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EMAN- EU 2011 CONFERENCE

ACCOUNTING FOR CLIMATE CHANGE – WHAT AND HOW TO MEASURE

PROCEEDINGS

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FOREWORD

Accounting for climate costs: What and how to measure?

There is growing evidence and scientific consensus about global warming. Companies are increasingly being challenged by uninsurable risks from unpredictable weather conditions as well as new governmental regulations, like the EU Emission Trading System, carbon taxes, building codes and energy efficiency standards. At the same time, new business opportunities can arise from energy efficiency innovations, product developments, new business models and other mitigation and adaptation initiatives. This conference is the first to provide a forum for systematically accounting for the business costs of these challenges and for analyzing the role of accounting in developing economic business potential. The conference will focus on the assessment of business costs and benefits arising from climate change as well as mitigation options.

There is wide knowledge of these climate related costs (Stern review 2006) and mitigation costs (McKinsey report 2007) at an economic level. The above-mentioned studies, however, focus mainly on the macroeconomic level. Surprisingly little coverage can be found of the costs to business of climate change or mitigation policy.
The costs are real though, and are discussed in non-scientific forums such as insurance company websites on increasing climate change-related damage and aviation-related journals on carbon offsetting, etc. Climate change related costs may spill over to industries that are usually not involved in conventional climate change cost analyses.

How can these costs be categorized into conventional management cost categories? (Schaltegger, Burritt 2000) What is the present and predicted magnitude of those costs? Which are the business sectors most likely to be impacted? How can such costs be managed? Can we expect significant spillover costs? Are there quantifiable business benefits from climate change or mitigation policies? How can carbon mitigation policies impact business costs?

A comprehensive review of these costs is timely and needed The 14th EMAN-EU Conference will be one of the first devoted to systematically focusing on the business costs of these challenges and to analyzing the role of management accounting in developing business potential.

This is the second time Corvinus University of Budapest has accepted responsibility for organizing an EMAN conference. We hope that participants will enjoy the academic program and the social programs at least as much as they did 3 years ago. We would like to thank the TÁMOP-4.2.1/B-09/1/KMR-2010-0005 program for generously supporting this event, as well as the Norway Grant and the Act Clean program for supporting a workshop within the framework of the conference.

Wishing you an academically-rewarding conference and a pleasant stay in Budapest.

Welcome to the 14th EMAN-EU Conference:

Maria Csutora
Conference Chair
Steering committee of EMAN

Sandor Kerekes
Vice Rector for Research
Project leader of the TAMOP "Research Excellence" program

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SUSTAINABILITY MANAGEMENT CONTROL

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Abstract: Sustainability issues create opportunities for and threats to business success. This paper discusses ways in which management control can deal systematically with ecological and sustainability business challenges. Given the strength of current research and practice focusing on operational management issues, a core challenge is to link management control with strategic management of sustainability issues. Based on the core logic of the balanced scorecard perspective a structure for sustainability management control is discussed.

I. INTRODUCTION

Sustainability has become a driver for business risks and economic opportunities to be managed; witness as examples the effects of BP's Deepwater Horizon oil spill and the growth of renewable energy supplies. Elements of sustainability can work through market or non-market processes to have an effect on business success. One important challenge is for strategic management to take sustainability information about these risks and opportunities in market and non-market settings into account. This conceptual paper discusses the ways in which management control can be used to address these sustainability challenges faced by business, especially through use of the balanced scorecard. Section II considers the difference between market and non-market issues and processes in sustainability; Section III reviews the literature on sustainability management control and the fourth Section sketches an approach which is based on the structure of the Balanced Scorecard.

II. MARKET AND NON-MARKET CHARACTER OF SUSTAINABILITY ISSUES

Environmental and social issues involve corporate risks as well as opportunities for business [1, 9, 17, 19, 25]. These issues can have a visible, market based economic impact or they can have a non-market character. In order assess the relevance of social and environmental issues as elements of sustainability to business success in a systematic way, characteristics and processes of market and non-market issues must be considered.

Market issues relate to the market under consideration – financial, product, labour, investment, etc. and can be viewed from the integrated perspective of demand and supply. Market demand relates directly to, for example, the price of purchasing CO_2 emission certificates, or declines in sales of products thought to be socially questionable. Market supply can be linked with savings in energy costs or lower use of natural resources through greater efficiency in production. Costs saved through the reduction of materials and energy used in production [35] can be directly expressed in accounting systems and, hence, can directly influence economic performance of the company.

In contrast, non-market environmental and social issues operate indirectly on businesses. Many environmental and social topics develop outside the market sphere, in the regulatory and societal business spheres [3, 28, 29]. Laws and regulations, social trends and political matters may change suddenly or they may change over a period of time leading, for example, to increases in costs or to an increased willingness on the part of consumers to pay higher prices [9, 13, 26]. For instance child labour employed by sub-contractors does not have a direct link to costs or revenues of the contractor. Nevertheless, it is not necessary for there to be either a direct contact with the children or with the sub-contractor to give the sustainability issue "child labour" economic relevance for the leading brand company in the supply chain. As Nike, the world´s largest sports article manufacturer experienced, non-market issues can suddenly become economically relevant through lower sales and reduced reputation when non-government organisations (NGOs) include the matter in their agendas and attention is drawn to the issue by the media. In some cases these non-market issues can have a stronger economic effect than issues with a clear market link.

In addition to the differentiation between market and non-market *issues*, a distinction between market and non-market *processes* is helpful. Non-market processes can be societal processes driven by media or through social communities, such as on the internet, and can have a large influence on values and social attitudes towards companies and products [18]. Such processes also include actions of regulators [7] and public administrators, for example by reacting to protests from neighbours of an airport against noise outside normal hours by restricting daily flight times through a curfew.

Influences from market processes on political developments and regulations are less relevant to business, however, they do exist. An example of such a development is the increasing (European Union) regulatory activity on genetically modified organisms even though these products are not purchased to a significant extent in Western Europe.

In summary, different and interacting paths of influence exist where market and non-market issues influence the economic success of companies. Conventional management tends to focus on market issues and market processes; sustainability management adds economic value to management by identifying, analyzing and managing non-market aspects and processes in addition and in relation to market issues and processes. The goal for sustainability management is thus to find methodologically convincing approaches for dealing with these cause-and-effect chains [for conventional management, see 15]. Management control constitutes one such formal approach which supports the translation of general corporate sustainability strategies into action [8, 23, 34]. It faces the challenge of identifying both, market and non-market sustainability issues and processes, evaluating their relevance to business success and supporting management in decision-making and action-taking.

III. SUSTAINABILITY MANAGEMENT CONTROL SYSTEMS AT PRESENT UNDERDEVELOPED

Conventional management control systems focus on formal indicator based control with a particular emphasis on corrective actions centred on differences between planned and actual financial performance [10, 11, 33]. The value of formal management control is to provide a systematic basis for regular updates about business achievements and financial results in order to enable management to make comparisons with defined goals based on accepted strategies and to act and control early if these goals are not expected to be

achieved [33]. More recent literature recognises the importance of broader definitions and informal as well as formal control [36, 37].
Unfortunately, conventional management control systems tend to neglect sustainability issues if these are not directly expressed in monetary terms. However, the basic principle of organising a performance management system to achieve continuous improvement promises a systematic approach towards achieving important corporate goals and has been transferred successfully in various areas such as quality management [30] and environmental management (as expressed in environmental management systems standards such as ISO 14001 which focus on physical impacts, or eco-control; e.g. [8, 21, 24]).
Although the term "sustainability management control" has been sporadically mentioned, a detailed elaboration of the concept does not exist. The same can be said, with the exception of Dubielzig (2009), of management social accounting and control. As far as management eco-control is concerned, the notion has been evident, both in academic publications and in business practice, for about 15 years with a focus on manufacturing processes and formal management control systems orientated towards energy and materials flows (cf. for example, 5, 6, 24). Eco-control systems are dependent on the development of environmental management accounting [8, 21]. A comprehensive management control approach towards sustainability management is thus missing, so far.
The notion of sustainability is complex and has a great variety of elements that are relevant to business success [26]. These can operate in both market and non-market processes. In order to recognize and successfully manage these elements better however it is essential that an expanded understanding of management control be developed, as well as a broader but well-structured concept of sustainability management control.
A systematic management approach is needed to structure the processes relating to how to consider various and varying sustainability factors. Since the balanced scorecard [15] systematically integrates non-financial factors into management [16] it offers great potential for structuring a broader concept of management control that also includes non-market aspects.

IV. THE BALANCED SCORECARD AS A STRUCTURING CONCEPT FOR SUSTAINABILITY MANAGEMENT CONTROL

A central task of strategic management control is turning strategic planning into strategic management [11] by specifically taking into account external market opportunities and threats. The balanced scorecard (BSC) is able to help in the systematic implementation of strategy as well as in the structuring of a variety of management control approaches [33]. The BSC includes non-monetary and monetary causal relationships in support of strategic management [11, 15]. The sustainability balanced scorecard (SBSC) is a management and structuring method for better integration of the environmental, social and economic aspects of corporate sustainability measurement and management [2, 23, 27].

A. The fundamental logic of the SBSC

The SBSC is a multidimensional concept and it is well placed to address the major challenges of corporate sustainability management in an efficient way. It combines performance measurement across all dimensions of sustainability [23, 27]. In reality, environmental and social performance indicators rarely stand on their own [21, 22].

Therefore, questions arise as how to a) combine the indicators into an overall performance measurement system which covers all significant environmental and social performance aspects of a company's activities, b) determine the indicators needed in an overall performance measurement system to measure and manage strategic as well as operational goals, and c) organise and support the information management processes to help improve the indicators.

The starting point of the SBSC is the business strategy which is operationalised through five market and non-market perspectives. Four of these represent the conventional BSC view of important measurements to be provided by management accounting - finance, customers, processes, learning and organizational development [14]. The fifth is the non-market perspective (see 23). All are based on cause and effect chains linking the strategically relevant aspects from each perspective.

When developing an SBSC environmental and social exposures have to first be identified. The SBSC process then continues with the identification of strategically relevant environmental and social aspects, which potentially have a material impact on the firm's business success. Identification starts out from an analysis of the financial perspective and then progresses through the customer perspective, internal process perspective, down to the learning and development perspective, and last but not least, the non-market perspective. With this process cause-and-effect chains are developed to reflect linkages between strategically relevant social and environmental aspects and the company's economic success. An important tool used here is the strategy map [16], which focuses on the essential links between the business strategy, economic success, performance indicators and operational activities. The sustainability performance indicators defined on this basis and their implementation in operations are then supported by management control activities.

B. A framework for structuring management control

As a management system, the SBSC offers a systematic approach to strategic sustainability management, which leads to a system of key performance indicators. The SBSC is thus an excellent framework for structuring sustainability management control.

There has been little in-depth discussion so far of the conceptual or instrumental relationship of the SBSC to management control and sustainability management control. As a structuring approach that helps to break down management strategy, the SBSC provides a framework to organize sustainability management control and its orientation towards the effective and efficient implementation of corporate strategy. The starting point is business strategy and the identification of the environmental and social exposure of given strategic business units. Following the top-down approach of the BSC, first the environmental and social elements are identified and their relevance is determined and then they are analysed step-by-step for all SBSC perspectives. The result of the analysis is the identification of key performance lead or lag indicators for each perspective.

Success factors are identified by developing a strategy map and key performance indicators (KPIs) are analysed as to their relevance. These make up the starting point for an operative sustainability management control system orientated to a given sub-system. Such a concept of sustainability management control supports management by providing market and non-market information to help it achieve its sustainability objectives as defined by the relevant key indicators from the SBSC perspectives. Controllers work as advisory sparring partners with management, providing information and support with the analysis of the

actual situation and the development of proposals for target situations. Sustainability management control has the central task of supporting management so that the success of the company can be strengthened through the special consideration given to environmental and social issues.
Thus, sustainability management control has the goal of continuous improvement of environmental and social performance, in an iterative process with management, while at the same time furthering the company's business success through five perspectives.

C. Perspectives of sustainability management control

Market and non-market issues and processes are reflected in five perspectives of sustainability management control.

- The capital market. Finance-orientated sustainability management control is based on key SBSC performance indicators which are also aligned with current concepts in financial management and unite environmental and social elements with accounting. The task of finance-orientated sustainability management control is mainly in the provision of information, management and adaptation of accounting concepts [20, 22]. While there are already concepts and in some instances extensive practical experience with individual topics such as shareholder value-orientated environmental management (so-called environmental shareholder value), materials flow accounting or the influence of contaminated sites on (potential) liabilities and sustainability accounting, there is still a need for work in other areas (e.g. social elements and shareholder value, sustainability and economic value added) of finance-orientated sustainability management control.

- The product market and the customers. Product market-orientated sustainability management control looks towards effective and efficient sustainability management of company activities through marketing and supply chain success [31]. Thus for example ecologically orientated changes in production processes or changes in product design can have a considerable positive or negative influence on sales and market acceptance, which means that a rethinking of communication and marketing is necessary. The development of product market-orientated sustainability management control can begin with internal company customers (such as different types of managers) asking for management control services and with the clarification of which new management control services could be important for existing and new customers. Responsible contacts can be found in production, human resources as well as the sustainability, environmental and carbon departments. For empowerment such people should be involved in discussions about the KPIs at regular intervals and in writing the public sustainability report.
  Performance indicators are extended beyond the boundaries of the company, while being clearly targeted at ecological and social improvements in overall performance in the relevant product market.

- The technology and supplier market influence on process-orientated sustainability management control. The focus of environmental management accounting and eco-control on production processes has become a tradition [cf., also for published case studies 5, 6, 24]. To the fore are financial indicators in production as well as the

relationship between non-financial indicators in production and financial results [12, 20]. Process-orientated sustainability management control, however, goes beyond a concentration on environmental problems with technical production processes. Alongside production processes other business processes such as innovation, management, logistics or customer service are a part of the process perspective of the SBSC. Many "management fads" such as lean management, systems reengineering or total quality management essentially involve a process orientation. Some of these approaches can at least to an extent be found in environmental and quality management (e.g. total quality environmental management). The most important steps of process-orientated sustainability management control include the analysis and optimisation of processes. Distinctions can be made here between core processes and core process chains, the definition of customer, social and environmental requirements, the implementation in causal relationships and measurable indicators as well as internal reporting.

- The labour market's influence on know-how in the company. Knowledge and learning orientated sustainability management control depends on how motivated and innovative the employees are, as well as their capabilities. Sustainability management control is challenged to provide support in employee retention and acquisition and the successful development of know-how in the workforce. In information technology, consulting services and the rising share of services even in material-intensive industries such as the automobile and machine tool industries, the importance of know-how, information and employee motivation is increasing. Knowledge management includes not only the use of IT solutions in environmental and social management (e.g. environmental databases and software) and the provision of training seminars. It is more important to enable employees to create, identify and successfully implement innovations. It is thus crucial to focus on those areas that a prior SBSC analysis has shown as being relevant to business success. This can include non-market processes in the social, legal and political environment of the company.

- Non-market elements of sustainability. The market is shaped by market parameters and is a social, political and legal construct. Since they can change the rules governing the market, in certain cases non-market factors can have a more fundamental character than market factors. The non-market environment can be divided into socio-cultural, legal and political factors. Socio-cultural issues involve the social acceptance or legitimation of business activities and the provision of business products and services, traditions, social values, media reactions and public opinion. An important part of issues management involves the relationship to opinion leaders, trendsetters and other key organisations and individuals. Management control of non-market factors also takes into account those legal developments relevant to the company. An interface between the socio-cultural and legal environment is provided by voluntary standards of environmental and sustainability management (such as for example EMAS, ISO 14000 [30], ISO 26000). A central challenge for small and medium-sized enterprises is attaining an overview of the innumerable social and environmental laws as well as ensuring legal compliance with such legislation. Multinational corporations are additionally confronted with a great variety of national legal systems. The dynamic development

of legal conditions and the increasing importance of regional regulations (eg EU) create special difficulties. Interest-group processes, another non-market element, often have a very direct influence on the ability of management to take action [3], yet they are rarely explicitly analysed. Interest-group activities are, however, the most effective way of pursuing goals for a number of stakeholders, especially NGOs [4]. Consumer boycotts, neighbourhood protests, actions to influence politicians, and media attention are examples of the different ways interest-groups express themselves usually by questioning legitimacy. However, interest-group activities are not limited to negative action. An increasingly used and powerful approach of interest-groups is to express themselves in social media through the internet. Here various internet communities have developed with the aim of supporting "strategic consumption", i.e. the consumption of fair-trade and organic products or responsible companies. If non-market elements are seen to be strategically relevant when developing the SBSC – taking the form of performance drivers such as corporate reputation or social trends – then it is important to manage them explicitly using sustainability management control for non-market issues. However even when non-market environmental and social factors are seen to be "only" hygiene factors for a company, sustainability management control can still help to manage legal compliance issues in an efficient way. The task of management control of non-market elements of sustainability then takes on the character of information provision. In situations of great strategic relevance, by contrast, the role of management consulting plays a crucial role.

