own interests. Image and reputation are key elements for the company, and their restoration is very costly and almost impossible (Raiborn & Payne, 1990).

Consequently, the role assumed by stakeholders is particularly important when it comes to the decision to relocate or not. Under the pressure of ethical groups, that may cause financial losses for the company, corporations now realise that satisfying these stakeholders' interests may be an element of success in terms of value, at least as important as that of the reduction of production costs induced by the outsourcing operation. The relocation of productive and commercial activities in France enables companies to enhance their public image. By fully endorsing their corporate social responsibility, they will be perceived favourably by the stakeholders. Therefore, today companies strive to reach trade-offs between profitability and legitimacy.

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6

Sustainable Management of Historic Urban Centres

James Ritson

ABSTRACT

There is an increasing acceptance that in dealing with the existing built environment is critical if carbon reduction and other sustainable goals have to be met. While frameworks have been developed for much of the built environment, the frameworks for refurbishment and redevelopment of historic centres remains at best ambiguous. It is accepted that sustainability involves environmental, economic, social and cultural issues. While sustainability has very much entered the public consciousness, cultural and social issues are rarely discussed by the general populous in terms of sustainability, this is not to say that the culture and social environment of our cities and surroundings are not discussed, but it is rarely seen as an equally important aspect of sustainability. In areas of enhanced historical value, cultural history and obvious historical importance there is a heightened awareness of the importance of the built environment and its effect on the cultural heritage. In many areas of heritage and cultural importance the focus tends to be on preserving the tangible historical assets and this preservation is often at the cost of meeting the local needs of today and tomorrow.

INTRODUCTION

This paper aims to show that historic centres are intrinsically sustainable. Cities and through sustainable management, historic urban centres, can have a sustainable future. There needs to be an acceptance that preserving historic assets, both tangible and intangible, is part of cultural sustainability. Also the key focus of any management strategy, for a historic urban centre,

should be focussed on preserving 'a sense of place'. This paper will discuss the many often conflicting policies faced by historic centres and the possible consequences that incorrect policies can have on the very heritage that they are seeking to protect. There is an increasing acceptance that dealing with the existing built environment is critical if carbon reduction and other sustainable goals are to be met.

While frameworks have been developed for much of the built environment, the frameworks for refurbishment and redevelopment of historic centres remains ambiguous at best. Many of the standard practices for refurbishment of existing buildings and urban renewal can have disastrous results on historic buildings and their inherent cultural heritage. The 'one size fits all strategy' is problematic while dealing with historic towns and their buildings this is particularly apparent when applying standard refurbishment methodologies to historic buildings. Management of historic centre needs to be both 'top-down' as well as 'bottom-up'. The involvement and empowerment of local businesses and residents as well as clear leadership from large civic bodies such as the mayor's office, planning departments and tourist boards is necessary for the success of any management and development policy in an historic urban setting.

PROBLEMS OF DEFINING HERITAGE AND CULTURAL HERITAGE

The very notion of heritage and its definition is an area where conflicting and disputing arguments exist. Many define heritage as merely a form of a product in a process of preservation and conservation which is more concerned with the consumption of the asset rather than the preservation of what already exists. (Nassar, 2003). It is well recognised that the preservation and management of historic properties cannot be a purely commercial operation (Cullingworth & Nadin, 2006). However, Nassar (2003) argues that if heritage cannot logically exist without the consumer then in effect the consumer defines the very heritage needing to be preserved. *If heritage is objective and defined by the 'consumer' be it visitor or resident.* There could be a question of preservation of assets that might be very unpopular at one time but non-the-less an important part of the history of the place or centre. Another example, may be a symbol of an 'over thrown' political regime, should it be destroyed as a symbol of its unpopular link to a part of history that the populous want to forget, or should it be preserved as a part of the centre's history. In such situation an overriding national or international body such as UNSCO may need to inter-

vene and mediate between the opposing bodies. The acceptance of the history and heritage of the place may involve unpleasant aspects of the past, often difficult and controversial, but may be a necessary part of any conservation framework or management plan, if the true past is to be preserved for the future generations. This part of cultural sustainability, and what in fact constitutes sustainable heritage, shows, as with many areas of sustainability, there is more than a hint of contradiction on the priorities given in sustainable Heritage. (Cullingworth & Nadin, 2006). Defining Heritage may be a complex task but one thing that is clear is that if something is to have heritage status does not mean that it has to be historic. Modern artefacts can have clear heritage potential and are meaningful to the wider population.

Historic centres represent layers of evolving forms of architecture and urban grain that together have created a sense of place. Many towns have evolved over time and hence offer a variety of architectural responses, reflecting status and function through styles and technologies. These towns can be faced with the problem of favouring certain periods or architectural styles over others; as a result, less favoured areas often fall into economic decay and fabric deterioration whereas others receive priority funding (Nassar, 2003). Built heritage assets encompass a wide range of different buildings, it is not only confined to the grand and outstanding but even modest buildings can be recognised for their heritage significance (Judson & Iyer-Raniga 2010). By accepting that heritage does not have to have an historical component, it can be better viewed as having a constantly evolving entity. This definition can be further stretched in relation to historic urban centre to say that as the city evolves as does its heritage evolves and remains evolving to the current day.

Cultural heritage is made up of a series of complex interconnected processes which are both global and local (Urry, 1995). The understanding of how the connections and processes affect local community as well as other key fields of sustainability is vital to the sustainable management of change and preservation within historic centres. Cultural heritage encompasses not only the material objects themselves but also their *meaning* as understood by the wider populace. This is often articulated as either tangible or intangible. The tangible refers to the fabric of the physical material of the place including the buildings the objects in the artefacts and the intangible heritage refers to the nonphysical components including traditions, social practices, skills and memories (Judson & Iyer-Raniga 2010). Understanding cultural heritage and its value is important in preserving a sense of place within historic centre. The values may not be

tangible or measurable in numerical terms but the notions of values are critical to sustainable heritage, values give significance and differentiation. The question of values is a key issue in modern conservation with the very notion of heritage is an area of conflict and contention with different views on what constitutes heritage and what is worth conserving (Judson & Iyer-Raniga 2010).

SUSTAINABLE HERITAGE

It is accepted that sustainability involves environmental, economic, social and cultural issues. While sustainability has very much entered the public consciousness, it tends to focus on environmental elements such as carbon emissions, energy consumption and recycling. With the economic downturn, economic sustainability has increasingly entered the public awareness (Tweed and Sutherland, 2007). However cultural and social issues are rarely discussed by the general populous in terms of sustainability. This is not to say culture and the social environment of our cities and our surroundings are not discussed, but it is rarely seen as an equally important aspect of sustainability. Cultural heritage is an important part of social and community well-being that communities need, and of a wider understanding that heritage is both tangible and intangible. It may be obvious to count the built environment as a tangible piece of our heritage but it also can encompass many intangible less well understood heritage and cultural issues.

Sustainability is commonly defined as meeting the needs of today without endangering the needs of tomorrow. In areas of enhanced historic value, cultural history and obvious historic importance, there is a heightened awareness of the importance of the built environment and its effect on the whole cultural heritage. In many areas of heritage and cultural importance the focus tends to be on preserving the tangible historical assets and this preservation is often at the cost of meeting the local needs of today and tomorrow. Historic urban centres are arguably intrinsically sustainable as they have demonstrated, through their longevity, their ability to respond to and survive significant change; They possess many of the more recently defined sustainability criteria, through inherent evolution of place and process that is present in constantly evolving historic cities.

Historic buildings are a finite resource as are all historic assets and need careful management, care and attention if the intrinsic cultural and historical value is to be preserved. Increasingly there is the recognition of tangible and intangible heritage by policymakers to be an important part of our national as

well as regional and local heritage. However the two most common forms of preservation of listing individual historical assets and building and the designation of areas of conservation does little to preserve anything but the physical parts of our built environment heritage. (Tweed and Sutherland, 2007).

By an understanding of a historic centre as an sustainable city and that heritage is a constantly evolving process: the correct way to manage the city would be through a thorough enforcement of the full gamut of sustainability criteria. Preserving the historic built environment is an environmentally sustainable working framework; via the recognition of the embodied energy inherit within the existing buildings. Their age proves their long-term durability and the use of vernacular materials and methods provides an exemplar of both cultural and environmental sustainability methodologies by the use of local materials and workmanship. (Carroon, 2010). The very existence of many historic buildings proves adaptability often absent from modern architecture. The Georgian terrace houses of London, for example, have not only found continual use as sole residences but have also been converted into flats, offices, as well as other commercial premises. These changes occur internally with little or no change to the exterior of the building, thus, preserving the street and area's sense of place, its genus loci.

The potential conflict between environmental and heritage preservation remains an area of contention due to various problems. Part of the problem is that policy makers, planning for climate change are faced with a lack of reliable data about the environmental performance of historic building fabric (English Heritage, 2006). This is exacerbated by the lack of consensus as to the terminology and definitions used between the various policy makers, professionals and all of those working in redevelopment and refurbishment. Within Architecture, it has been accepted that specialist knowledge is needed when dealing with historic buildings, by the setup of specialist registers and qualifications. The same professional rigor and registration is needed with the professions and trades involved in application of sustainable technologies such as renewable energy systems and other energy-saving technologies in historic buildings. Historic buildings behave very differently from contemporary buildings (Cassar, 2006). With large variances in construction techniques and vernacular building materials, detailed local knowledge is normally required to make a correct decision on the materials and technologies to be applied to the building to help lower energy consumption and emissions, while at the same time preserving the heritage of the building. An ex-

ample is the introduction of insulation to the outside of the historic building, which can both damage the building fabric as well as impact on the intrinsic cultural value of the building.

THE CONFLICTS BETWEEN VISTORS AND RESIDENTS

One of the most common conflict of interest is between residents of a historical centre and visitors. The perceived economic benefits of tourism are often made a higher priority than the needs of local residents, who can through rising economic pressures, move out of the area. Is this truly preserving the heritage of an area? Many historical urban centres face continual often opposing pressures of redevelopment and preservation. By focusing and prioritising tourism as an economic driver there is a danger that traditionally resident focused local economies will be severely and permanently damaged. The economic benefit of tourism may not be as relatively high as first perceived with as little as 20% to 25% of the income staying within the local economy (Nassar, 2003). Any development framework strategy will have to look at both local and visitor needs in equal measures often compromising between the interests in an effort to establish year round economic stability and growth, while still preserving cultural and historic heritage of the site.