V. OUTLOOK

The sustainability balanced scorecard is a management and measurement concept that systematically accounts for elements of sustainability according to their relevance for business success in strategic management. The analysis of causal chains and the development of a strategy card are designed to build a good basis for an indicator-supported strategic measurement and management system.

A sustainability management control system based on the SBSC concept has market and non-market perspectives – capital, customer, business process and labour market orientations and, in addition, a non-market perspective on sustainability management control. Sustainability management control can act as a process to take on a coordination and integration function that does justice to the interdisciplinary character of sustainability management. However there is still the challenge of making a real contribution to the various functional areas of a company. This complex challenge should not, however, act as a deterrent, because the sustainability management controller takes on a role of moderation and consultation that would be necessary in any case. The danger of dilettantism in many functional areas only exists when the internal customer orientation of the sustainability management control process is confused with that of an internal police officer pursuing environmental and social wrongdoings, a task that at any rate would be doomed to failure.

The concept of an SBSC-based sustainability management control system outlined here needs to be further developed, as even progressive companies have a tendency to manage individual functional areas in a fragmented fashion. If the logic of the SBSC, which serves to break down and implement corporate strategy and support the elements of sustainability relevant to business success, is followed then it becomes apparent that, if elements of

sustainability relevant to business success are to be systematically accounted for, management control should be closely involved.

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CARBON ACCOUNTING: A SYSTEMATIC LITERATURE REVIEW

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Abstract: The term Carbon Accounting is widely used by scientists in various disciplines and occurs especially within discussions of the integration of climate aspects into accounting, but no consistent definition of Carbon Accounting exists so far. The objective of this paper is a systematic literature review on the topic of Carbon Accounting in order to derive an appropriate definition of Carbon Accounting for different disciplines.

Therefore, a systematic literature review according to Fink was conducted: selection of research questions, bibliographic article databases and websites as well as the appropriate search terms; application of practical screening criteria for the inclusion of relevant literature and the exclusion of irrelevant literature; application of methodological screening criteria and synthesizing the findings.

The literature research showed that there is no appropriate definition regarding Carbon Accounting. In general the literature can be divided into four sections: physical carbon accounting with focus on global and national area, physical carbon accounting in terms of Carbon Footprint(ing), monetary carbon accounting with focus on management accounting and monetary carbon accounting with focus on financial accounting. Based on these findings a definition for Carbon Accounting is proposed.

Keywords: Carbon Accounting, literature review, financial accounting, management accounting

I. INTRODUCTION

To consider Greenhouse Gases (GHG) in entrepreneurial decisions experiences a growing attention much initiated by the introduction of emissions trading in the European Union (EU), but also by the recent work of the Intergovernmental Panel on Climate Change (IPCC), the Stern Report and the Carbon Disclosure Project (CDP). Due to emissions trading Carbon Dioxide (CO_2) allowances have to be entered in the annual financial statements. Therefore they are considered in management accounting, too. But the question arises whether and how all other climate-relevant aspects are taken into account in management accounting. These comprehend other "inside-out" effects, i.e. GHG of the company, which are not yet included in emissions trading schemes [1].

Lately the GHG Emission Allowance Trading Scheme (ETS) in the EU just includes CO_2 emissions from power generation plants and very energy-intensive facilities such as they exist in the (ferrous) metal industry and mineral industry. CO_2 emissions from other processes are not included yet [1]. This also applies to all other GHG, which are listed in the Kyoto Protocol such as methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6) [1], [2]. Besides legislation customers and investors might motivate companies to mitigate GHG emissions.

On the other hand changing climatic conditions lead to direct effects on companies, the so-called "outside-in" effects. Level effects (e.g. rising temperatures, decreasing precipitation amounts) or stability changes (e.g. extreme weather) can require adaptation strategies.

The discussion how to integrate climate aspects in accounting is often labeled Carbon Accounting. But natural scientists use this term as much as financial analysts. Do they have the same understanding and what are the differences?

These questions were the starting point for a literature review in order to elaborate on the understanding of the term Carbon Accounting in the different research areas and to offer a definition where a multitude of research strands is included.

II. METHODOLOGY

The objective of this paper is a systematic literature review on the topic Carbon Accounting in order to derive an appropriate definition of Carbon Accounting for different disciplines. According to Littell (2008) [3] a systematic review is "The application of strategies that limit bias in the assembly, critical appraisal, and synthesis of all relevant studies on a specific topic." Fink (2005) [4] proposes four steps for a systematic review, which we have taken as a basis. In the first step we selected our research questions, the bibliographic article databases and websites as well as the appropriate search terms. Then we applied practical review criteria for the inclusion of relevant literature and the exclusion of irrelevant literature. In the third step we applied methodological review criteria. Finally we synthesized our findings.

For the first step we decided to use on the one hand Google.Scholar[1] for a first overview and on the other hand the databases Academic Search Complete, Business Source Complete and EconLit with Full Text, which are hosted by EBSCO, for a deeper observation. We did not focus only on peer reviewed journals and books, we also searched for "grey" literature.

For the search itself we have chosen the following search terms: "carbon*accounting", "greenhouse gas accounting", "GHG*accounting", " CO_2 accounting", "GHG inventory" and "carbon*footprint". With these exact phrases we searched in the title, abstract or in the full text of the documents. Google Scholar only offers search "in the title" or "anywhere in the article". After a first review of the literature two dimensions occurred: literature with a physical focus and literature with a monetary focus. For a further research we used the combined search terms "environmental accounting" AND "climate change", "greenhouse gas", GHG, carbon, " CO_2", "global warming", "GHG inventory" in order to cover the non-financial area. For a deeper literature review in the second dimension we decided for the search terms: "full cost accounting" AND environment, "climate change", "climatic change", CO_2, "carbon dioxide", GHG, "greenhouse gas".

For the detailed review we excluded literature with a biologic, microbiologic, chemical and biochemical focus.

TABLE 1: REVIEW PROTOCOL

Author
Year
Name of the document
Type of the document
Definition or description of "Carbon Accounting"

[1] According to Google Scholar (2009) is the literature research with Google.Scholar "[…] a simple way to broadly search for scholarly literature." It is possible to search across many disciplines and sources like articles, theses, books, abstracts and court opinions.

Definition or description of similar phrases like “Carbon Footprint (CF)
Disclosure of CO_2, Kyoto-Gases or all GHG
System boundary (nation, company, person, project. etc.)
Physical carbon accounting
Monetary carbon accounting (Following the International Federation of Accountants (IFAC) we differentiate between financial accounting and management accounting that are applied within an organization typically. Financial accounting primarily focuses on standardized information about the financial performance of the organization to external stakeholders such as investors, tax authorities, consumers et cetera. Management accounting offers information to management for internal decision making.) ▪ Management accounting ▪ Financial accounting

III. RESULTS

To start with the literature research with the phrase “Carbon * accounting” was very useful because of the variety of this term: Among “Carbon emission accounting”, “Carbon credit accounting”, “Carbon budget accounting”, “Carbon storage accounting”, “Carbon stock accounting”, “Carbon offset accounting “, “Carbon temporally accounting”, “Carbon monitoring accounting“, “Carbon amounts accounting”, “Carbon balance accounting”, “Carbon activities accounting”, “Carbon equivalent accounting”, “Carbon fuels accounting” and “Carbon baseline accounting” are used. We got a similar result by searching for the term “GHG * accounting”: “GHG emissions accounting”, “GHG abatement accounting”, “GHG project accounting” and “GHG Inventory accounting”.

After the systematic literature review by using the presented coding schedules we divided the literature into four sections which are titled as followed:

- Physical carbon accounting with focus on global and national area
- Physical carbon accounting in terms of Carbon Footprint(ing)
- Monetary carbon accounting with focus on management accounting
- Monetary carbon accounting with focus on financial accounting

After presenting the main findings of every section we summarize our findings in one definition of Carbon Accounting.

A. Physical carbon accounting with focus on global and national area

The literature of this section focuses on physical accounting of carbon dioxide on a global or national scale. In these articles no explicit definition of carbon accounting was made, but phrases like “Full Carbon Accounting”, “Partial Carbon Accounting” or “Greenhouse Gas Accounting” were explained. Cairns and Lasserre (2006) [5] explain that “Carbon accounting is widely used by scientists in various disciplines, and is a standard

tool for the IPCC." [5]. Jonas et al. (1999) uses four different phrases: Besides the mentioned "Full Carbon Accounting" (FCA) and "Partial Carbon Accounting" (PCA) he also differs between "Global-scale Carbon Accounting" and "National-scale Carbon Accounting" [6]. In the first case, all (carbon-related) components of a terrestrial ecosystem are integrated and are applied continuously over time (past, present, future). If Jonas et. al. [6] uses this term in the context of the Kyoto Protocol, he refers to 'terrestrial full carbon accounting' – "the atmosphere–fossil fuel– terrestrial biosphere system where the atmosphere is adjusted for the oceanic system." According to Jonas et. al. [6] the "PCA is applied, e.g., under the Kyoto Protocol, which makes specific allowances for the inclusion of biological sources and sinks resulting from direct human-induced land-use change and forestry activities." FCA as well as PCA can be used in order to account on the national scale whereby the latter one is the most practiced form.

Cowie et al. 2007 [7] use the term GHG-Accounting and focus in their paper on accounting for biospheric carbon exchange. Based on the term "Accounting" which is defined as "comparing emissions and removals […] with commitments assumed by Annex I Parties under the Kyoto Protocol" [8] they enlarged this term to calculating 'debits' and 'credits' concerning an agreed target. Furthermore, emissions with anthropogenic origin should be accounted separately so that countries can decide for beneficial actions. If accounting isolates the anthropogenic component of estimated emissions or removals in order to provide appropriate incentives or sanctions for beneficial resp. detrimental actions, and to assess the effectiveness of policy measures.

Groen et al. 2006 [9] also don't define the term carbon accounting, but apply two approaches for carbon accounting: stock change and merchantable certified emission reductions.

Some authors such as Cowie et al. (2007) [7] and Jonas et al. (1999) [6] focus on GHG and other authors like Cairns et al. (2006) [5], Groen et al. (2006) [9] and Marland 2008 [10] concentrate on CO_2-emissions only. Additionally, the system boundaries differ between global [6], [10] and national [5], [7]; Jonas et al. (1999) [6], Marland (2008) [10] and Groen al. (2006) [9] chose projects as system boundary.

The investigated papers mainly focus on non-monetary aspects. Moreover, Cairns et al. (2006) [5] and Groen et al. (2006) [9] consider monetary aspects. For example Groen et al. (2006) [9] mention monetary terms like costs for site preparation, planting, thinning and harvesting that either recurring every year or as a fixed value for a year. Furthermore discounted costs and income as well as the Net Present Value are calculated.

B. Physical carbon accounting in terms of Carbon Footprint(ing)

In this research strand the term Carbon Accounting is not used, but the term carbon footprint (CF) is common. The CF can be traced back to the ecological footprint which is defined as "a resource management tool that measures how much land and water area a human population requires to produce the resources it consumes and to absorb its wastes under prevailing technology. The Footprint calculates the biologically productive land and water an entity (an individual, a city, a firm, a country) needs to obtain resources and dispose of waste. In this, it provides information to help manage ecological assets more carefully and to enable personal and collective actions that can move us towards truly sustainable development […]." [11] Kitzes and Wackernagel (2009) [12] explain that the CF is one part of a full Ecological Footprint and this global hectare-based CF can in addition to other components of the Ecological Footprint, for example cropland Footprint or fishing grounds Footprint, consolidate to the total Ecological Footprint of a population

or activity. According to Wackernagel (2008) [11] the CF "measures how much land would be required to absorb our emissions of carbon dioxide from fossil fuel (minus what is absorbed by the oceans)". In contrast to Wackernagel (2008) [11] Baldo et al. (2009) [13] describes the CF as "the overall amount of carbon dioxide (CO_2) and other GHG emissions (such as methane) associated with a product along its supply chain, which includes its use phase as well as product end-of-life management." This means that Wackernagel (2008) [11] measures the CF in hectares and Baldo et al. (2009) [13] in CO_2-equivalent. The latter unit is ascertaining by converting all GHG emissions into CO_2-equivalent. Kitzes and Wackernagel (2009) [12] accomplish that in the scope of a full Ecological Footprint the quantities of carbon dioxide emissions, measured in tones of carbon dioxide equivalents, are translated into the area, in global hectares. Wiedmann and Minx (2007) [14] prefer the measuring unit "tonnes of carbon dioxid", but don't include other GHG. Moreover, they investigated the usage of the term CF in all scientific journals of the SCOPUS and ScienceDirect databases between 1960 and 2007. Their findings evince that the term CF is used as a synonym for the CO_2 emissions or GHG emissions in CO_2 equivalents of specific products, companies or organizations. They recommend the term "Climate Footprint" unless all GHG should be included. Wackernagel (2008) [11] as well as Kitzes and Wackernagel (2009) [12] also only include CO_2-Emissions into the definition of CF, but Baldo et al. 2009 [13], Finkbeiner (2009) [15] and Sinden (2009) [16] involve further GHG although it is not clear if all GHG or only the Kyoto-Gases have to be accounted.

Moreover, Wiedmann and Minx (2007) [14] allude that all direct (on-site, internal) and all indirect (off-site, external, embodied, upstream, downstream) CO_2-emissions should be considered. By contrast Baldo et al. (2009) [13] divides the CF into direct/primary footprint and indirect/secondary footprint. Former involves the emission due to the combustion of fuels in the applicant plant and during the electricity generation; the indirect footprint encompasses these GHG that are generated from all the other sources.

However, in current discussions, CF is often used as abridgement of the product carbon footprint (PCF), which takes products and services as system boundary. Most of the literature discusses how to record CO_2-(equivalents)-emissions or GHG-emission and how to assess them in non-monetary terms (for example CO_2-emissions per product).

As described above CF measures and evaluates only CO_2 or GHG; other inputs and outputs are not considered. Thus, the examination is reduced to the environmental impact of "greenhouse effect". In contrast to that a Life Cycle Assessment (LCA) gathers and evaluates incoming (input) and outgoing (output) material and energy flows [18]. Therefore some "LCA purists" call the CF as a 'castrated type' of LCA. In their opinion all attributes or aspects of natural environment, human health and resources have to be considered [15]. In order to record GHG emissions companies can revert on different approaches such as the Greenhouse Gas Protocol (GHG Protocol) [19]. Another possibility is the international standard ISO 14064-1 which is also based on the GHG Protocol [20].

According to Wackernagel (2008) [11] the CF is nearly half of the total global Footprint and from 1961 to 2003 it was increasing more than 700% and hence it is the fastest growing component of the Ecological Footprint. So the CF might be an impetus to integrate life cycle approaches in organizations and decision making processes, a goal pure LCA did not reach yet [15].

C. Monetary carbon accounting with focus on management accounting

Similar to the already analyzed research strands the term Carbon Accounting is often used but not defined in the management accounting literature. Instead of Carbon Accounting terms like "Trade-based carbon sequestration accounting" [21], "Whole life carbon accounting" and "Operational carbon accounting" [22], "Carbon cost accounting"; "Carbon emission and sequestration (CES) accounting" [23], "Carbon management accounting" [24] and "Carbon business accounting" [25] are used, but only seldom described in detail. Prescott (2009) [22] distinguishes between "Whole life carbon accounting" that includes embodied and operational carbon for investment planning and "Operational carbon accounting" for annual reporting purposes. The basis for "Whole life carbon cost" is cumulative carbon emissions. Ratnatunga (2007) [23] applies on the one hand the term "Carbon emission and sequestration (CES) accounting" that has the objective to calculate the amount of CO_2 emitted by a source or sequestered in a biomass sink. On the other hand he uses "Carbon cost accounting" which is part of the "Environmental cost accounting". According to Ratnatunga and Balachandran (2009) [25] "Carbon business accounting", in short "Business accounting", encompasses strategic cost management (SCM) and strategic management accounting (SMA). It is discussed on the one side how the impacts of the (global) costs of CO_2 emissions can be captured by accounting systems and on the other side how they can be built into the cost and prices of different products and services. Furthermore, the impact on strategic decision making in organizations is discussed.

The researchers refer mostly to carbon dioxide although it is not always that clear. For example Prescott (2009) [22] uses among "carbon" also CO_2-equivalents what allows the conclusion that all GHG are included. ACCA (2009) [26] refers to GHG primarily. In contrast to the section above, a consistent system boundary is used: organization or entity. Prescott (2009) [22] focuses only on companies in the water sector.