Many historic centres have become desirable places to live raising residential house prices, office and retail unit rents beyond many local residents. This forces many traditional industries and local everyday services for the workers and residents out of the area. These are often replaced with tourist only orientated enterprises. Vital services and local industries and crafts need to be preserved as a matter of course as these form much of the intangible as well as tangible heritage of an area. To make these industries competitive all should be done to help the local businesses and many free market forces must be kept in check (Pickard & Thyse, 2001).The application of latest technology should be embraced not resisted in historic centres. Many technologies available today have many benefits and if sensibly and responsibly used and hugely increase the economic sustainability of the centre.

THE COMMERCIAL AND RETAIL SECTORS IN HISTORIC CENTRES

The temptation of the boom and bust development strategy and what has been seen as an unsustainable economic model of short-term gain must be resisted by those responsible for the management and planning of urban centres.

This has been shown throughout Europe as a road to ruin for historic centres. A much more holistic response to long-term growth and year-round prosperity is needed rather than short-term quick gains. Developing a strategy for this continual growth can often lead to competing and often opposing policies.

One of the key elements highlighted by all of the literature reviewed in this study is the need for keeping people living in urban centres. This is true of all urban centres not only historic centres. Residents not only provide a cultural but an economic tax base for a town to build upon. People provide the active life of the city and the continual heritage growth of the city. The management of commercial and retail sectors of the historic centre can be crucial to both the cultural, social and economic success of the centre in the future. The growth of the term clone town has long been a warning for many historical centres. While the inclusion of some brands may act as an incentive of growth, not only bringing in business for themselves but also for surrounding businesses. However, Too many national and international brands may end up making the commercial centre of the historic town seem like a copy of many others. Thus, losing its character and the very heritage it seeks to preserve and values. The preservation of 'a sense of place' is the key factor in the management of historic centres.

HISTORIC CENTRE ARE SUSTAINABLE CITIES

Historically sustainability was an issue of survival, building materials were chosen because of their inherent sustainability criteria due to their availability locally and their cost. Historic buildings need to be maintained and redeveloped utilising sustainable, suitable materials which could be different to those buildings of contemporary construction. Historic buildings often require completely different building skills and technologies as well as different working methods. The decrease in traditional building skills can often lead to a skill gap and a replacement of non-suitable building methods and materials because of the lack of availability of the preferred building methods and skills. This shortage of specialist knowledge and shortage of traditional building skills has led many organisations such as the National Trust, UK (National Trust, 2011) to set up apprenticeships in traditional building techniques to help preserve their building stock. This specialist knowledge is critical for the sustainable preservation of historic centres. The need to keep traditional building skills alive as well as understanding how traditional buildings can be redeveloped adapted and improved environmentally is crucial to the success

of any urban historic centre. Treating historical buildings in the same way as contemporary and more modern buildings can lead to increased rates of dilapidation and an increasing number of faults as well as the distinct possibility of key cultural and historical features being unnecessarily lost.

SETTING PROPRIETIES IN HISTORIC URBAN CENTRE MANAGEMENT AND DEVELOPMENTS

A centre's heritage and historic value is derived not just from singular assets but it's sense of place. A unique sense of place draws together the multitude of factors that give an historical centre its character and cultural value. It is this sense of place that can be threatened by both the free market forces and tourist focused interventions. This preservation of the inherent sense of place is key to successful sustainable management of historic centres. The need to accept that change is part of heritage is crucial for the sustainable development of historic centres. The historic built environment is not immune from needing to change, not only because of the need to reduce carbon emissions but also from other social and economic changes and demands. Many historical assets need protection with careful conservation and restoration. These assets need to be carefully chosen and designated as critical - important historical assets that help make up the character and appearance of the historic centre. The asset itself may be either tangible or intangible but crucial to the historical and cultural landscape of the historic centre. (Strange, 1997). The careful designation of these 'critical' assets is a necessity. Too many and the necessary changes required to make the historic centre sustainable may not be able to happen. Too few and the centre may lose a critical mass of historical assets that are needed to keep the centre's genius loci. Other spaces within the city centre, inter-spaces, need as a careful protection as the more tangible buildings. Streets, alleyways, squares and parks as well as they makeup and bind the city centre. Historic centres are often dense, tight, urban environments, much more so than modern cities that are designed around vehicle access. Therefore spaces in between buildings are vital and need addressing with the same importance and detail as the buildings themselves. Even more important are the larger urban spaces within historic centre such as central squares, plazas or cathedral grounds all of which have traditionally been the communal focus for an historic town.

The infrastructure of an urban centre, both physical and digital is vitally important to the sustainable development of any urban centre. Thus,

connectivity of a historic centre is as important as in a financial urban centre. In an increasingly shrinking and interconnected world, both physical and digital is rapidly increasing in importance. The need for transportation both public and private is key to both the economic and cultural sustainability of any urban centre. The needs of the car are often one of the most damaging factors in historical centres (Insall, 2000). The often narrow winding roads of historical centres such as in York with The Shambles and in Evora in Portugal is often in conflict with the more desirable wider open roads needed for efficient traffic flow. However as with many problems this can be turned into areas of opportunity. Many cities around the world such as London, Paris etc. are publicly and by policy trying to encourage the use of bicycles to replace the daily use of cars. Historical centres are designed not for the car but for the cart and are ideal to be seen for the encouragement of bicycle and pedestrian use. This is as a simple example of how by a different view of looking at an issue can help provide a solution for sustainable development within these areas, often difficult in policy terms. The perceived need for private vehicle ownership is often seen by the general populace as a requirement for modern life where are many situations through better connectivity integration of both physical and virtual connections such as high-speed broadband and a well-integrated public transport system the need and the necessity for cars in historic urban centre can be reduced.

Most historic centres can be defined as 'compact cities'. The compact city with its high density mixed use urban developments which have walk-able neighbourhoods and good public transport provision this is the traditional form of many historic towns, as well as being seen as the urban form of choice for a more sustainable urban future. The compact city strategy has been implemented both by central and local government, throughout Europe (including the UK), America to respond to the urgent need for a more sustainable and environmentally friendly future for the built environment (Rice, 2010). The identification of 'compensatable' assets which can be changed or redeveloped or altered without losing the historical value of the surrounding area are important to the development and sustainable management of historic centres. These assets may be previously poorly designed modern interventions as well as the more controversial redevelopment of historical buildings themselves. Without these designated areas there is a danger that growth of the historic centre will happen to the outer reaches of the centre. This decentralised growth brings the risk of urban sprawl and the loss of density and activity that traditionally most

urban centres are built upon. By understanding that culture is derived not from the buildings but from the people who live, work and play out their daily lives, Architects and planners will need to adopt a more progressive approach to sustainability, through their designs and developments, while rejecting objectism this embraces and reinforces of the historic sense of place.

The need to keep local crafts and skills and businesses alive within urban centres is critical to the continual development both economically and culturally, to keep historic urban centres alive. By making policies that encourage small local and traditional skills, often has a much more beneficial long-term economic growth pattern than the encouragement of new and often alien enterprises to come in and replace them. By designating areas that can be sympathetically redeveloped regenerated and changed, growth can be brought back into the historic core and help continue sustainable growth of the urban centre. The historic street patterns and place boundaries should be maintained and new buildings which offer contextual continuity rather than historical replication (Rodwell, 2007). Conservation in relation to the built environment should be about preservation of the locality of place as much as the work on the building itself. 'Critical' historical assets are not only merely historic but the asset if significantly changed or demolished, represent a threat to the place and setting itself (Urry, 1995).

The temptation of the boom and bust development strategy has been seen as an unsustainable economic model of short-term gain must be resisted by those responsible for the management and planning of urban centres. This has been shown throughout Europe as a road to ruin for historic centres. A much more holistic response to long-term growth and year-round prosperity is needed rather than short-term quick gains. Developing a strategy for this continual growth can often lead to competing and often opposing policies. People provide the active life of the city and the continual heritage growth of the city. The management of commercial and retail sectors of the historic centre can be crucial to both the future cultural, social and economic success of the centre. The growth of the term clone town has long been a warning for many historical centres. The inclusion of some brands may act as an incentive of growth, not only bringing in business for themselves but also for surrounding businesses. Key important services such as banks, post offices, general food stores as well as public services, are as necessary in an historic centre as in any urban centre (Knox & Mayer, 2009). These services are used not only by the residents but also by visitors to the historic core. Some successful pro-

tectionist policies can be seen in centres such as on the Isle of Man and within other controlled planning areas of cities such as Exmouth market in London UK. These policies do not completely bar large brands both international and national coming into urban centres but make sure that they do not come in at the sacrifice of either established local businesses or without altering the traditional streetscape. While major brands may want to bring in their corporate logos and branding to the high street they must be kept in line to comply with the upkeep of the traditional historic streetscape and sense of place. Restricting certain businesses because of their design requirements such as large supermarkets may seem anticompetitive even protectionist. But the question must be asked is allowing such large developments sustainable to that location. Does a large supermarket on the edge of town endanger the high Street? Does it encourage an increase in car use? Is there a more sustainable alternative? These questions are as much about economic and cultural sustainability as they are about heritage preservation. This is an example of how applying true sustainability development strategies are the key to preservation and management of historic urban centres. The preservation of the sense of place is the key factor in the management of historic centres.

CONCLUSION

Do not try and amend what is not already broken is a philosophy that should be truly embraced one of historic centres. With the acceptance that historic urban centres can be sustainable compact cities. The management and planning of these must embrace the ideals of compact cities in the planning procedures as well as the careful management in allowing local businesses and residents to stay within the urban centre. The idea of protectionism of the historic fabric should be replaced by the preservation of sense of place. By applying sustainability Management criteria to historic places the preservation of the buildings becomes an inherent part of the sustainability process.

It is accepted that change is part of the heritage process; it is the sustainable management of this change that is critical for the preservation of the historic assets within historic urban centres. This preservation does not mean that the historic urban centre cannot be as competitive or as vibrant as any modern contemporary city, quite the opposite is true if this change is managed correctly. The very sense of place and the notion of history within an area can bring not only a more socially sustainable society but also as vibrant economy based not only on tourism but on local business and innovation.

The key focus of any strategy is the sustainable management of the sense of place. The framework has to allow change but at the same time preserve the sense of place, the intrinsic historical character. The strategy has to prioritise local residents and businesses while still providing for visitors. Using both contemporary technology and modern sustainable strategies (encompassing; environmental, economic and cultural.) a historic centre should be allowed to evolve and grow as it always has and yet still preserve the historic sense of place that true heritage relies upon.

The main themes discussed in this paper can be summarised by the below categories. This paper avoids giving distinct proposals but rather issues that need to be applied or discussed in the management strategies of historic centres.

Historic centres are only meaningful if inhabited: Culture and heritage is derived from people who live work and play within the Centre rather than just from tangible historical assets.

Identify and protect critical assets: With clear sustainable and preservation methodologies.