The screened literature addresses the evaluation of returns on low-carbon investments, the development of carbon-related Key Performance Indicators (KPIs), and the identification of the financial consequences of climate change. [26] Kundu (2006) [27] analyzes the financial aspects of emissions trading. In his mind companies need to buy or generate Certified Emission Reductions in the scope of the Emission Trading or they have to pay penalties. Therefore accounting comprehends two facets: first, the value of the allowed amount of emissions and second, the costs that occur in order to meet emission-reduction commitments.

In King (2000) [21] a standardized accounting method is preferred which is applicable for the assessment and comparison of "early" carbon sequestration trades on the basis of the amount of CO_2 emission offset credits they will provide and their cost; Ratnatunga (2008) [24] discusses in his paper the impacts of carbon related issues on strategic management accounting. On the level of performance evaluation he suggests to extent the Weighted Average Cost of Capital (WACC) to Carbon-WACC, if financing of carbon related investments can be isolated. Also a Carbon-Economic Value Added (EVA) can be ascertained. The precondition is that carbon related net-income, investments and capital costs can be isolated. (Ratnatunga and Balachandran (2009) [25] reveals that there is a need for accurate carbon cost accounting using life-cycle costing techniques. In doing so not only costs for transport of a product or service to the point of sale, but also the carbon costs that occur ´presale` and ´postsale` have to be accounted. This includes the costs for time on rejects and recovery, meeting emission standards and production waste (presale) as well as landfill waste or litigation for environmental pollution (postsale).

The basis for an appropriate monetary management accounting forms an accurate capturing of the CO_2- or GHG emissions which means an organizations´ CF [26],[23]. As explained above Ratnatunga (2007) [23] mentioned the phrase "Carbon emission and sequestration (CES) accounting" which focus on the estimation of CO_2 emitted by a source or sequestered in a biomass sink.

Similar to the section "Physical carbon accounting in terms of Carbon Footprint(ing)" also some researchers in the area of management accounting (with focus on monetary terms) see some significant risks in the trend towards researching environmental KPIs in general and carbon accounting in particular. Parker (2008) [28] explains that a compliance measurement system for carbon impact will dominate the overall social and environmental responsibility program.

D. Monetary carbon accounting with focus on financial accounting

Especially accountancy firms address carbon-related financial accounting issues. That is one reason why we extended our literature sample beyond peer reviewed journals. The term carbon accounting focuses implicitly on the accounting for emission rights or emission permits (see [29],[30],[31],[32]). Currently within International Financial Reporting Standards (IFRS) or United States' Generally Accepted Accounting Principles (US GAAP) there is no accounting standard or interpretation that specify how to account for emission permits. Usually organizations conform to the general principles of IFRS [30] and in result there is a multiplicity of possible realizations in practice [31]. The consequences of a missing accounting standard is that financial performance is influenced concerning timing of recognition of assets, liabilities, profits and losses, measurement of balance sheet items at nominal value, cost or fair value, current and deferred tax and Value Added Tax (VAT) implications as well as presentation and disclosure [32]. Furthermore there are impacts on decision making regarding the participation in the EU ETS. Because of these two aspects a company needs to illustrate its accounting policy to the market [29]. Bakhshi (2007) shows in an example which changes could occur for balance sheets because of climate change. Thereby he concentrates on the most likely affected areas: product portfolios, property assets and long-term liabilities

Another problem accrues from the missing international carbon accounting and also reporting standard: it is very difficult to compare data sets [26].

According to Ratnatunga (2007) [23] "current financial accounting framework appears to be ill-equipped to provide the information required by companies to meet the challenge of global warming.", because accounting information systems are not created to cope with physical measures such as CO_2 sources and sinks. Even though these physical measures could express in monetary terms, the question if they should be categorized as assets or liabilities remains unanswered.

Mainly the explanations center on carbon (dioxide). Beyond that KPMG mentioned also the Kyoto-Gases which could be relevant in future times [32]. The system boundary is consistently the organization or entity.

Since the introduction of the European-ETS in 2005 capturing information about CO_2 emissions are obligatory for all companies, which have plants for energy conversion and transformation, plants to produce or to process ferrous metal, plants to produce pulp from wood, straw or similar fibrous materials or to manufacture paper or paperboard (production capacity exceeding 20 tones per day) and plants of the mineral industry. The captured emissions have to transmit to the Emission Trading Authority. [1]

The integration of the aviation sector will be proceeded into the European emissions trading scheme by the EU Directive 2008/101/EC [35], which provides the integration of aviation from 2012. This means that emission rights need to be purchased for all flights that start or land in a certain sovereign territory in a quantity which is linked to the ejected emissions. From 2013 further GHGs will be included within the emission trading scheme such as PFCs, that is ejected from the production of primary aluminum, or N2O from some chemical manufacturing processes [36]. Prospectively it will be expected that the range of sectors will expand continuously either directly through the inclusion of a sector, or indirectly through the inclusion of other GHG. The existing or potential regulatory requirements have a direct impact on the balance sheet as well as profit and loss account. Therefore, companies need and will need to identify CO_2-intensive processes to implement appropriate countermeasures. Consequently, a direct incentive exists to include CO_2 and GHG emissions in business decisions. But some companies record and evaluate their CO_2 emissions voluntarily, not due to regulations.

On the one hand government and EU and on the other hand other stakeholders such as investors or customers have got an interest to know about the firm's GHG emissions. Investors could inform on their own about firm's climate risks by using the CDP, which arose out of an initiative by financial investors in 2000. In times of global climate change such information is increasingly important regarding investment decisions [37]. The CDP as an independent non-profit organization has got the world's largest corporate climate database. Disclosure according to relevant business information will play a decisive role for interested parties regarding investment decisions. i.e. CDP gains in importance. But even other organizations ask for companies' climate impact according to their investment decisions like SAM Indexes GmbH, which stands for Dow Jones Sustainability Indices.

Even customers and the public are increasingly interested in Carbon Disclosure, i.e. to give an account of companies' GHGs. Firm's climate impacts are focused thereby in general and their CO_2 emissions and CO_2 mitigation and avoidance strategies are focused in particular. The Global Reporting Initiative (GRI), which was founded in 1997, aims to develop a global standard for Sustainability Reporting. Further it offers a guideline how firms ought to display social, ecological and economical aspects of their activities. Five environmental performance indicators (EN 16, EN 17, EN 18, EN 29 und EC 2) focus on companies' climate performance such as ecological indictor "total direct and indirect GHG emissions by weight" (EN 16) or economical indicator "Financial implications and other risks and opportunities for the organization's activities due to climate change" (EC 2) [38].

Independently of the research strand no definition of Carbon Accounting is used. In summary we propose that Carbon Accounting should encompass all GHG because present regulations will enlarge to others GHG such as CH_4 in future times. The majority of the screened literatures focus either on organizations solely or among product etc. also on organization level so that the system boundary should be "organization". The distinction between management accounting and financial accounting is carried over (according to IFAC) but we also consider non-monetary terms so that the CF can be incorporated into the definition.

Therefore Carbon Accounting encompasses the capturing and valuation of GHG emissions with the object of non-monetary and monetary valuation for internal purposes (management accounting) or non-monetary and monetary valuation for external purposes (financial accounting). Organization can use for capturing CO_2 or other GHG the guidelines of the GHG Protocol or the ISO 14064-1. On the financial accounting level is

an additional differentiation need to be considered: mandatory and non-mandatory accounting.

An extension of Carbon Accounting to Climate Accounting is a further step, in order to take into account "outside-in" effects, that means if impacts of climate change require business adaptations.

IV. SUMMARY

We did a systematic literature review regarding the term Carbon Accounting. The review showed that no definition exists but that there a different research strands. Within of any research strand there are different understanding regarding the disclosed gases (CO_2, Kyoto-Gases or all GHG), the system boundary (global, national, organization) and valuation of disclosed gases (non-monetary or monetary). Therefore we divided the literature into four sections: physical carbon accounting with focus on global and national area, physical carbon accounting in terms of Carbon Footprint(ing), monetary carbon accounting with focus on management accounting and monetary carbon accounting with focus on financial accounting. We deduced from these findings following definition: Carbon Accounting encompasses the capturing and valuation of GHG emissions with the object of non-monetary and monetary valuation for internal purposes (management accounting) or for external purposes (financial accounting).

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SOME ASPESCTS OF EUROPEAN CLIMATE POLICY

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Abstract: ***Being heavily energy dependent, it is not much of a surprise that Europe pays special attention to reducing the use of fossil fuels. Each one of the ten new member states is characterized by relatively low per capita energy consumption and relatively low energy efficiency, and the share of renewables in their energy mix tends to be low, too. The paper examines the problem, when the policy measures create a decrease in environmental capital instead of an increase. In this case it hardly seems justified to talk about environmental protection.***

The authors describe a case of a rapeseed oil mill which would not be of too much interest on its own but given that almost all similar plants went bankrupt, there are some important lessons to learn from its survival. The enterprise the authors examined aimed at establishing a micro-regional network. They completed a brown-field development to establish a small plant on the premises of a former large agricultural cooperative. By partnering with the former employees and suppliers of the sometime cooperative, they enjoyed some benefits which all the other green-field businesses focusing on fuel production could not. The project improved food security, energy security and population retention as well.

Keywords: renewable energy, game theory, sustainable development in rural regions, EU climate policy

I. UNRESOLVED PROBLEMS IN EUROPE AND IN HUNGARY

We have examined the Hungarian legislation and environmental performance from an European perspective The IMD in Switzerland publishes yearly a competitiveness report, in which they evaluates the country's performance in many dimensions. Based on the ranks we can create clusters according the difference between the overall and the environmental performance. There are five group of European countries:

To the first group belongs countries like Sweden, Austria, Switzerland, where the overall performance is good and the environmental performance is excellent. In this countries not only the so called eco-efficiency is high but the environmental assets like arabic land per capita and the urbanisation level are favourable. So they have good environmental assets. (The ecological footprint is not too big.)

To the second group belong countries where the overall performance is in harmony with the environmental performance like Denmark, France, Germany, Italy. In all this countries the favourable natural environment is combined with a relatively lower level (in European term) of population density and urbanisation.

The third group contains countries like Hungary, Spain, Poland where the environmental performance is much better than the overall performance, what is the "gratis effect" of the under development and the favourable natural circumstances (fertile soil, low urbanisation level etc.)

The fourth group contains totally different countries with relatively good overall but weaker environmental performance like Norway, UK, Belgium, Netherlands, Ireland. In this group the problem mainly not the week environmental management, in most cases the high population density and/or the overgrowth economy (high per capita energy consumption), the high level of urbanisation are typical.

The fifth group of countries, where both the overall performance and the environment are unfavourable. In this cases, the environmental infrastructure is weaker like in Greece, or in the Czech Republic.
It would be a mistake to over evaluate the reliability of the above mentioned data, but interestingly one can see some correlation
Historically EU environmental policy has mostly had the declared objective of integrating environmental policy with other sector policies. The relatively "autonomous" role assigned to environmental policy does not necessarily lead to a weak system, although it does mean that if the economy as a whole fails to support the objectives set forth by that policy, then environmental policy is doomed to failure.

EU environmental policy has moved from direct 'command and control' regulations to the declared objective of subsidiarity and, by now, it is employing the entire gamut of control mechanisms, the system of 'voluntary agreements' being one of its more recent additions. Early government policies, as almost all measures at the birth of the environmental protection, were reactions to specific crises. In other words, like the measures themselves, environmental policy at that time was 'reactive' in character. While 'end-of-pipe technologies' will most likely remain irreplaceable for some time to come in areas such as environmental rehabilitation, sewage or waste treatment, a 'reactive environmental policy' is always the result of a backward political system. In Hungary, the biggest problem, besides a poorly developed institutional structure, is a distrust of already functioning institutions.

In the table below we collected the major characteristics of the **two 'basic approaches' to environmental policy on the macro level**:

characteristics of...	"reactive env. policy"	"preventive env. policy"
government control	sector-specific, ministry of the environment	the env. ministry playing an integrative, co-ordinating role
problem management	differentiated by env. media and nature of pollution	integrated, holistic
control tools	command and control: penalties, product charges, user charges, subsidies	environ-friendly tax system, voluntary agreements, EMAS, early warning and emergency systems, educational campaigns
foundations of environmental economics	Pigou's theory of the internalisation of negative externalities	Coase, and theory of institutional economics
typical activities of env. bureaucracy	inspection, punishment, licensing, damage control	planning, co-operative problem solving, professional expertise
technical solutions for the protection of the environment	"end-of-pipe" technologies	cleaner production and consumption methods
financing	central budget, allocated funds	private sector, local government, foundations
measuring effectiveness	env. expenditures in % of GDP, % of pollution reduction	welfare indicators (ISEW, HDI), biodiversity index, public awareness, changed life-style
time-line of results	temporary, superficial, appearing in the short run	lasting results, appearing after some delay
participation of stakeholders	within a closed circle, 'greens' are the enemy	broad-based, civic groups as partners
environmental sector	developed env. industry and counselling system	educational programmes, information systems, clean technology advisors

Remarks: the table contains only those tools and theories that have already seen practical application.

The two extreme positions are never manifested in their pure form in practice, they always overlap at some point; the phenotype of the system is determined by the frequency of occurrence and the weight of constituting elements.
The transition between the two stages of development is full of contradictions. On macro, as well as micro level, development is hindered by existing structural factors. On the micro level, managers are reluctant to risk replacing well functioning (e.g. profitable) technologies under given circumstances, an understandable position when seen from the point of systems-theory. On the macro level, at the same time, the environmental policies of developed nations are rather ineffective. Although environmental trends in efficiency point in a positive direction, there are no signs of real improvement in absolute terms. It is precisely the failure of the system that should spur change on the macro level, yet it is the present structure itself that resists any movement. And the failure of 'reactive environmental policy' is evident both in the legal and economic spheres. In practice, even rigorous theory resists application. In addition, a number of elements making up EU environmental

policies cannot stand up to theoretical analysis. For instance, some of its basic assumptions, such as the principle of 'polluter pays', can only be accepted on moral grounds, but often lacks economic rational. It is well known that on occasion protection against harmful effects by the 'victim' would be more economical, in which case the principle of 'polluter pays' harms the Pareto optimum.
It would be easy to prove with numbers that in Hungary development projects, financed by incomes from fuel product charges (i.e. catalytic converter programme, the phase-out of two-stroke engines) have contributed to increased motorisation and the decline of mass transit and, instead of reducing, have actually boosted per capita fuel consumption. If we consider anticipated difficulties attending the recycling of used auto parts, coming up in a few years, the programme's environmental equation is even more discouraging. Many may assume that we are mismanaging these programmes. The problem lies somewhere else, however; it is the entire concept of 'reactive environmental policy' that creates these unintended results.

In all developed countries governments reacted to environmental problems with encouraging the emergence of an independent environmental ministry. In institutional terms this has led to a contradiction. Environmental policy which, we are convinced, should be integrated into economic and other sector policies, is segregated and downgraded, eventually becoming one of several sectors of the economy. Turning environmental issues into an industry is a natural 'developmental deficiency', the result of a functional division of labour. Environmental policy should attempt, more than anything else, to slow economic expansion, to work out and support, with the help of pressure groups, economic activities that reach their target by reducing per-unit fuel consumption and raw material requirement, while keeping economic activity within the regenerating capacity of the natural environment.

Due to its separate function, the success of the ministry of environment is measured by the size of redistributed resources (budget revenues) it receives and the effectiveness of its lobbying efforts. However, in this context its vested interests lie in propagating pro-expansionist forces. Does it mean that voices questioning the legitimacy of an independent environmental ministry are correct? With the present administrative structure the elimination of the environmental ministry would be a mistake; its presence strengthens efforts to protect the environment, competing successfully with other areas (i.e. health care, social welfare, etc.) for the scarce resources.

As a result of these contradictions the environmental ministry and the protection of the environment do not necessarily share the same interests. A reactive environmental policy actually favours the emergence and implementation of sector interests. The environmental bureaucracy, the nascent and growing environmental industry all strengthen the ministry's lobbying power, making more funds available for environmental protection (end-of-pipe variety) which, in the final analysis, do end up benefiting the environment itself.

In contrast, the lobbying power of a preventive environmental policy is considerably more limited. Improvements in the environment in this case are not simply due to the efforts of the environmental sector. In a preventive system the environmental industry remains weak and lacks independence, fewer budgetary resources come available for environmental projects and the ministry loses some 'respect' which, in the public eye is tied to the size of its budget. It is hardly reasonable to expect the environmental ministry, after early successes promoting the interests of its sector, to support a 'preventive environmental policy' that, while increasing its socio-political influence and efficiency, would ultimately leave it in a 'weakened position'.