Identify compensatable assets: To help re-centralised growth and encourage sensitive redevelopment.

Long term planning for growth, not short gain: By planning for gradual, continual sustainable growth that is both economically successful and culturally sensitive.

Protect and maintain the genius loci, Respect local residential community: Rejection of the clone town by reinforcing the historic sense of place by the inclusion of both 'bottom-up' and 'top-down' input into development and management strategies.

The future must be linked to the past: Preservation and conservation is more about preserving the sense of place rather than specific historical assets.

Restrict further damage caused by car use/ road building: By investing in public transport and digital infrastructure and through positive encouragement of more sustainable forms of travel such as cycling.

Change is part of heritage: Historic cities are constantly evolving. By sustainably managing this change both the historic fabric and cultural value of the historic centre can go hand in hand with economic success.

The understanding the full remit of sustainability and applying this as the driving force in any management strategy. The very intrinsic historic

qualities can go hand in hand with economic sustainable future that meets the needs of both residents and visitors, perhaps the definition of sustainability in historic urban centres should be- *meeting the needs of toady without compromising the ability of the future generations to meet their needs. While applying the necessary preservation and conservation requirements for preserving the intrinsic sense of place within the urban historical centres.*

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7

Participatory Environmental Sensing for Better Environmental Decision Making and Spatial Governance

Kostas D. Karatzas

ABSTRACT

Participatory Environmental Sensing is related to the recording, collection and access provision to data concerning the environment's status and quality. The availability of such data, as well as of methods and tools that allow for their analysis, interpretation and 'intelligent' information provision, is expected to lead to better understanding of environmental problems, their temporal and spatial dimensions, and thus to better environmental decision making and spatial governance.

Keywords: participatory environmental sensing, quality of life, environmental pressures, decision making

INTRODUCTION

Humans have been sensing the environment they live in for thousands of years, with the aid of sophisticated sensors that constitute their senses, and with the goal to access, analyse and predict the quality of the environment they live in. Such information was essential for their survival as it would help them, e.g. to keep a safe distance from wild animals and seek shelter under heavy weather conditions. They then recorded and exchanged this information with the aid of written evidence and drawings, in order to create a commonly accessible environmental information pool that would serve the needs of the community and the wellbeing of its members. Although contemporary life is profoundly different in comparison with life before some thousands of years, and technological developments in environmental sensing as well as communication have also demonstrated a considerable development,

the basic needs for monitoring the environment we live in have not changed. People are still interested in finding out whether there are potential threats or quality degradation agents in the environment surrounding them, in order to take preventive measures and make 'wise' decisions. They also have the tendency to communicate information on environmental pressures and conditions, in an effort to optimise the quality of life orientation in the use of such information.

It should therefore not come as a surprise that, on the basis of scientific developments, the modern legal and regulatory framework orchestrated the establishment of environmental monitoring and modeling for providing sufficient information to citizens. On the other hand, the developments in ICT and the widespread of internet usage, smart phones and social media, has created a drive towards information exchange and digital societies, especially among the younger generation.

This was the fertile ground upon which the idea of participatory sensing started to grow, in order to allow citizens to actively take part in the creation, exchange and use of environmental information. Thus, participatory environmental sensing (PES) may be defined as the participation of citizens in the monitoring of the quality of the environment they live in with the aid of (a) mobile devices of everyday utility, (b) specialised environmental sensors, (c) general purpose sensors and (d) personal, subjective recordings, alongside new information annotation and exchange methods, coming from social media or other similar platforms and technologies (Karatzas, 2011). The concept of PES has been proposed in the last 10 years (Burke *et al*., 2006; Goldman *et al*., 2009; Karatzas, 2005) and a number of terms has been used for describing similar approaches. Thus, 'participatory sensing' is a term already used by Burke *et al*. (2006), described as a way to apply everyday mobile devices, such as cellular phones, *"to form interactive, participatory sensor networks that enable public and professional users to gather, analyse and share local knowledge"*. Krause *et al*., 2008, made use of the 'community sensing' term, to focus on information coming from populations of privately-held sensors. The Center for Embedded Sensor Networks, UCLA, has been among the first research centres to work on PES, and has introduced the term 'urban sensing' (http://urban.cens.ucla.edu/). Campbell *et al*. (2008) have been using the term 'people-centric sensing'. The Wikipedia, on the other hand, has already included an article on the participation of citizens in monitoring activities for scientific purposes, under the term 'citizen science' (http://en.wikipe-

dia.org/wiki/Citizen_science). It is interesting to note that citizen participation and the fuse of informatics to urban life and decision making has also led to the term 'urban informatics', to describe *"the study, design, and practice of urban experiences across different urban contexts that are created by new opportunities of real-time, ubiquitous technology and the augmentation that mediates the physical and digital layers of people networks and urban infrastructures"* (Foth *et al.*, 2011).

PES projects have appeared especially in the USA (e.g. PEIR, http://peir.cens.ucla.edu/, Living Environments, http://www.living-environments.net/, Citysense, http://www.citysense.net/, Common Sense, http://www.communitysensing.org/) and in Europe (e.g. Envitori, http://knowledge.vtt.fi/, Message http://bioinf.ncl.ac.uk/message/, Everyaware http://www.everyaware.eu, Opensense http://opensense.epfl.ch, MIMAQ, http://mimaq.org/,). In addition, the use of PES in monitoring spatial infrastructures like roads has also delivered some first results (Mohan *et al.*, 2008 and Eisenman *et al.*, 2008). Overall, PES projects have already appeared supporting sustainability as well as spatial governance.

QUALITY OF LIFE (QoL) AND SPATIAL GOVERNANCE

Modern societies have developed a legal and regulatory framework for the continuous monitoring and assessment of the environment in which we live. This framework addresses various environmental agents like noise, waste, air pollution, water quality, etc. As the air we breathe is a vital component of our everyday environment, the quality of the atmospheric environment was among the first environmental issues to be addressed. On this basis, a number of monitoring facilities have been established, which measure the concentration of specific substances (air pollutants) in the air, on a 24/7 basis. Modern air quality information systems now include real time access to the monitoring station data, as well as environmental information produced with the aid of sophisticated air quality models, in order to provide with forecasts as well as other environmental information. Evolving the concept of PES is considered to be the new model of access, exchange and utilisation of information related to the atmospheric environment, resulting in the creation and adoption of personalised, society oriented services, leading to information systems for quality of life reassurance.

Quality of life is associated with environmental pressures and conditions, as well as with the choices we make, or the behaviours we develop. PES

can identify the spatial as well as the temporal characteristics of environmental pressures and behaviours, and help us identify patterns and extract useful information from data. By employing computational intelligence methods to PES data, we can arrive to 'smarter' decisions that would support spatial governance, and promote QoL and sustainability. In order to do so we need a feedback loop from the citizen towards the information system. This requires that we provide with the necessary functionality for the electronic annotation (tagging) of information related to the quality of the environment, and its 'posting' to a digital community, for others to use, thus generating the content of an environmental information service (Karatzas, 2006). Such research ideas have already been pushed much further in the frame of various projects, like in the case of the Cenceme project (http://cenceme.org), that allow participants to track the current status of friends in a social networks way, and exchange environmental and activity information. Another project example is your.flowingdata.com, which allows people to record via Twitter data on their current status, mood etc, share or exchange these data, and visualise them in relation to spatial information, to identify patterns and spatial interrelationships. Yet, this sharing of personalised information raises various issues of privacy as well as surveillance, as discussed in Shilton (2010). The aforementioned concepts have been tested for the air quality domain, and are expected to act as paradigms for future environmental information services. Such services are expected to include specific QoL aspects like the feeling of discomfort associated with the spatial and temporal variation of atmospheric parameters, or symptoms associated with the interaction of biological factors like aeroallergens.

Information on pollen is increasingly been produced, at least in Europe, but a fundamental difference between the so called biological weather and chemical weather is that the latter is regulated via the Air Quality (AQ) legal framework, while there are no official thresholds or limit values associated with aeroallergens. Moreover, the symptoms of allergic people to aeroallergens vary among people as well as among countries, making a commonly agreed set of limit values quite difficult to establish (www.eupollen.eu). On this basis, personalised models for the forecasting of symptoms are expected to play an important role in environmental information provision and in the support of spatial governance for health and environment. Such models are nowadays capable of being constructed on the basis of computational intelligence methods, and pollen observations (Voukantsis *et al.*, 2011). PES can

certainly increase the number, density and quality of the observations, as well as their usefulness, as PES can include symptoms, and allow for patient data to be exchanged on the basis of a social network-based operation (http://www.patientslikeme.com/)

TECHNOLOGICAL BACKGROUND OF PES

The accelerating technological developments in the mobile phone industry have transformed phones to mobile computing, sensing and communication platforms, enabling ubiquitous capture and dissemination of data of all types: text, image, video, audio, location, etc (Lane *et al.*, 2010). In addition, new web standards such as HTML5 and fast JavaScript interpreters are turning web browsers on desktops, laptops and mobile devices alike into powerful software platforms, fusing together Web and desktop applications. Moreover, there is a tendency to increase the flexibility and the functionalities of Web applications on mobile phones, with open source projects such as www.phonegap.com. There is also a great advancement in the area of ad-hoc sensors' design, able to record and distinguish levels of different types of pollutants, while sensor web enablement has already entered the standardisation phase, supported by the OGC (http://www.opengeospatial.org). The interconnection of devices and the bidirectional data transfer between users, through a system for collecting, processing and routing data to different means of communication, allows for the development of a dispersed environmental quality monitoring network that will record, map and process data of particular importance. Thus, it is possible to include and to communicate with people of all backgrounds, located everywhere in the world, to record sources of pollution in any spatio-temporal level and to benefit from personalised services, available on-demand or real-time. This will also allow for the application of 'persuasive technologies' approaches, in order to help people adopt a more environmental friendly, QoL oriented, sustainable way of living (http://www.vrolik.de/green/).

When it comes to PES QoL services (PEQoLS), the aim is to record, collect and access data about the environment's status and quality, at the individual user and business level, through the use of available ICT, web 2.X and social media technologies. These can include data like actual sensor readings (such as those found in official air quality and meteorological monitoring networks but also those operated by individuals, amateurs, research groups), as well as 'soft sensor data' gathered through the subjective sensory perception of

the general populace, which can be determined by examining personal remarks and comments about their personal status and the status of their present environment. Regarding the latter, such data are often recorded and shared automatically and/or voluntarily on various social networking media and can be enriched with the aid of digital, georeferenced, time stamped recordings, made with mobile devices. There is a large volume of such indirect data, which can be mined e.g. from social networking sites, blogs, forums, or personal tracking applications like twitter. While lacking the rigor of actual sensor readings, they can be used to extrapolate useful data or provide an extra set of parameters to use during modeling. Mining technologies of social network data have helped in the development of the necessary knowhow for the development of PES related systems (Khac Le *et al*., 2011).