Looking at the problem from the point of system-theory and sector interests, it is clear why in their response to the EU questionnaire different ministerial departments were motivated in painting such a negative picture of the state of the environment. At the same time the positive image presented concerning enforcement issues and the development of the institutional system is equally unrealistic. The discrepancy in responses on the state of the environment and institutional structure

can be explained quite easily: for ministry officials the state of the environment is something beyond their control, caused by outside forces, by 'polluters'. The establishment and improvement of institutional structures (including legal instruments) is the responsibility and competence of the Ministry of the Environment and Regional Policy, its own 'brain-child', as it were. This is only to be expected; every institution has a more critical view of others' work and is inclined to put its own achievements in a better light.

NGOs are also pressuring the ministry to present the state of our environment in an unfavourable light. NGOs too have a vested interest in interpreting environmental indicators in dramatic terms. The bureaucracy, that once sharpened its claws in bargains over planning targets and regulatory policy and, lately, in budgetary skirmishes, hopes to take a larger 'bite' out of redistributed revenues and anticipated EU subsidies.

The negative image on the state of the environment, more than anything else, makes EU bureaucrats wonder how all needed infrastructure development and environmental rehabilitation projects could be financed. The favourable image on the institutional system, on the other hand, raises doubts about its efficiency - if the system works so well, why is the environment in such a poor state.

II. EU EFFORTS TO CONTAIN THE IMPACTS OF CLIMATE CHANGE

Being heavily energy dependent, it is not much of a surprise that Europe pays special attention to reducing the use of fossil fuels and to exploring and promoting the employment of renewable energy sources. In order to fight climate change, member states made the following commitments for 2020 at the European Council Summit of 8-9 March 2007[2]:

- Reduce carbon-dioxide emissions by 20 percent
- Improve energy efficiency by 20 percent
- Increase share of renewable energy in the EU energy mix to 20 percent
- Increase the share of biofuels to 10 percent

The decision was criticized even before it was made. Not only for being premature and lacking any and all background calculations but also because these amounts are simply not sufficient from a climate change point-of-view. Green NGOs (like Friends of the Earth) claim a 60-70 percent reduction in emissions is needed. According to the above-cited WETO project, Europe will only achieve 10 percent by 2050. The 20 percent reduction thus even contradicts the EU's own professional forecasts and what is more, is quite marginal in importance considering climate change. The best we can say about these commitments is that they might indicate that the EU believes climate change to be a real threat and that they are ready to make efforts to avoid a catastrophe. The Copenhagen Climate Conference did not bring anything new to the table, either. The only thing the world's countries could agree on was that they should keep making the necessary efforts.

European emission reduction achievements have been very contradictory. Table 2 shows commitments vs. actual data on the energy consumption and carbon dioxide emissions of fifteen countries (using a ranking of the top thirty).

[2] Data source: Presentation of Professor István Láng at Corvinus University of Budapest, April 2009.

TABLE 2: ENERGY CONSUMPTION RANKING OF CERTAIN EUROPEAN COUNTRIES (from amongst the first 30) SOURCE: Eurostat

	Per capita consumption	Consumption per unit GDP	Distance from carbon dioxide emission target	Share of renewables
Austria	19	5	18	4
Belgium	25	18	10	15
Bulgaria	6	29	5	28
Czech Republic	16	28	1	17
Denmark	17	4	11	2
Estonia	16	28	1	24
Finland	28	25	21	3
France	23	11	18	14
Germany	22	10	8	7
Hungary	8	17	9	26
Ireland	20	3	29	16
Italy	11	1	15	9
Latvia	3	20	2	22
Norway	27	12	19	10
Poland	5	22	6	20

It is quite apparent that the commitments mentioned, while requiring serious efforts from some of the countries, do not constitute a problem at all to some others.
Surprisingly enough, Finland, though usually considered a pioneer of environmental protection, lags far behind – not only because of its high per capita consumption but also because of its per unit GDP consumption. Something similar applies to Norway, as well, even though both countries boast very favorable advantages concerning renewable energy production thanks to their hydropower resources.
These rankings also confirm the well-known fact that rich countries tend to have higher per capita but lower per unit GDP energy consumption while the exact opposite applies to poor states.

These trends are not changed between 1997-2007 (Figure 1) and are not too much of a surprise, but according to Figure 1 and Table 2 the aforementioned ”uniform” commitment of the EU states is rather hard to interpret.

Each one of the ten new member states is characterized by relatively low per capita energy consumption and relatively low energy efficiency, and the share of renewables in their energy mix tends to be low, too. This situation clearly calls for energy policies which improve both energy efficiency and the share of renewables in the energy mix. It is not only carbon emissions but also energy security and the non renewable character of fossil fuel reserves which justifies increased interest in opportunities to employ biomass or wind energy. Many consider the renewable energy industry a potentially lucrative area for investment.

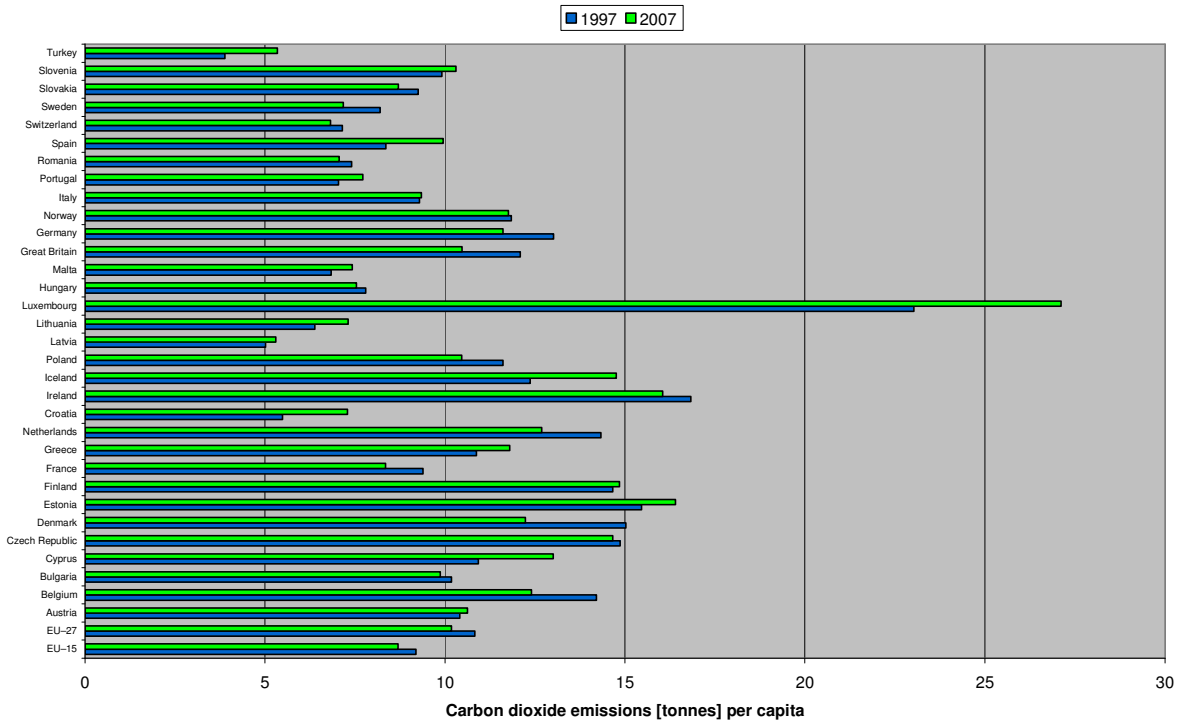

FIGURE 1: CHANGES IN COUNTRIES' PER CAPITA CARBON DIOXIDE EMISSIONS BETWEEN 1997-2007 SOURCE: Eurostat

III. DECISION DILEMMAS ABOUT RENEWABLE ENERGY SOURCES

All green NGOs find it desirable to support the spread of so-called "green energy", though there are debates about the exact details. Some opt for wind power, some for biofuels while others demand increased subsidies for geothermal energy production.

In table 3. we describe three cases which tend to divide the public. "Stakeholders" (entrepreneurs, government, NGOs and others) are all part of a so-called "decision game" and, not having read the book of János Neumann[3], they believe that the objective of the "game" is to win. Whereas one should rather decide first what kind of game they are actually playing. In our examples, the stakeholders and especially the government and the NGOs believe the game to be about environmental protection. Those in support of wind turbines, of increasing the mandatory bioethanol or biodiesel mixing rate and of the natural gas program are acting for a good cause by supporting environmental protection. Both the government and NGOs are convinced that the purpose of using renewable energies is to slow down the exhaustion of natural resources and to reduce the emission of greenhouse gases. Both of these objectives can be related to sustainable development and environmental protection. Thus the decision "game" appears to be about environmental protection. But is it really? Let us take a look at what the environment "gains" and how

[3] János Neumann and Oskar Morgenstern published their book „Theory of Games and Economic Behavior" more than sixty years ago in 1944. Even on its 60th anniversary it was only a very small group from the professional elite who celebrated the authors even though their work has revolutionalized economic thought. There have been many works from many authors on the economic applications of game theory ever since – but even today, it is the 'imperative to win' that springs to one's mind when games are being discussed. But the most important thing about any game is to know what type of game one is playing. Concerning environmental protection and sustainable development, it is very important for us, environmental economists, to ask ourselves the question: do we know what type of game we are playing?

environmental conditions improve through the use of wind power, bioethanol or a natural gas program.

TABLE 3: ENERGY AND CLIMATE CHANGE RELATED "GAMES" BETWEEN NGOS AND THE ECONOMY

Replacing fossil fuels or reducing their negative effects	**NGOs believe the game to be about…**	**The game is actually about…**
1. Biofuels	Renewable energies to slow down resource exhaustion, reduce carbon emission	Rural development, energy security
2. Wind generators	Renewable, no carbon dioxide emission	Utilization of drought areas, local energy production
3. Natural gas program	Improve energy efficiency, reduce air pollution	Supply security, reduce urban air pollution

It is apparent from Table 3 that "environmentalist" arguments for the natural gas program, biofuels or wind power plants are rather weak ones. Remember: all three solutions have received or are still receiving state subsidies which are labeled 'environmental'. Though any one of them might be useful under certain conditions, all three solutions are marginal innovations only, thus none of them should qualify for unconditional support irrespective of location, time and social conditions. Cost-benefit analyses could yield either a positive or a negative present value depending on the actual parameters. In all cases, results heavily depend on the framework within which they are evaluated.

If and when the measures introduced because of a given decision result in a decrease in environmental capital instead of an increase then it hardly seems justified to talk about environmental protection. The fault lies in the definition of the game itself – in the above cases and in many other situations as well. Mentioning pro-environmental arguments for bioethanol or biodiesel as renewable sources of energy is not exactly reasonable. 'Environmental protection' and 'automobilism' are paradoxical concepts already. One could, however, look into the effects of bioethanol production on employment or rural development and it is quite possible that both cultures along with their upstream industries could qualify for subsidies in that very framework.

The issue of renewable energy sources might be considered an "energy security decision game", accepting the self-sufficiency rate and import dependence to be strategic questions, thus the construction of wind turbines might turn out to be a reasonable choice in this very game. As an environmental protection decision game, however, no sound solution exists to this problem. If we wanted to turn the aforementioned solutions into economically sound choices, we would soon get to the issues of, in the case of bioethanol, GMOs and industry-like production systems, which are taboo to environmentalists (for good reasons, most probably). Wind turbines would lead us to thinking about water reservoirs like the one planned at Prédikálószék (plans for the hydroelectric power station Bős-Nagymaros included a pumped storage reservoir here in a site of natural beauty in Pilis mountains), and today's "greens" would for sure not be very enthusiastic about it either. All the above leads us to one conclusion: before participating in meetings to make decisions, we really

should consider what type of "game" we are playing and whether we have the necessary competence for the role. Since if we do not know the game or if it is not us who should be sitting there but we still happen to win - that will only bring trouble on all of us.

In Hungary, where there is hardly any wind according to scientific meteorological statistics, the actual installation of the already permitted wind power capacity of about 350 MW seems unavoidable, and investors' expectations are even estimated at several times this figure. Soon, the next "permit race" is about to start. An important question is: what would happen to the Hungarian energy system if, for some environmental/economic policy reasons, the government decided to leave alone the -apparently liberalized, but actually subsidy-driven- market?

As environmental economists, we are worried about subsidies for bioethanol and biodiesel production. No matter how hard we try to cover it up, these subsidies are definitely harmful from an environmental point-of-view. These subventions make fuel cheaper than it would be without them which indirectly fosters the expansion of automobilism – though it should rather be decreased worldwide, and even more so in Europe. It is a known fact that, in Hungary, the use of bioethanol as a fuel and bringing in wind turbines to the existing electricity system is only possible with strong and continuous state support.

The real price of energy itself is changing rapidly, yet recently we witnessed substantial price changes within relatively short periods of time instead of the usual few percent fluctuations. From USD 60 per barrel in February 2007 crude oil prices rose to USD 145 a barrel in July 2008. Then a downward trend followed with the price finally dropping to USD 30 in February 2009, yet again bouncing back to USD 70 per barrel by September 2009[4]. With oil prices above USD 100, pretty much any type of renewable energy seems competitive and rate-of-return calculations in the energy sector indicate incredible opportunities for innovation. Then energy prices had halved in a couple of weeks thus any previous calculations became invalid right away.

Accordingly, Europe and the world have seen the rapid spreading of corn and rape fields during the last two years. Processing plants also started to appear, and then the experiences of one single year turned previous evaluations upside down. And it was not only crude oil prices changing dramatically, but also, something "turned out" that has for long been known by many: biomass is sourced from where our food comes from, thus the two types of use are in competition. In 2008, bioethanol became very economic because of high crude oil prices and mandatory mix rates artificially fueled the market boom as well. Demand for corn-based bioethanol drove corn prices to heights which poor people could no longer afford, causing starvation in Mexico and in some other regions of the world. Sure enough, there are some who found other explanations. According to New Energy Finance, the use of grain for bio-fuel production "only" accounts for 8.1 percent of the total increase in food prices. As they put it: "In grains, during the period from 2004 to April 2008, global dollar prices increased by an average of 168 percent. The rising price of oil accounts for an increase of 32.5 percent and other inputs - such as land and labor costs - contributed 7.4 percent. Dollar depreciation accounts for a further 17.9 percent. Supply and demand imbalances account for the remaining 57.7 percent, with biofuels responsible for up to an 8.1 percent increase in global average grain prices (the impact on U.S. corn was clearly above average). The biggest issues were failure to improve yields to compensate

[4] Source: WTI Crude Oil Database: Cushing, OK WTI Spot Price FOB (Dollars per Barrel), http://www.eia.doe.gov/dnav/pet/pet_pri_spt_s1_d.htm

for global population growth, along with the failure of the Australian harvest". (LaMonica, Martin: 2008)

The evaluation we cited above did not really clear things up but rather provided further proof that averages tend to cover the truly important matters and that a universal energy policy cannot be right, not even in today's globalized world. An 8.1 percent average price increase does not seem too much, indeed, yet in some regions, it might very well be enough for some to die of hunger.

IV. Experiences from a successful alternative thinking business venture Energy production, rural development or …?

Back in 2007, the owners of an existing business decided to contribute to the EU renewable energies strategy: they founded a rapeseed oil mill for producing biodiesel raw material – a true model plant from a sustainability perspective. They employed an integrated approach to all the social, political and economic dimensions and ecological-environmental aspects and thus developed a tailor-made strategy for the given conditions. Sustainability was also accounted for in the location decision-making process. The primary objective was to find an agricultural region where a sufficient amount of rape could be produced in a 50-60 km range, as by minimizing transportation distance one can decrease both transportation costs and the burden on the environment.

As for all business ventures, profit maximization was the primary goal – but social and environmental benefits were also taken into account, knowing that in the long run, these would actually bring even more serious benefits for the business as well.

The plant started its activities in the renovated buildings of a former agricultural cooperative. Today, it has six employees. Thanks to the processing of 5200 tons of rape annually and related logistics needs, downstream employment benefits are significant. The plant now has a processing capacity of 430 tons of rapeseed in a month, which yields 150 tons (170000 liters) of rapeseed oil and 280 tons of rape pellet.

The plant we have been presented is located in Transdanubia and produces crude rapeseed oil, a raw material for biodiesel production. If it was not for the law, this oil could well be used to fuel agricultural and other machines or a power generator, thereby providing for the electric energy needed by the plant itself (i.e. a rapeseed oil-fueled generator). Oil sales constitute the majority of the plant's income. Rape pellet may serve as livestock fodder or be used in pellet stoves as well. Ideally, rape production, oil milling, livestock farming and the energy production infrastructure should all be within a 60 km range. Calculations suggest that approximately 5000 hectares of rape acreage is what it takes to operate an economically sustainable system. In such a case, there is no need for long-haul transportation and crop rotation becomes possible.

Following heavy fluctuations, the rapeseed market stabilized in summer 2009. The price for rapeseed settled at HUF 63000 per ton. Considering price and cost levels from 2009, the plant can be operated economically (as 3 tons of rapeseed yield 1 ton of rapeseed oil and 2 tons of pellets): (1 [t rapeseed oil] x 620 [EUR/t] x 270 [HUF/EUR]) + (2 [t pellet] x 37.000 [HUF/t]) – 3 [t rapeseed] x 63.000 [HUF/t] = 52.000 [HUF]

According to estimates by Oil World (AgroLine, 2009), the EU harvested a record amount of rapeseed in 2009. In 2010 the rapeseed crop totaled 20.12 million tons which even exceeds the previous year's record figure of 18.91 million tons.

In spite of the above calculations, there is no reason for optimism, as it is uncertain how over-production will affect the market. Neither do we know how slow or fast our

emergence from the crisis will be and how that will influence the crude oil market, which, as we have indicated earlier, fundamentally determines rapeseed oil prices.

TABLE 4: FLUCTUATIONS IN THE PRICES OF CRUDE OIL, RAPESEED OIL AND RAPESEED AS A RESULT OF THE CRISIS (2007-2009)
SOURCE: Compiled by the authors based on data from rapeseed oil millers

	Crude oil price (USD / barrel)	Rapeseed oil price (EUR / t)	Rapeseed price (thousand HUF / t)
July 2007	75	580	50
July 2008	145	1100	110
Dec. 2008	35	600	70
Sept. 2009	70	620	63

Rapeseed oil prices are closely related to changes in crude oil prices as it is shown in table 4. In July 2007, rapeseed cost HUF 50.000 per ton, while it was already HUF 110.000 per ton at the time of harvest. This figure is not that surprising when compared to rapeseed oil prices which rose from EUR 580 per ton to EUR 1100 per ton following a similar trend (they fell back to EUR 600 per ton by 2009 and are now around EUR 620 per ton). Experience from the last three decades suggests that it is advisable to buy up at least 50 percent of one's annual rapeseed requirement at harvest, when it tends to be the cheapest. This is what the present plant did: they bought up 3000 tons at HUF 110.000 per ton.

As a result of the outbreak of the financial crisis in August 2008, the price of rapeseed plummeted to HUF 70.000 per ton by December 2008, thus the change in the cost of raw materials alone caused losses of HUF 120 million [3.000 t x (110.000 HUF/t-70.000 HUF/t) = 120.000.000 HUF].

The problem is that such businesses are very seriously affected by any change in the world in the economic environment. Everything which is somehow related to agriculture in the European Union is heavily influenced by the EU's subsidy policies. But changes in energy prices, which are influenced by the operation of the economy as a whole, might well be dominated by factors far more powerful than agricultural subsidies – for example, the crude oil price fluctuations between USD 145 and 35 we witnessed during the last one and a half years. This was a strikingly high level of variability for a time span of only eighteen months, no sign of which appeared in any of the forecasts.

Fluctuations of the past three years have by far surpassed anything considered normal, even in the crude oil market – and they are completely new to the agricultural sector, as the costs of agricultural inputs used to be rather balanced. The price of biodiesel, however, is so closely bound to that of crude oil that any radical change in the latter ruins biodiesel initiatives as well. The majority of businesses in this sector are small enterprises, usually with strategic investors. The past two years have proved that businesses founded with the promise of high incomes and government subsidies in mind are doomed to quick failure when exposed to the vagaries of the rapidly fluctuating energy market. Such hectic market conditions could only have been survived by companies who had stable financial investors able to dampen these impacts and to hedge out some of the risks. Local entrepreneurs, having built their businesses on "agricultural potential", however, rarely have financial investment groups as investors. Because of their lack of capital, the immediate sale of the end product – rapeseed oil in this case – is an absolute must for them. Thus it may seem reasonable (only to the "sensibly minded" environmentalist, of course) to ask the question

"should production be considered 'local' if the factors for successful production are in the hands of global capital?"

The rapeseed oil mill we introduced would not be of too much interest on its own but given that almost all similar plants went bankrupt, there are some important lessons to learn from its survival. One of them is the existence of the aforementioned financial investor, allowing for a positive cash flow. Another point is that biomass energy production was not the sole purpose for founding this mill. Most rapeseed mills simply wanted to produce biodiesel raw material, thereby taking advantage of the EU policy prescribing the relevant mandatory mix rates, whereas the enterprise we examined aimed at establishing a micro-regional network. They completed a brown-field development to establish a small plant on the premises of a former large agricultural cooperative. By partnering with the former employees (now farming their own land) and suppliers of the sometime cooperative, they enjoyed some benefits which all the other green-field businesses focusing on fuel production could not. Its close relations with agricultural entrepreneurs guaranteed strong local support for the company. The project improved food security (livestock kept on controlled, locally produced fodder), energy security (public institutions heated with rapeseed pellet) and population retention (stable jobs) as well. This mutual cooperation is something rural people can make a living from. If they realize that livestock farming is worth considering, they might very well create the basis for the revival of rural farming activities. Cooperation provides for a win-win situation. Neither a rapeseed mill, nor livestock farming or biomass heating seems a promising project on its own, individually. As part of an industrial-ecological system, however, the undertaking as a whole can actually operate economically, and the countryside can also remain a place that is worth living in.

V. CONCLUSION

Recent years have showed us that the harmony between environment and economy lies with those smaller enterprises which offer significant employment opportunities and thus are desirable from a social point-of-view as well. Considering rural development purposes, bio-fuel production projects might well be worth supporting as they might provide employment for the rural population, improve population retention in these areas and aid in maintaining viable rural communities.

All the above leads to the conclusion that environmental issues require location- and time-specific decisions, thus international experiences alone are far from being enough. What is good for the US might cause starvation in Mexico. What seems favorable in Brussels might appear undesirable in Hungary, and, what is more, the use of land which perfectly fits the Great Hungarian Plain might turn out to be nonsense for the Transdanubian region. It might happen that rape production remains a rational choice both economically and ecologically for a couple of years, yet later on, it might become explicitly harmful along any one of these two dimensions, or maybe along both. This might seem to suggest leaving everything to chance or to the market (which are quite the same for many, by the way). But there is another possible conclusion: the need for flexible adaptation – a concept also re-discovered by literature, having received abundant coverage in recent years under the name 'resilience'.

Resilience stands for a decentralized or regionalized type of "planned economy", as opposed to the centrally-planned system we were used to until Hungary's transition –

memories of which we might happen to recall when faced with an EU bureaucracy trying to cope with its own managerial challenges. Walker Brian (2005)

The need for a sustainable relationship between nature and mankind requires us to focus on ecological flexibility as it primarily deals with the scale of opportunities between stabilization and destabilization: concerning our present development, concerning global environmental changes, the loss of biodiversity, degradation of ecosystems and concerning sustainable development.

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AN ETHICAL ISSUE ON CARBON REPORTING: EVIDENCE FROM FORESTRY RELATED ORGANIZATIONS

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Abstract: ***The present research discusses an issue which seems that has not gained the focus of the academic society and is relevant to environmental accounting and, more specifically, carbon accounting subjects: how should the organizations report their carbon emissions when they produce a non product output out of the scope of their operation- that is the carbon sequestration service? Is it ethical to account for it in a way that it offsets their carbon emissions? Should they report it separately as a positive non product output? The previous questions are raised mainly to forestry sector organizations where sometimes plants and trees are produced for other than carbon sequestration objectives. The present research is a first attempt by the authors to address this theme.***

I. INTRODUCTION

The need for a global effort to protect natural environment has forced organizations to take actions for measuring, reducing and reporting their carbon footprint [1]. The Global Reporting Initiative (GRI) includes carbon related indicators in its guidelines for sustainability reporting, which demand, among other things, the disclosure of the actual emissions in CO_2 equivalent and the reductions achieved by the application of cleaner production techniques [2]. GRI suggests that the calculations of the emissions can be performed by using the corporate accounting and reporting standard [3] of the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). According to Huang et al. [4] "the Greenhouse Gas Protocol (GHG Protocol) is the most widely used international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions".

The GHG Protocol has formed guidelines on how to measure greenhouse gas emissions originating directly from the organization (scope 1), indirectly from energy inputs that are purchased from the organization (scope 2), and indirectly from all supply chains connected to the organization, that is, emissions across the entire life-cycle of all operational inputs and outputs (scope 3) [5]. However, it is observed that no guidelines have been suggested to organizations in order to measure carbon sequestration that may occur outside the scope of its operation.

Although this case may not seem very common, it can occur quite often in organizations that use trees and plants for the scope of their operation. There are a lot of organizations in forestry sector that their production process results in outputs that mitigate CO_2: trees and plants. Hence, there is an ethical issue here: these organizations produce plants, trees and possibly manage whole forests for their operational objectives. Should these organizations measure and report the quantities of carbon sequestration resulted from this output, which in terms of "Environmental Management Accounting" and "Material Flow Cost Accounting" terminology is a non-product output? [6], [7]. For example, hunting

organizations in Greece implement habitat improvement projects for the benefit of wildlife species, and especially game species. They include tree plantations, seed cultivations and avoided crop cutting. All these actions result in carbon sequestration. Is it proper for hunting organizations to report the quantities of sequestered carbon as offsets for the carbon emissions which result from their operation (car fleet, flights, electricity consumed)? On the other hand, public forest service in Greece, according to its ten-year management plans, harvests forests and sells timber products to forest industry. Should it be penalized for the carbon emissions produced by this action? Should it be forced to be carbon neutral? The objective of the present research is to discuss this issue on carbon reporting, and present some solutions and recommendations for the forestry-related organizations sustainability reports.

In the following discussion it is not included the common approach selected by the majority of organizations not included in forestry sector in order to offset carbon emissions: the participation in afforestation, reforestation and avoided-deforestation projects, either by undertaking the whole project, or by purchasing carbon offsets that pay such projects. These actions are end of pipe environmental actions and should be reported as the other similar actions are.

II. CARBON REPORTING AS A PART OF ENVIRONMENTAL REPORTING

The need to report on environmental issues has been recognized since the 1970s. In 1973 the Study Group of Financial Statements in USA advised that a basic objective of the corporate reporting should be the disclosure of the activities undertaken by corporations for the protection of natural environment [8]. However, before the 1990s business was seeing environmental issues as peripheral to its core activities [9]. It was in the 1990s and especially after the Rio de Janeiro Earth Summit in 1992 that the environmental issues started appearing more systematically in the business agenda [10].

Corporate environmental reporting is an activity which can include [9]:

> "outlines of the organization's attitude to the environment, glossy pictures of 'bits of the environment', reference to EMS and environmental audit, tables showing selected data on the levels of emissions and wastes produced by the organization and suggestions about levels of environmental investment" (p. 241).

The above definition implies that the relatively new issue of carbon reporting is a part of environmental reporting. Taking into consideration that also environmental reporting is considered now as a part of sustainability reporting [11], [2], [13], it can be concluded that carbon reporting is a subdiscipline of sustainability reporting.

Carbon reporting is not defined in the literature. The term is usually connected to the action of "carbon footprint analysis" [5]. The latter is also new in the literature concerning corporations. Wiedmann and Minx [13] researching the term in the scientific journals databases Scopus and Science Direct for the years 2005, 2006 and 2007 found only 3, 8 and 31 hits respectively. They also observed that no research was defining the term. Therefore, they gave a definition for carbon footprint [13]:

> "The carbon footprint is a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product". (p. 4)

Following the previous definition, an attempt is made here to define the issue of carbon

reporting:

"Carbon reporting is the process undertaken by organizations in order to disclose to stakeholders data about the carbon footprint that results entirely from their operation".

III. CARBON FOOTPRINT

Carbon footprints became firstly popular in nongovernmental organizations, companies and other private entities, before catching the interest of academic research [14]. Wiedema et al. [14] believe that this term has the potential to increase consumer awareness about the environmental impacts of organizations' products. They compare it, also, to the complexity that the application of the relatively similar methodology of Life Cycle Assessment presents, which has failed to catch the attention of the public.

In order to define and calculate carbon footprints, there are several protocols available such as The Climate Registry in United States, or the more popular worldwide GHG Protocol [1]. The former suggests the reporting of emissions for every greenhouse gas of the Kyoto protocol, while the latter divides the organization's emissions into three scopes and suggests reporting for greenhouse gases for at least the first two scopes. The first scope refers to direct emissions resulting from the operation of organization's premises; the second scope refers to indirect emissions from the energy inputs that the organization uses; and the third (voluntary) scope refers to the emissions from all the inputs and outputs in the production process of the organization [1]. For the third scope there is now more attention given [4], [5] and the Greenhouse Gas Protocol published in November 2010 draft versions of guidelines for this scope [15], [16]. However, the issue discussed in the next section (IV.) seems to not be addressed even in these new versions.

IV. DEFINING THE ETHICAL ISSUE

In forestry sector there are many organizations that produce significant negative environmental impacts by their operation. These organizations have started measuring these impacts and try to reduce them. For example, [17] examined the corporate environmental reports of a hundred organizations in the forest and paper industry worldwide, and found that in 2003 most of these organizations were mainly discussing forest management and fibre procurement issues, but no carbon sequestration. A newer research [18] which examined ten of the largest pulp and paper companies in the world showed that only two of them discussed in their sustainability reports issues concerning carbon sequestration. One, especially, performed also a carbon footprint analysis.

However, these organizations by cultivating trees and plants for their production process, they produce a positive externality for the environment, a positive non product output, which is the carbon sequestration service derived from the photosynthesis function of the plants. So there is a complex and ethical issue here: how should these organizations behave when it comes to carbon footprint analysis, and eventually to carbon reporting? Should they measure the quantity of the potential carbon sequestration and present it as an offset for the carbon that they emit? Should they ignore it and present only their carbon emissions and the reductions they achieve in them through cleaner production technologies? Should they only try to sell the carbon credits they produce through this positive externality? (although the latter would by this way be no more an externality, but

the organization would have internalized the non product output).

In forest sector the following main organizations can be distinguished:

a) Wood, pulp and paper companies: these companies are using wood products for the production of intermediate or final products. They need wood, therefore they own forests, or cultivate forest plantations on bare lands.

b) Public forest service: this organization (especially in countries where forests and forest land is public) manages forests in order to produce products and services that can be sold, or can offer protection and recreation to citizens.

c) Hunting organizations: these organizations aim at managing sustainably the game resources through habitat improvement actions, therefore they lease land in order to afforest, reforest or leave it uncropped.

d) Rangeland livestock enterprises: these companies use the system of extensive grazing for the production of meat and milk.

The first two types of forestry sector organizations are constantly in a process of planting and harvesting forests. The third type usually only plants but never harvests plants or forests, while the fourth one usually first harvests rangelands through livestock grazing and then leaves the land unaffected in order to produce feed for the livestock again.

Thus, the first two types and the fourth apart from their carbon emissions through their production process (scopes 1,2 and 3 according to GHG Protocol) they constantly sequester or emit additional carbon through the use of plants and trees, and the third one, apart from scopes 1 to 3 usually only sequesters additional carbon.

In the following section a first attempt to address the issue of reporting this additional carbon is presented.

V. CONCEPTS FOR THE ETHICAL ISSUE

In order to form some concepts for this issue on carbon reporting, two attributes are taken from the literature. The first one is “additionality”, a key characteristic of the Clean Development Mechanism of the Kyoto Protocol. The second one is the “carbon neutrality”, which refers to the need to have carbon neutral organizations in economy.

A. Additionality

The Clean Development Mechanism refers to the mechanism of allowing developed countries to invest, among others, in afforestation or reforestation projects in developing countries. By this way they offset their emissions and contribute to the sustainable development of the hosting countries. In order a project to be accepted it must be proved that it is additional to a baseline scenario. This means that the emission reductions are ‘real, measurable and long-term’ [19]. The reductions are additional to any emission reductions that would have occurred in the absence of the project [19].

Thus, it is suggested that the attribute of additionality is taken into consideration by forestry sector organizations when it comes to report the additional carbon. For example, in a case where a paper company reforests a private land after a clear-cut, there is no additionality. It would be no ethical to present the sequestered carbon as mitigation action. When it buys a bare forest land, or agricultural land, however, in order to turn it into a forest for its scope of operation, then this action is additional to the baseline scenario and the company should be allowed to measure the offsets that occur until the clear-cut of the

afforested area.

In the case of hunting organizations implementing habitat improvement actions, it is more possible to have additional projects, since these organizations lease agricultural or marginal lands in order to plant trees or crops. Even when they plant crops the production is cleaner than the corresponding agricultural one, since hunting organizations usually do not use agrochemicals. However, when they lease agricultural land for avoided crop cutting, this should not be taken into account, as exactly avoided deforestation is not eligible to the Clean Development Mechanism [19].

B. Carbon neutrality

There is now a call in the literature to transform the organizations into carbon neutral entities [20], [21]. According to [21] the United Kingdom Sustainable Development Commission (SDC) defines a carbon neutral organization as follows:

> "one that causes no net accumulation of CO_2 emissions to the atmosphere. Therefore carbon neutrality allows emissions to be netted off in some other location, a process which is called 'offsetting'. However the SDC would caution against a carbon neutrality policy which is focused solely on carbon offsetting. As the aim should be to reduce overall emissions over time, simply offsetting emissions without a carbon management strategy in place is at best misconceived, and at worst counter-productive."