PARTICIPATORY SENSING IN THESSALONIKI, GREECE

Environmental decision making and spatial governance are interlinked via the spatial nature of environmental pressures. This is of particular importance in the case of air quality problems as they are associated with the spatial distribution of emission sources as well as with the spatial nature of human activities contributing to pollution in addition to being affected by it. On this basis, the example of the city of Thessaloniki is presented as a case where air quality problems are of major importance for the city's inhabitants, and due to the fact that the abatement of air pollution in the area has proven to be a very complicated and issue.

Thessaloniki is the second largest city of Greece and one of the most densely populated cities in Europe, accounting for approximately 16,000 inhabitants per km^2. Located at latitude of 40.4 degrees the city covers an area of approximately 18 km^2, while the urban web of the Greater Thessaloniki Area covers approximately 93 km^2. Thessaloniki city suffers from high air pollution levels and the problem of managing it seems to have long way to go (Moussiopoulos *et al*., 2009).

The Thessaloniki PESQoL system makes use of the 'sensory presence' to record environmental information attached to personalised mobility and activity paths within the city. It is therefore expected that environmental pressures may be accessed on a personal level, and thus decision making for the individual will be more effective and QoL oriented. On the other hand, the availability of a data pool rich in spatial information of environmental pressures, can help in the identification of hot spots which may have a multiply-

ing negative effect to human wellbeing and thus may be treated by targeted spatial governance methods. The Thessaloniki system aims to integrate sensory presence with popular social networking applications, thus allowing unprecedented levels of connection between people belonging to the same groups within those networks. The system is based upon the belief that creating a framework to allow collecting, organising, presenting and sharing the personal sensory, daily habit and status data of the user and his/her activity environment, will be of service to a large number of citizens as well as tackling the challenge of making people-centric environmental sensing a reality (Miluzzo *et al*., 2007).

The PESQoL System

The creation of PESQoL system in Thessaloniki combines (a) mini sensors of atmospheric conditions (currently temperature and relative humidity, provided by www.neuronica.polito.it), (b)Android smartphones, (c) a PES data storage and visualisation application, (http://knowledge.vtt.fi/greek/) and (d) Computational Intelligence (CI) methods for data analysis and forecasting. The sensor is linked to the smart phone via Bluetooth, and the values from the sensor are passed over the smartphone. The monitored information, together with user annotations and tagging data, are uploaded to the PES data storage and visualisation application. Then, a number of CI methods are employed for data analysis and for the extraction of useful knowledge towards the citizens.

The application that would allow for the collection of air quality data has already been developed, while the application that would handle the collection and exchange of subjective opinions on the urban environment is currently under development. A number of CI algorithms for monitoring data analysis have already been developed, while additional algorithms are under development. The computational methods that allow for the analysis of environmental monitoring data and user health and QoL recordings have already been developed and tested for pollen data (Voukantis *et al*., 2011).

In order to collect personalised, subjective information by the users, a simple list of predefined terms is being applied, such as the following:

Personal health status:

1. Asthma
2. Respiratory problems
3. Cardiovascular diseases

4. Diseases of respiratory system
5. Allergies associated to specific plants (tick box list to include local flora e.g. cypress, grasses, goosefoot, wall pellitory, pine, ragweed, plane, plantain, hazel, poplar, oak, olive tree, etc)

User's observations:

1. Type of observation (meteorological parameters, sources of air pollution, emergencies, etc)
2. Quality of observation
3. Observation area
4. Time of observation

Alerts defined by the user:

Combination of parameters or other user's observations that are considered important for the QoL of an individual.

Texts and multimedia files generated by the user:

These include recordings of pictures, movies, sounds etc.

The Thessaloniki PESQoL system has a server side with a Data Management Framework (DMF) and the User Application (UA) from the client side. An observation is the main type of data object that the DMF recognises and consists of actual measurements (such as air temperature, and humidity), soft measurements like the citizen's categorisation on the quality of the environment like (poor, adequate, good, etc), additional soft measurements like event recordings (local pollution sources, etc), short text messages generated by the citizen, and multimedia files. Within the DMF, observations are organised into data objects, each one having a unique ID, accompanied by a time stamp and a location stamp, thus allowing for time related and/or location aware service generation. The arrival of new data causes notifications to be generated, with a notification containing no actual data, but including all the available metadata such as the time range of the new observations, their type, etc. These notifications are placed on the 'event bus' that manages them and routes them to their appropriate destinations. Appropriate software entities (listeners) register on the event bus their interest on notifications by the way of a filter, which decides whether the registered listener will receive notifications based on the characteristics of the data object, i.e. its actual content cat-