Taking this definition into account, one would have concluded that there is nothing unethical for the forestry sector to use the additional carbons in order to offset the usual carbon emissions from its operation. Indeed there are cases where the organization can be in the long term carbon neutral. For example, Papaspyropoulos [22] measured the carbon emissions and reductions by the operation of the Hunting Federation of Macedonia and Thrace and found that in the long term it can become carbon neutral if it reports also the carbon reductions by its habitat improvement actions.

However, such a policy on carbon reporting in forestry sector would possibly give an excuse to these organizations so as not to undertake proactive actions to prevent their carbon emissions and not just offset them. They cannot have also the excuse, even if the carbon reduction project has a higher cost than a cleaner technology initiative. The carbon reduction project is not a real carbon reduction project but just another input in the production process of the organization.

Therefore, carbon neutrality should be combined with additionality until a specified limit when it comes to carbon reporting. Forestry sector organizations should be allowed to report on the carbon reduction that is created by the positive non product output of their operation when it has the characteristic of additionality and confirm their carbon neutrality through this process. However, they have to prove that this is not their only climate mitigation action (which is not really a climate mitigation action for this sector) and that they take proactive measures for their carbon emissions.

VI. CONCLUSION

The present research attempted for the first time to address an issue concerning carbon reporting in forestry sector organizations. It seems that there is a gap in the carbon reporting literature on how to report emissions reductions that result as an externality of

the operation of such organizations. It is suggested that the key characteristic of additionality and carbon neutrality are taken into account. If the afforestation or reforestation project is additional to a baseline scenario, the emissions reductions can be allowed to offset the carbon emissions from the organizations operation. In such a case, the organization should be allowed to achieve its carbon neutrality, as long as it undertakes also significant proactive actions to reduce the prior carbon emissions from its operation. On the contrary case, it would have been unethical to report these carbon reductions as carbon offsets. With these primary conclusions it is believed that the present research contributes to possible future formation of GRI supplementary guidelines for the forest sector.

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ECONOMIC BENEFIT ASSIGNMENT IN ENVIRONMENTAL COST ALLOCATION: TOWARD A SUGGESTION MODEL

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Abstract: ***This paper aims to suggest a model to reward a 'dirty product' which has the potential to offer sales promotion services to other 'clean products' in a multiple product firm. During a six months market study in five retail cosmetic shops, consumer purchase preference was observed on four products made by WBC Company, it is found that the polluting product of the company – weavon ('dirty product'), attracts consumers to patronize other three products ('clean products') of WBC. It also disclosed that management decision to increase the production of weavon as a booster for the sales of other products increases the direct waste costs of weavon. The paper argues that since the increase in production of weavon and associated increase in direct waste cost is beyond the control of weavon department, equity and objectivity in waste cost assignment should mean that such waste costs, although direct to the 'dirty product' - weavon, be proportionately assigned to the 'clean products' which derive sales promotion benefit from the 'dirty product'. The paper suggests a model – economic benefit assignment (EBA) for apportionment of direct waste costs where a polluting product offers a sales promotion benefit to other 'clean products' of the same company, which proposes that benefiting products should be assigned a proportion of the direct waste cost of the polluting product (as a service charge) based on the proportion of promotion benefit (sales benefit) received from the polluting product. The idea is that, based on transfer pricing theory, such promotion service would be paid for, if offered by an outside agent. Whilst academic debate is expected to ensue from this suggestion model, further case research is imperative to demonstrate industrial applicability.***

Key words: ***environmental cost allocation; waste cost allocation; economic benefit assignment, performance evaluation; activity based costing; transfer pricing.***

I. INTRODUCTION

Contemporary pressure for corporate environmental responsibility has caused reforms in costing systems to properly account for environmental costs. Popular methodology to achieve transformation is rooted on polluter pays principle [1] in which the polluting department is meant to bear its polluting costs by applying the activity based costing (ABC) system [2]. Thus improvement in traditional costing system has contributed to improving divisional performance evaluation and incentive schemes in decentralised organisations such as in multiple product firms [3]. This is a notable contribution as divisional performance and incentive schemes depend on effective cost allocation and transfer pricing [4]. However, although rationally, a polluting product should take responsibility for associated environmental cost; this paper attempts to present a simple case of an intangible valuable service which a polluting product may offer to clean products of the same firm, and which may warrant possible sharing of an established direct waste costs of a 'dirty' product amongst benefiting products.

Consequently the paper is guided by this question: can direct waste costs of a 'dirty' product be possibly shared amongst multiple products which derive sales promotion benefit from a 'dirty' product, and what possible method can be used for such allocation? The objective of this paper is therefore to use a simple case to explain how an acclaimed 'dirty' product may offer sales promotion service to 'clean' products in a multiple product

firm; and to suggest a possible model to allocate the direct waste cost of a 'dirty' product to benefiting products.
The paper is organised as follows: section II presents a brief conceptual background; following this, section III describes the methodology and section IV presents the suggestion model; finally section V concludes the paper.

II. BRIEF CONCEPTUAL BACKGROUND

Revolution in business cost accounting system emerged in the late 1980s when famous American authors – Robin Cooper and Robert S. Kaplan posited that the conventional costing system requires adjustment to cope with contemporary trends in manufacturing technology and market conditions [5]. Corporate environmental stewardship has benefit from such innovation in costing system; it assists in tracing environmental costs to responsible products in a multiple product firm. However, complex interactions amongst multiple products may at times hinder objective performance evaluation in a multiple product firm. Such interactions may occur in firms' market environment. For instance according to Cooper and Kaplan; "many customers value a single source of supply", consequently a company may not simply drop a product line because it is unprofitable [6]; they posit that a product line, even when unprofitable, may boost the performance of other products in a multiple product firm. Hence objective evaluation of a product performance in relation to other products is vital in building incentives to enhance the efficiency of activity centres [7]. However objective performance evaluation may depend on objective cost allocation. Some authors have therefore examined the fairness in internal cost allocation; for instance, Choudhury [8] examine cost allocation "from the perspective of intra-firm distributive justice" and highlights that unfair cost allocation may cause redistribution of profit and rewards between organisational subunits. But if the controllability principle in cost allocation is adhered to, the uncontrollable factors in performance assessment is neutralised and thus instils fairness in performance evaluation, [9] [10].
To avoid possible bias in cost allocation especially as regards environmental costs, a close attention need to be given to the performance of a product that is considered 'dirty' in a multiple product firm. In the simple case presented in subsequent pages, a 'dirty' product appears to be promoting the sales of 'clean' products in a multiple product firm. The paper therefore suggests that objective evaluation of product performance in this company should recognise the obscured sales promotion service offered by the 'dirty' product. Although activity based costing has been effective in environmental cost allocation; it may not be "inherently positive" in all cases, [11]; in relation to this Kallunki and silvola [12] argue that internal and external characteristics of firms may influence the phase of using the ABC system. This implies that ABC may not be suitable in all stages of a product or firm's life cycle and/or specific conditions given the impact of internal and external factors including customer purchase habit and management's marketing priority. This is because in some conditions such as in waste cost allocation problems, whilst ABC allocates direct waste costs to a responsible product, such direct waste cost may be obscurely driven by management decision beyond the control of departmental manager. This is exemplified in this case where the management of WBC Company desires to boost sales of 'clean' products in a multiple product firm by increasing the production of a 'dirty' product in order to stock enough quantity of 'dirty' product in the stores, which the management of WBC believes motives customers to purchase the 'clean' products. This is based on the firm's experience that the 'dirty' product's quality endears it to customers and that such

patronage is transferred to other products of the firm when stocked together in the stores. But the cost allocation implication, notably, direct waste costs seem to be eluding the attention of WBC managers.

This paper proposes that such hidden service by a 'dirty' product deserve recognition, which conventionally should be priced in consonance with the transfer pricing objectives [13] [14] [15] however, given complex marketing interaction existing between the multiple products in this case; further research is imperative to find possible internal transfer scheme for such obscure and valuable service from a polluting product. Whilst awaiting a suitable internal pricing scheme, a cost allocation model may help to share the extra load of direct waste cost triggered by the clean products' reliance on the 'dirty' product's sales promotion service. This paper suggests a model, which imply that management accounting deserve dynamic innovation [16] [17] given growing influence of environmental factors in production planning. The case summary which is a foundation for the suggestion model is briefly presented in the following pages.

III. METHODOLOGY

This suggestion model of environmental cost allocation is based on a six months market study of consumer purchase habit on products manufactured by WBC Company, a multiple product firm in Nigeria. WBC Company (a Pseudo name) in place of the real company name, manufactures four products weavon, soap, cream and perfect finish. Weavon is an artificial ladies hair, acclaimed to be 'dirty' because of much waste involved in the manufacturing process. The company is considered suitable for this study because it is a typical example of a multiple product firm whose products exhibit two characteristics referred to in this paper as 'dirty' and 'clean'. It aroused research interest because the 'dirty' product (weavon), although operating at a loss is still retained by the firm. According to the marketing manager:

> We keep weavon in operation because it helps to retain our market share in the other three products – soap, cream and perfect finish, and occasionally we increase production volume of weavon to maintain stock in the stores to boost the sales of other products.

With the support of WBC Company, a simple market observation in five different retail shops was carried out from January to June 2010 to confirm the marketing manager's claim, and to suggest possible cost implications. Weavon – the 'dirty' product was placed in the stores for three months and was also removed from the stores for three months in an alternating fashion. But the clean products – soap, cream and perfect finish were kept in the stores throughout the six months observation. The aim is to ascertain whether the presence of the dirty product in the stores actually promotes the sales of the clean products and whether the sales volume of clean products may decrease if the dirty product is out of stock. Furthermore, direct waste cost implication on weavon due to increase in volume of production is obtained from the cost accounting department of the WBC Company, and a methodology for allocation to benefiting products is suggested. The focus is on direct waste cost since according the production manager

> Heavy cleaning and washing of raw cotton and wool during the production of weavon enhances its admirable quality which we believe endears weavon to the patronage of our consumers

Tables 1 to Table 6 shows the sales performance of 'clean' products of the WBC Company when the 'dirty' product was placed and removed in stores with the 'clean' products in alternating fashion between January to June 2010.

TABLE 1: JANUARY, 'CLEAN' AND 'DIRTY' PRODUCTS ARE PLACED TOGETHER, SALES VOLUME OF CLEAN PRODUCTS IS OBSERVED AND RECORDED

	Shop 1	Shop 2	Shop 3	Shop 4	Shop 5	Total
Soap	400	300	200	350	220	1470
cream	500	400	300	420	350	1970
Perfect finsih	450	420	350	400	300	1920

TABLE 2: FEBRUARY 'CLEAN' PRODUCTS ARE PLACED TOGETHER EXCLUDING THE DIRTY PRODUCT, VOLUME OF SALES FOR THE 'CLEAN' PRODUCTS ARE OBSERVED AND RECORDED

	Shop 1	Shop 2	Shop 3	Shop 4	Shop 5	Total
Soap	200	120	100	150	120	690
cream	250	180	140	200	150	920
Perfect finsih	220	200	120	180	140	860

TABLE 3: MARCH, 'CLEAN' AND 'DIRTY' PRODUCTS ARE PLACED TOGETHER, SALES VOLUME OF CLEAN PRODUCTS IS OBSERVED AND RECORDED

	Shop 1	Shop 2	Shop 3	Shop 4	Shop 5	Total
Soap	410	280	210	340	200	1440
cream	520	410	305	400	360	1995
Perfect finsih	460	440	370	410	320	2000

TABLE 4: APRIL, PRODUCTS ARE PLACED TOGETHER EXCLUDING THE DIRTY PRODUCT, VOLUME OF SALES FOR THE 'CLEAN' PRODUCTS ARE OBSERVED AND RECORDED

	Shop 1	Shop 2	Shop 3	Shop 4	Shop 5	Total
Soap	180	130	105	140	115	670
cream	260	200	150	205	170	985
Perfect finsih	230	210	130	185	150	905

TABLE 5: MAY, 'CLEAN' AND 'DIRTY' PRODUCTS ARE PLACED TOGETHER, SALES VOLUME OF CLEAN PRODUCTS IS OBSERVED AND RECORDED

	Shop 1	Shop 2	Shop 3	Shop 4	Shop 5	Total
Soap	420	300	230	360	240	1550
cream	510	405	315	420	380	2030
Perfect finsih	440	450	360	400	340	1990

TABLE 6: JUNE, PRODUCTS ARE PLACED TOGETHER EXCLUDING THE DIRTY PRODUCT, VOLUME OF SALES FOR THE 'CLEAN' PRODUCTS ARE OBSERVED AND RECORDED

	Shop 1	Shop 2	Shop 3	Shop 4	Shop 5	Total
Soap	190	150	110	130	125	705
cream	280	220	170	215	190	1075
Perfect finish	210	205	125	180	160	880

Tables 1 to Table 6 above presents the result of a six month market study which reveals that 'clean' products experience increase in sales volume if stocked together with the 'dirty' product, and that clean products experience decreased sales volume when the 'dirty' product is out of stock.

Information from the production department shows an increase in the production of weavon; which according to the marketing manager is meant to keep enough quantity of weavon in the stores to promote the sales of other products. The crux of this paper is that this increase propels an increase in the direct waste cost of weavon which could not have arisen if normal production quantity of weavon was maintained. Hence this paper argues that since this increase in production of weavon and associated increase in direct waste cost is driven by the management's desire to promote the sales of other products; therefore weavon should not be held responsible for the increase in the direct waste costs since it is beyond the control of weavon department. Consequently it may be objective to assign the increase in direct waste cost of weavon to the benefiting products according to the ratio of benefit derived (i.e. increase in the sales volume of 'clean' products) which results from stocking the 'dirty' product in stores. The increase in volume of weavon produced due to management decision and associated direct waste cost is presented in Table 7.

TABLE 7: TOTAL VOLUME OF WEAVON PRODUCED FROM JANUARY TO JUNE 2010 WITH ASSOCIATED INCREASE IN DIRECT WASTE COSTS

	January	February	March	April	May	June
Volume produced	5000	5100	5200	5250	5300	5400
Direct waste cost (000)	N100	N110	N130	N150	N155	N162

IV. SUGGESTION MODEL OF ALLOCATION OF INCREASE IN DIRECT WASTE COST

TABLE 8: CALCULATION OF INCREASE IN SALES VOLUME OF CLEAN PRODUCTS RESULTING FROM KEEPING THE 'DIRTY' PRODUCT IN STORES*

Soap		Total increase in sales volume
Sales volume for soap whilst weavon is in stock = 4460		
Less		
Sales volume for soap excluding weavon in stock = 2065	=	2395
Cream		
Sales volume for cream whilst weavon is in stock = 5995		
Less		
Sales volume for cream excluding weavon in stock = 2980	=	3015
Perfect finish		
Sales volume for soap whilst perfect finish is in stock = 5910		
Less		
Sales volume for soap excluding perfect finish in stock = 2645	=	3265
		8675

* Volume of sales with the presence of dirty product less volume of sales without the presence of dirty product

Using the month of January as the base year, the increase in direct waste cost associated with increase in the volume of weavon is:
N10 000 + N20 000 + N20 000 + N5 000 + N7 000 = N62 000

Suggestion Model of Allocation: Economic Benefit Assignment (EBA)

This is based on the ratio of promotion benefit derived in relation to other clean products

EBA = $\frac{\text{increase in the sales volume of a clean product}}{\text{Total increase in sales volume of the three clean products (soap, cream, perfect finish)}}$ x increase in direct waste costs of weavon

Soap = $\frac{2395}{8675}$ x N62 000 = N17 117

Cream = $\frac{3015}{8675}$ x N62 000 = N21 548

Perfect finish = $\frac{3265}{8675}$ x N62 000 = N23 335

From the market study above, the 'dirty' product (weavon) is found to boost the sales of the other 'clean' products in the market, thereby offering an obscured sales promotion service to the 'clean' products, but this relationship appears to be neglected by management. This unrecognised service offered by the 'dirty' product gives rise to two conditions: the sales promotion service (though hidden) is unrewarded, and the 'dirty' product continues to shoulder the burden of increasing direct waste costs associated with increased production volume of 'dirty' product which is strategically increased by management to sustain the sales of the clean products. since the increase in production volume of weavon and increase in direct waste cost is beyond the control of weavon department, the above model apportions the amount of increase in direct waste costs (N62 000) to the clean products according to the ratio of sales volume increase in relation to other benefiting products. Hence weavon is freed from the burden additional direct waste cost which it is not actually responsible to.

V. SUMMARY AND CONCLUSION

This paper has attempted to suggest a model to reward a 'dirty product' which has the potential to offer sales promotion services to other 'clean products' in a multiple product firm. It is based on a simple case of a six months market study in five retail cosmetic shops. Consumer purchase preference was observed on 'clean' products made by WBC Company as the 'dirty' product was made to be on and out of stock in the stores in an alternating fashion. It is found that the polluting product of the company – weavon ('dirty product'), attracts consumers to patronize other three products ('clean products') of WBC amidst other substitute brands by other companies in the same shops. It is also found that the quality of weavon – the 'dirty product' of WBC Company endears it to consumers and that this patronage is transferred to other products of WBC such that if weavon is out of stock in the shops, the 'clean products' experience low sales volume in contrast to when the 'dirty product' is in stock. This paper argues that since the cost of cleaning and washing of weavon enhances the 'dirty' product's admirable quality which in turn favours

other ‘clean products’ of the WBC Company, equity and objectivity in waste cost allocation should mean that the increase in direct waste costs, although direct to the ‘dirty product’, be proportionately assigned to the ‘clean products’ which derive sales promotion benefit from the ‘dirty product’ according to the ratio of promotion benefit derived. It is argued that this is imperative given that the desire by the WBC management to place weavon in the stores as a booster for other products increases the production of weavon which also increases the direct waste costs of weavon, which is beyond the direct control of weavon department. Hence this paper suggests a model – Economic Benefit Assignment (EBA) for apportionment of direct waste costs where a polluting product offers a sales promotion benefit to other ‘clean products’ of the same company, which proposes that benefiting products should be assigned a proportion of the direct waste cost of the polluting product (as a service charge) based on the proportion of promotion benefit (sales benefit) received from the polluting product. The idea is that, based on transfer pricing theory, such promotion service would be paid for, if offered by an outside agent. Further research is recommended to design suitable transfer pricing scheme for such hidden sales promotion service by a ‘dirty’ product, this is important for objective performance evaluation especially in contemporary period where proper environmental cost allocation has become relevant in divisional performance evaluation and toward incentivising managers innovative practices in cleaner production.

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EVALUATING INTELLECTUAL AND ENVIRONMENTAL CAPITAL – THE WHATS AND HOWS – PERFORMANCE EVALUATION AND ENVIRONMENTAL MANAGEMENT ACCOUNTING

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Abstract: ***As the intellectual capital became the most important recourse of the information era, and management relies on information and innovative intelligence, organisations should change the system of evaluation and find new, up-to-date methods. The traditional (especially financial) performance evaluating methods (general accounting methods) are not able to visualize the value of the knowledge, information, or immaterial stocks, in spite of these are the critical, key factors of today's and tomorrow's organization. In addition the environment should not be forgotten in the rank of the critical recourses of a company's success factor, especially that the improvement of the organisation's environmental performance increases the benefits. The lack of effectiveness of traditional performance evaluating methods and environmental management accounting in case of evaluation of environmental performance is a consequence.***

Have the organizations realized their intellectual capital and the benefits of the environmental performance's improvement – maybe in connection with climate change mitigation? Have they evaluated it? How does an organization know the usability of the new, modern evaluating methods in case of intellectual capital or in case of environmental performance or in case of environmental management accounting? Or maybe do they need incentives for evaluation?

The paper is the summary of different secondary and primary researches, which tries to answer these, before mentioned questions and the key issues of the intellectual capital and the environmental performance (evaluation) and also of the usability of the new, up-to-date methods in case of environmental management accounting. Therefore the paper – the answer – is the consequence of theoretical research and the practice also will be appear in the paper, because the common solution – in connection with up-to-date methods, environmental performance (mitigation) and environmental management – will be presented by the method of Sustainability Balanced Scorecard (SBSC).

I. INTRODUCTION

As the intellectual capital became the most important recourse of the information era, and management relies on information and innovative intelligence, organisations should change the system of evaluation and find new, up-to-date methods. The traditional (especially financial) performance evaluating methods (general accounting methods) are not able to visualize the value of the knowledge, information, or immaterial stocks, in spite of these are the critical, key factors of today's and tomorrow's organization. In addition the environment should not be forgotten in the rank of the critical recourses of a company's success factor, especially that the improvement of the organisation's environmental performance increases the benefits. The lack of effectiveness of traditional performance evaluating methods and environmental management accounting in case of evaluation of environmental performance is a consequence.

The paper is the summary of different secondary and primary researches, which tries to answer the main questions and the key issues of the intellectual capital and the environmental performance (evaluation) and also of the usability of the new, up-to-date methods in case of environmental management accounting.

To resolve the background of this paper there will be a summary about the characteristics of information era and the key, success, critical factors, resources of the

organizations. Also will be presented, why the authors claim, that the intellectual and environmental capitals are the critical, success factors, resources. After the introduction of the background, the problems of evaluation of these resources will be presented, but solutions for the problem also will be summarized, accordingly will be examined the performance evaluation of intellectual capital, the new, up-to-date methods, the environmental performance evaluation and environmental management accounting. After these examinations will be a conclusion which also claimed by authors, namely that the up-to-date methods, used in case of intellectual capital, can be able to evaluate the environmental capital too. To confirm this claim/hypothesis authors will collect arguments and show an example for the integrated evaluation, which is the improved version of Balanced Scorecard, called Sustainability Balanced Scorecard. At final there will be summarized the relationship between new, up-to-date methods and environmental management accounting.

II. RESOURCES OF COMPETIVENESS

At the beginning it is important to get to know the base, background of the paper. Firstly it is important to mention the characteristics of information era. In the age of industry the technology and the mass production were important in the market's competition. But form the second part of the 20th century, there is a new competition where organizations can't create value only from for example the technology change. The new age, the information era, means the management of the intellectual capital (IC), because these are the main resources of the age. [1] Intellectual capital is a hard and difficult expression, concept and there are different definitions for it. This makes the capital difficult and handful – especially in case of evaluation – for corporations. The most suit definition for the authors comes from Tóth, who writes that the immaterial capital is an asset, which is not-subjected. One part of this capital can be visual in the balance sheet, between the intangible stocks, but the other part completes these intangible assets. This part cannot be visual in the balance sheet, thanks for the special, different property. [2]

Secondly it is necessary to mention the second base, background of this paper. According to Kapusy [3], the organisation, the company is able to work on long run with success if ambient society and environment (like resources) also be on long run, so it means that the resources and the market (consumers) also have to be viable. Therefore the responsibility for the future generations is a part of the responsibility of owners. Concept of sustainable development –which meets the needs of the present without compromising the ability of future generations to meet their own needs – and the pillars – environmental, social and economic –confirm the importance of the environmental and social points in the competitiveness. Confirmation of this background it is not aim in this paper, but the conclusion is that the environment and the society are also the main resources of the age.

After the short introduction of the background the authors create a hypothesis and like a summary tries to confirm it. The hypothesis is that as the intellectual capital is an important, critical factor of the competiveness in the information era, so the environmental and social responsibility are also critical factors of the success, therefore the management of the environmental and social capital can be parallel with the management of the intellectual capital. (In the paper only the environmental capital will be examined, because of the limit of compass.) To confirm the importance of the before mentioned critical

capitals, it is necessary to examine that how the characteristics of success factors (resources) appear in connection with the examined capitals, like factors. According to Gyökér [4] resources make competiveness for corporations which are valuable, rare, can't be copied and can't be replaced. Results of this examination can be found in table 1. According to the authors both of these capitals reach the characteristics, so the hypothesis is confirmed, the intellectual, and environmental capitals can be the critical, success factors of the organisations in the information era.

TABLE1: EXAMINATION OF INTELLECTUAL AND ENVIRONMENTAL CAPITAL
SOURCE: OWN ANALYSIS AND COMBINATION

	Intellectual Capital	*Environmental Capital*
Valuable (able to achieve the opportunities)	*The knowledge, the relationship, the organizational culture and structure ensure the utilization of opportunities*	*There are many advantages for organization which are come from the protection of the capital. So the liveable environment is valuable.*
Rare (it is really slim or competitor doesn't occupy it)	*The human knowledge, relationships are properties of person.*	*This capital is limited (finite). There are no limitless natural resources and there is no limitless receiver, occlusive capacities.*
Can't be copied (the competitor cannot copy it correctly)	*It is copiable with learning, improvement, but it never will be the same.*	*The environmental behaviour, actions (e.g.: use of standards) are organization-specific.*
Can't be replaced (without these cannot be work)	*The knowledge, the relationship, the information can't be fungible with physical or monetary resources.*	*It is an interesting question, because the mainstream is the replacement with alternative resources.*

III. EVALUATION OF THE CRITICAL, SUCCESS FACTORS

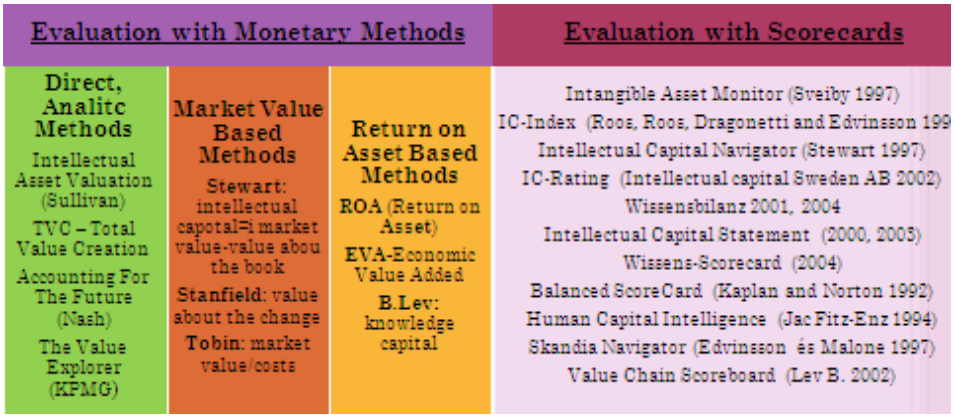
A. Evaluation of Intellectual Capital

The new age means the management of the IC, because it is the main resource of the age. As the main resource changed, the evaluation also should be changed, because these new values can't be measurable by the traditional financial methods. The financial models measure the past events, and don't measure the ability of the investment to future value-maker resources. [1] According to professors of Cranfield School of Management, the IC is the topmost recourse, which is the leader aspect of the organizational value system. But the traditional financial system cannot show to the managers and investors that how the capital can produce value in the future. So, this is why should be special interest of intellectual capitals' evaluation. [5]

Sveibys' work also confirms the failure of traditional financial accounting in case of intellectual capital, because it completes the balance sheet with different elements, which can show the value of the IC. This completed balance sheet is called invisible balance sheet, because it shows the value under the surface, under the visible part of value. The invisible intangible assets part of the balance sheet can be classified as three families:

Internal structure, External structure and Individual competence. In the liabilities side there are two classes, the Invisible Equity and the Market Value. [6]

FIGURE 1: NEW, UP-TO-DATE METHODS OF EVALUATION OF INTELLECTUAL CAPITAL
SOURCE: OWN COMBINATION ACCORDING TO [7], [8], [9]



There is a need to change the performance evaluation, need to arrive in the period of performance evaluation system, because of the changes in the economy. To achieve it, there are more methods, which can help, and promote that the organization can evaluate from different aspects and not only from the financial aspect. The base of these methods is a Performance Prism, which was developed by the workers of Canfield School of Management and Andersen Consulting. [9]

The Prism is a performance management model, which build upon the existing methods, models, but also improve them. Shaping the model the most important factor was to take into account the flexibility, so the method could be able give closer and wider spectrums too, according to the claims of user. The model is able to fasten on whatever business activity and process, because it is able to evaluate from different aspects, be extensive and integrated to achieve the common thinking in organizational performance. [10]

The Performance Prism was the mother of the most of performance evaluating methods. These are different methods, but the base philosophy is common. According to Gyökér and Finna there are two ways of these new, up-to-date methods: the first one is the improvement of the traditional bookkeeping and financial system, and the second one tries to find this invisible value by examining the quality factors of it. [9] Sveiby prepares four categories of the methods: direct methods, methods based on market value, methods of return on assets and the scorecards. [7] The figure 1 summarizes some methods in two groups. In the first one there are methods of the evaluation where the capital is expressed monetary. The second one is the group of scorecard methods, which measures the performance from different aspect. Indicators are defined in scorecards, but it is hard to find the best indicators, because these should be measureable, enough, easy to define, cost-effective and be able to measure the performance time to time. All of these methods can help to eliminate the failures and faults of the traditional methods, and the evaluation can be concentrated into the intellectual capital.

Like a primer research the authors made a short comparison between the methods and the Performance Prism to show the usability of these methods. As it was mentioned before

the Prism is the base, mother of these methods, so it can be the base of the comparison. The Prism is an extensive, multi-faceted performance management system, which can give balanced picture about the performance of the organization. It is usable in the different levels of the organization, measures and evaluates the performance in all of the levels, which is important for the success of the organization. [11]

The model has three dimensions: the base is the Stakeholder Contribution, the top is the Stakeholder Satisfaction, and the sides: Strategies, Processes and Capabilities. The concept of the prism is to evaluate the performance by different point of views, which are the dimensions of the Prism. (In contrast with the 'just financial point of view' methods.) [9]

The aim is to make a comparison between some of the mentioned methods for evaluation and the Performance Prism. The first chosen method was the EVA, which is the indicator of the financial performance, measures the real business profit of the organization. It is also a good method to set aims, define premiums, forecast (judge) value and communicate with investors. [12] After the comparison with the performance Prism, the result shows that the aspects of the Prism are in the EVA, but it is incomplete. Especially it is incomplete in the stakeholder contribution and strategy definition.

The Skandia Navigator is one of the main scorecard methods, which treats and measures, integrated and dynamic, the elements of intellectual capital. There are five dimensions (elements): financial focus, costumer focus, process focus, renewability and development focus, and human resources focus. [8] This method has more connection to the Prism than the EVA, but it is also not complete. The main connecting-point is the precedence of stakeholder claims (Stakeholder Satisfaction from the Prism), because the human resource is in the centre in the Skandia Navigator. In the method there is no definition for the strategies, which can help to achieve the stakeholder claims. There is also not information in the method about the capabilities.

The Intangible Assets Monitor (IAM) defines the market value of the organization like the summary of the subjected assets and the intangible assets. This method helps to evaluate by indicators in different points of view: grow, innovation, effectiveness and stability. [13]

The IC Index is a model, which tries to collect the different indicators and prepare a common indicator for the evaluation and tries to make a connection between the changes of intellectual capital and changes of the market.

Analyzing together the IC index and IAM with the Prism, the results show that the indicators in different points of view are not too emphatic as the Prism expected it.

The most popular method of the performance evaluation is the method of the Balanced Scorecard, which measures the performance from different points of view: financial, consumer, processes and learning and growth. This method uses indicators, which measure the performance and the strategy. This method is really compatible method with the aspects of the Prism.

To answer one of the main goals of this paper the results of the analysis show that there are relevant methods for evaluation, but there are methods which are not really relevant, because of the missing, weak points. All of the mentioned methods can prove the claims, aspects of the Prism, but some of these need to concentrate more for strategy, capabilities and processes (of course the claims of stakeholders should be the most important aspect according to the Prism), so these methods could be up-to-date, relevant methods to evaluate the intellectual capital at the age of information.

It is not enough to find in theory the usability of these tools, it is necessary to use in practice too. According to other previous, special researches the attitude of organizations in connection with intellectual capital and evaluation can be summarized. These researches can show that most of the corporations have realized and know the importance and value of the intellectual capital, but there is less attention of the evaluation. According to the authors this situation is reversible, and the organizations are impulsive for the usage of evaluation. To impulse the organizations there are two ways according to the authors (created by authors). One way is a way of 'list of incentive evidences' of the incentives, which is a method where advantages of intellectual capital and evaluation are showed for managers, top-managers. They can be proved about the importance and advantages by the evidences, and maybe can impulse them for the evaluation. The other way is a 'quick guide about organizational intellectual capital' which contains four questions for managers. These questions should not be answerable, because the aim is to start thinking about the questions and the answers. These questions are also in connection with different quotes of experts (and it also promote the 'list of incentive evidences'), and they are guides to measure how the organization relates to the intellectual capital and evaluation. These questions and also the potential answers can be thought-provoking for managers, organizations, which is the aim, goal of the quick-list. [14]

B. Environmental Performance Evaluation

The environmental performance evaluation (EPE) is an essential tool for decision makers to support the decisions in issue of environment. It is necessary to use the EPE, because as was it mentioned and confirmed the environment is a critical, success factor for organizations. The EPE is the measurable result of the management in point of environmental aspects. It is an internal, continuous management process and tool, which uses environmental indicators to make a comparison between the present and past environmental performance (EP) and the criterions of the environmental performance. [15]

There are many tools and methods for EPE, but the main point is the use of indicators. These are the first, real methods of the evaluation. Organizations have to define enough and measurable indicators, which should reflect the operation and the volume of the corporation, and complexion and intensity of the possible environmental impacts. [15] The EPE also helps the recognition, implementation and check of the opportunities which have strategic importance.