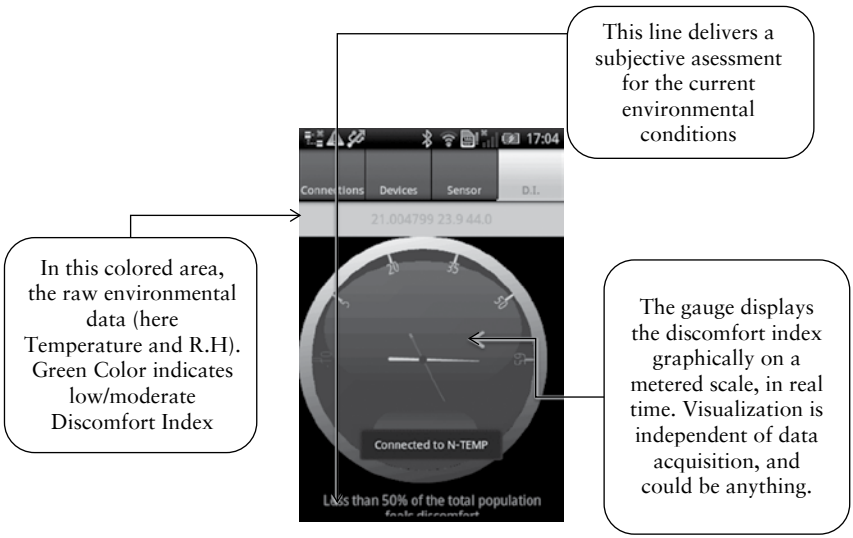
egories and types. A listener may, on arrival of a notification, fetch the relevant data object from the data store, compute something (e.g. the maximum value, the frequency – popularity of the observation), and send the results to the data store as a new data category of a new data object, possibly causing a cascade when another listener has expressed interest in the data object. On the basis of this mechanism, an event-based architecture is being implemented at the server side of the system, on top of the OSGi framework (www.osgi.org), which is a module system and service platform for the Java programming language that implements a complete and dynamic component model (http://en.wikipedia.org/wiki/OSGi). The system's architecture is utilising the event bus and plug-in architecture of OSGi to ensure extensibility. The event bus is being implemented via the 'EventAdmin' service of OSGi, where the notifications are 'Events' with multiple properties, and the listeners are registered 'EventHandlers' with filters on those properties. The data store is currently implemented with a PostgreSQL database.

The UA currently consists of a client that runs on Android. The client reads information from a set of mini sensors of atmospheric conditions (currently temperature and relative humidity, provided by www.neuronica.polito.it), via Bluetooth, and the values are then passed over the smart phone. The application manages the connection with the sensors as well as the data flow, and makes use of these observations to calculate the Discomfort Index (DI), which is an integer denoting the level of discomfort felt by humans. The actual information is being presented to the user in an intuitive way, with the aid of a colour code, as well as a graphical representation of the DI that is of a speedometer type. A screen shot of the application is presented in **Figure 1**.

Technical Challenges

As in many pervasive computing projects, the estimated technical challenges of the PESQoL Thessaloniki system are related to software, networking and hardware. On the software front, gathering data from social networks and blogs will require employing data and screen scraping techniques orchestrating voluntary submission of information as well as automated gathering of data using web crawling bots, text analysis, and heuristics in order to determine context and contents of a message automatically. For example, just encountering the word 'polluted' in a tweet doesn't necessarily mean that it refers to the environment's condition without further context analysis, otherwise very low quality and reliability data may be produced. Yet, many senso-

FIGURE 1
A Screenshot of the User Application that has Been Implemented for the PESQoL System in Thessaloniki, Greece



ry presence projects substitute real sensor readings for indirect assessments such as in the previous example.

For the Thessaloniki project, the aim is to also exploit real sensors as much as possible, taking advantage of the sensors typically built into the latest generation smart phones. The target smartphone platform of choice is, for now, the Google Android mobile platform. Reasons for this choice include the relatively low cost of Android-powered devices in the Greek market as well as their market penetration. The free open source and open development model and freely available high quality development tools, as well as an Application Programming Interface that allows accessing most sensor functions in a straightforward manner using standard library functions, were all important in choosing this particular platform.

CONCLUSIONS

The development of participatory sensing projects for serving quality of life needs addresses the citizen on the basis of everyday activities (temporal resolution of the approach), and for every location and scale (spatial resolution of

the approach). The impacts of such PESQoL systems should allow people to associate environmental information with everyday utility (to cope with personal habits and interests), including:

- Perception of information
- Context of use of information
- Places (for location awareness)
- Living patterns, for information about personal habits and behaviours

These impacts also include exchange of user tailored information on well being as well as better advice, including health related advice, for improving QoL. All these impacts formulate the frame for better environmental decision making and spatial governance, and are expected to play an important role in the way that e-government will be developed in Europe in the near future. In order to have a positive impact towards citizens, such a PES approach should address environmental domains that are of interest for everyone and not for special citizen groups, have a sufficient legal and regulatory framework already behind them, and affect people wherever they are, and whatever they do. It is therefore evident that a very suitable environmental domain is the quality of the atmospheric environment. On this basis, the Thessaloniki PESQoL system was designed in order to promote belter decisions on a personal basis and better government for the community. For this reason, the use of a web-based platform for information provision is combined with state-of-the-art sensor and smart phone technologies, and computational intelligence methods are being employed in data analysis. The services address the atmospheric environment, and more specifically air pollution and pollen, where the number of potential users is increased due to the number of people suffering from allergies or respiratory diseases (Karatzas, 2009). In these environmental domains, decision-making on the level of the individual or the administration may play an important role in QoL, this being the reason behind the services developed. In this way, it is expected to have the promotion of a new applied research area and of an integrated, shared environmental information space, to support a new 'e-services model' that will increase citizens' participation on environmental decision making and will advance green entrepreneurship, in a sustainable way. This is also expected to support the creation of a new paradigm concerning the way that

citizens perceive and interpret the quality of environment they live in and take action.

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