Here, like in case of evaluation of IC, are also has some problem. According to Kulcsár there are two basic characteristics of the goods. One is the financial value, price of the goods, another is the functional value. However the goods from nature, environment only has functional value, and has not got financial value. While the financial value is the dominant in the market, the natural, environmental goods with functional value are outside of the basic economic values. So tools only used in the market made the secondary management of the natural, environmental values, goods. [16] The traditional management accounting systems inform about the general cost, but mostly these not inform about the environmental costs and benefits. It causes the deprecation of environmental costs, which generates more problems. It is impossible to find the cost of environmental performances' activities and the benefits of these activities in financial, traditional accounting systems. Environmental management accounting can be a solution for this problem, because it can help in correct separation of environmental costs and also helps to measure the benefits to. So it helps in the evaluation of environmental performance evaluation in the better way,

than traditional, financial methods. EMA also helps to make better the results of traditional EPE methods too. It can be offered to use the EMA parallel with EPE.

C. Common Problems with Evaluation

One of the aims of this paper is to find a relation between the performance evaluation and (environmental) accounting. So it is necessary to emphasise the role of accounting in information era. It was mentioned that the traditional financial system is not able to visualise the value of the intellectual and environmental capital (Sveibys' balance sheet and problem with environment costs). One of the course books of general accounting shows that the method of general accounting is really creditable, because it is based on double-entry bookkeeping, which is yet more than 500 years old, and it is a closed system with self-checking mechanism. According to Laáb there is some new claim – in connection with evaluation – of challenges of information-society, which cannot be answered with the help of traditional financial and accounting tools. [17] This opinion also emphasizes the necessity of new tools of evaluation. It is true in connection with intellectual and environmental capital too.

As was it mentioned there is problem with the traditional, financial evaluation of intellectual and environmental capital tool. This problem is the same, because it is difficult or impossible to give financial value for the knowledge, relationships, for immaterial elements and for environment too. Even this problem caused the necessity of up-to-date methods of performance evaluation in case of intellectual capital. Like a conclusion the authors' opinion is that if new, up-to-date methods born for the evaluation of the intellectual capital because of the same cause which is the problem of the evaluation of natural, environmental capital, then these new, up-to-date methods should be able to evaluate the environmental capital too.

IV. SOLUTION – INTEGRATED EVALUATION

The before mentioned relationship can be the second hypothesis of the authors – the up-to-date methods of the IC can be able to evaluate the environmental capital too – which will be confirmed by the next arguments.

The first argument has been already mentioned, that there is some problem in connection with the effectiveness and compliance with financial, traditional methods, tools in case of intellectual and environmental capital too. Just like an example, the traditional accounting is able to inform about the costs, profits, but these do not contain information about the environmental or intellectual costs and profits. In general the environmental costs are hidden in the category of general costs, and this can cause faults in decision making.

The next argument is the use of indicators. Method of indicators is the real method of EPE and in figure 1. many of tools were also mentioned which are based on indicators. Indicators have a really important role in the evaluation of both capitals, because with these the main aim is the continuous check of performance.

The need for determinable (quantifiable) value in case of intellectual capital and environment is also can be an important argument. If there is no financial value, it causes disadvantages in the market, than there will be a need for better evaluation, to define value for these capitals. The new, up-to-date tools help for managers evaluating the capitals from different aspects. The already existing tools of EPE are evidences for it, because for example the ISO 14031 standard (which is the most known method for EP indicators)

contains operating-, and management (also financial) performance and environmental condition indicators too.

It is not enough to collect the main arguments. There is one up-to-date method which already an existing evaluating method in case of intellectual capital and sustainability (environment) too. This is the most known method from figure 1, the improved version of Balanced Scorecard, the Sustainability Balanced Scorecard. This method can be an evidence to confirm the hypothesis of the authors, still there is a novelty in the hypothesis: the environment can be managed in the same way like the intellectual capital, maybe with all of the mentioned tools, methods.

V. THE SUSTAINABILITY BALANCED SCORECARD

The Balanced Scorecard (BSC) breaks down the strategy into exact objectives and indicators, and manages them, evaluating the performance according to four different perspectives: traditional financial perspective, perspectives of customers, internal business processes, learning and growth. The four perspectives represent that it is necessary to complete the financial evaluation, so organizations can check the financial results, performance (for example the profit and loss) and they can measure how they exploit the capabilities and reach the intellectual goods which are necessary for future improvement. [1] BSC is a complex performance evaluating system, so it is able to join the different fields of corporate performance, in this way the BSC is good to measure the environmental activities too. Harangozó suggests the implementation of environmental, social aspect to the scorecard system, and call it Sustainability Balanced Scorecard (SBSC). [18] According to secondary researches ([19], [20]) the authors creates a model for implementing SBSC. Because of the limit of compass the aim is just summarizing the operation of SBSC.

Defining the good BSC it is necessary to get to know the processes, the organization well. Different management models (SWOT analysis, BCG matrix, EFQM, value chains, activity analysis) help in case of BSC, but in case of SBSC it is necessary to complete this work with the help of tools of EPE (eco-mapping, input-output analysis, indicators of ISO 14031), which can make a better picture about the EP. After this step corporations need to define the vision, the strategy. In SBSC it is in connection with environmental strategy, which is a general idea in point of environmental aspects and impacts. In the next step the strategy has to be broken down into objectives and aims, the critical factors have to be found (6-8 gross is sufficiency). With these objectives strategy map (which is a system of broken down strategies) should be prepared, which shows the relations between the objectives, which together reach the strategy, vision. The possibility must remain to group the objectives according to the four perspectives of BSC and then indicators have to be defined near every objective (25-30 gross is sufficiency). It is not enough defining the indicators, also targets, and initiatives should be defined. The operation of the SBSC is making a comparison between the measured value of the indicator and the expected value, which is a target. The analysis of the comparison shows the performance and the necessary steps, activities, initiatives, because the aim is reaching the expected value of indicators. If it is realized it means that the corporation achieved the objective, which is a step to the strategy to the vision.

So with the steps, SBSC can break down the strategy and can measure it with indicators, so the organization can evaluate the performance in point of environmental aspects and impacts, so can evaluate the environmental performance. The existence of BSC and SBSC

can confirm the hypothesis and inspire the authors to find new, up-to-date methods for evaluating environmental and intellectual capital together.

Method of BSC is also mentioned by accountant, and books of accounting. This method can use the indicators of traditional financial and accounting systems, but it also completes these with other, new perspectives and indicators. As it is true in case of "general" BSC, it can be true in case of SBSC too. So, the indicators of SBSC can complete the system of environmental management accounting. With the help of SBSC corporations can break down the activities of environmental performance, can measure and evaluate it, and can visualise the environmental costs and benefits too. Not only the traditional financial perspective helps, than in the other perspectives can be defined indicators in monetary. It can be summarized shortly that SBSC and EMA should be used parallel, because can give useful indicator: environmental costs and benefits can be indicators in SBSC or the broken strategy helps to define and specify the environmental costs and benefits. Maybe this relationship can be viable in case of other new, up-to-date methods (from figure 1) too.

VI. SUMMARY

The paper is the summary of different secondary and primary researches, which tries to answer the main questions and the key issues of the intellectual capital and the environmental performance (evaluation) and also of the usability of the new, up-to-date methods in case of environmental management accounting.

The main conclusion of the paper is that intellectual and environmental capital are the critical success factors, resources of organizations in the information era because these are valuable, rare, can't be copied and can't be replaced, and the new, up-to-date methods of evaluation of performance can be usable in case of intellectual and environmental capital and performance evaluation too. As the new, up-to-date tools complete the traditional evaluating systems, especially financial and accounting systems, these methods can complete and make better the system of environmental management accounting too. So, the final conclusion is that new, up-to-date tools of performance evaluation are really useful tools in information era for corporations which ones would like to be responsible (manage in reliable way) for environmental and intellectual capital and would like to complete or change the traditional or environmental (management) accounting system.

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THE EFFECT OF EMISSION RIGHTS ON PROPERTY STATUSES, INCOME CONDITIONS OF OPERATING COMPANIES

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Abstract: ***The current accounting standards do not treat the emission reduction ways and means uniformly and on the basis of their real contents. In this article I present that the items of the current standards are accountable, and the production factor derived from them, that is emission rights, is a new income item in companies' financial records. I expound current potentials of the emission trading accounting transformation and indicate their shortcomings. From the current standards of the International Financial Reporting Standards I deduce the best solution, and then I think it over in order that it would meet the demands of operating companies and investors.***

Keywords: emission units, IFRS, US GAAP

I. HOW ACCOUNTABLE AND INFORMATIONAL EMISSION UNITS ARE

Emission units are binding rights, have an independent market and need for doing business related to emissions, because when economic entities cannot account for their emission units, they have to pay penalties and they will have to meet the unrealized liabilities in the next accounting period. Company properties contain phenomena which could be gripped and evaluated on the bases of their characteristics, so they own economic contents from the points of view of those given to companies [1] emission units are portions of company properties.

How accountable and informational income items are depend on the characteristics of income items. The phenomena are called accountable when they can be recorded financially. The items which do not meet the accountability criteria but can be shown in a report are informational [10]. If we examine the current accounting standards we find that emission rights allocated free of charge have differing accountable and informative treatment. The main reason for that difference is the problem of the reliable measurement related to units and value assignment. According to the International Financial Reporting Standards, (IFRS) income items allocated free of charge have to be recorded in the balance sheet at fair value, while under the United States Generally Accepted Accounting Principles (US GAAP) they are not accountable and they could only be recognised as additional remarks.

II. INTERNATIONAL ACCOUNTING STANDARDS

It was first in 2002 when the International Accounting Standards Board (IASB) dealt with emission right trading system which belonged in the so called cap and trade model. In 2003 the International Financial Reporting Interpretations Committee (IFRIC) published its draft interpretation on emission rights, *Draft Interpretation DI, Emission Right*[5]. According to that interpretation, emission rights can be regarded as intangible assets no matter how they became the property of their operating companies either as government

[5] IAS Plus 2006. *IAS Plus* [2006]: http://www.iasplus.com/ifric/emission.htm

allowances or by trading. Therefore, the International Accounting Standard, *IAS 38 Intangible assets*, relates to it.
The IFRIC 3[6] declared emission units to be intangible assets, and their fair values have to be measured in case they were allocated free of charge by the government. The allowances have to be recorded as revenue in compliance with the *IAS 20 Accounting for Government Grants and Disclosure of Government Assistance*.
Under the IAS 38 both the Acquisition Valuation Model and Revaluation Model can be used for evaluating rights acquired or purchased in other ways.
Company emissions which are either covered or not by emission rights have to be made provisions for, and then those provisions have to be measured at their market value in conformity with the *IAS 37 Provisions, Contingent Liabilities and Contingent Assets.*
As both book accounting and fair value accounting were allowed to be used, there appeared to be significant differences in company results [3].
Emission units in fair value accounting affect own capital through reserves. Meanwhile, if there are significant differences between the fair market value and book value, emission units make either a profit or a loss of liabilities on the bases of the market value relation, i.e. affecting results.
Faults of the interpretation withdrawn in June 2005 can be found not only in its measurement but also in its rating as it was analysed later in some studies [8], [10]. In consequence of the IFRIC 3 withdrawal and while the emission market is developing, no guidelines to help are set for operating companies, investors are also forgotten by every one, and national accounting standards came into force independently and in contradiction to themselves.
During the accounting transformation of emission trading, complex problems need to be solved [6]. In November 2003 the arbitration committee participating in the US standard forming process, the Emerging Issues Task Force (EITF) dealt with the financial accounting of emission trading participants. The Federal Energy Regulatory Commission (FERC) regulations accepted in 1993 were applied to the base of its accounting. Here they regulated the financial standards of public utilities and energy providers' emission plans, which were connected with the Clean Air Act Amendments (CAAA) passed in 1990.
According to it, on occasions of making financial reports [7] units have to be measured at their historic cost as financial assets or intangible assets. In accordance with the actual emissions, the amounts of the available units have to be examined, and weighted average market value has to be assigned to those of them which need to be recorded..
Item-based and value-based balance sheet criteria fundamentally have to be agreed on, but unfortunately that system could not cope with the task to ensure that units allocated free of charge and rights purchased on the market could not be mixed, and by doing so, they could not distort assets, liabilities and operating revenues.
The fault in the system was pointed out by a statement of the Financial Accounting Standards Board (FASB) in February 2007 which suggested that an overall project should be launched in order to promote participants of emission trading to transform accounting, and then in 2008 by a FASB agreement with the IASB leaders to cooperate in devising proposals relating to emission trading systems. However, the solution is still keeping us waiting.
After the IFRIC 3 withdrawal, participants of the growing EU emission market missed the authentic accounting guidance. Consequently it does not astonish us that multicoloured

[6] *IFRIC 3* [2004]: http://www.iasplus.com/interps/ifric003.htm
[7] Issue no. 03-14. Participants' Accounting for Emissions Allowances under a "Cap and Trade" Program

accounting practices were formed. Fornaro (in Fornaro, Winkelman and Glodstein, 2009) refers to a 2007 survey in which the International Emissions Trading Association (IETA) examined authentic accounting practises of 26 large enterprises in the European Union. The study reveals that those companies follow wholly differing practises in areas of great importance. 76% of companies keep zero value to emission quotas, because they do not admit that they should account for related incomes on the basis of IAS 20. On the day they receive the quotas, 24% of the examined companies record them at fair value in their books, and they account for revenue in the given period. 58% classified units as intangible assets, 22% as investment and 20% as some kind of current assets (inventory, liability, securities). Amortization was applied for half of the units which were classified as intangible assets.

There were significant differences in utilizing quotas. According to the study, 79% of companies measure units at their historic cost, 47% calculate them under FIFO and about the same percentage of companies on weighted average market value. However, there happened to be one which revaluated units kept for covering emission liabilities at fair value.

On the basis of the study, the IETA analysis emphasized that the comparability of reports could not be ensured, therefore it should be questionable whether financial information was relevant to users.

III. DIFFERING EFFECTS OF SOLUTIONS FOR ACCOUNTING

From now on I show the current item-based and value-based accounting transformation on the bases of the US GAAP, the IFRIC 3, the common practice in the European Union and the Hungarian Accounting Act.

Emisszió Zrt. participates in the European Union emission trading project and aims to hold its CO_2 emissions under the previous year's level. On 3 January 2009, the year under review, it was allocated 24,000 emission units free of charge by the state. According to the forecasts the company expected emission level will rise above those amounts. Preparing to supply units missing, Emisszió Zrt. purchased further 1,000 emission units on 31 March, and 1,000 on 30 June. At the end of the year its actual emission value reached 28,000 tonnes, so the company acquired further 2,000 units on 31 December. In the beginning of the next year with those units Emisszió Zrt. could liquidate its existing liabilities.

During the year under review the fair market value of the emission units was as follows $6.00 on 3 January, $7.00 on 31 March, $7.50 on 30 June, and $8.00 on 31 December.

TABLE 1 THE ECONOMIC EVENTS OF EMISSZIÓ ZRT.

Events	US GAAP	IFRIC 3	Current EU practice	Hungarian Accounting Act
Acquisition 3 January	Inventory, but only in the additional records, of which value is zero.	Intangible assets $144,000 (24,000 units x $6)	Intangible assets, but on the additional records, its value is zero.	Intangible assets or inventories: $ 144,000 (24,000 units x $6)
		But then $144,000 deferred revenues		But then $144,000 deferred revenues

Events	US GAAP	IFRIC 3	Current EU practice	Hungarian Accounting Act
Purchase **31 March** **30 June** **31 December**	As inventory $7,000 $7,500 $16,000 $30,500	Intangible assets $7,000 $7500 $16,000 $30,500	Intangible assets $7,000 $7,500 $16,000 $30,500	Intangible assets or inventories $7,000 $7,500 $16,000 $30,500
Expense of actual emissions	$30,500	28,000 units x $8=$224,000 (provision)	Under FIFO, or at weighted average acquisition cost, actual emissions here are $30,500 Provision	It could make provision but only for the difference! Here the liabilities are on-hand inventories so they do not exist.
		Expense $224,000		
Value at the balance sheet day	Inventories $0 Liability is $0 because units based on actual emissions are valued and recorded monthly!	Intangible assets: $174,500 Liability (Provision): $224,000	Intangible assets: $30,500 Liability: $30,500	Intangible assets or inventories: $174,500 Deferred revenues $144,000
Carried over to the next accounting term	Do nothing	Writing off intangibles and liabilities	Writing off intangibles and liabilities	Writing off intangibles and liabilities.

THE FINANCIAL REPORT FOR 2009
AN EXCERPT FROM THE BALANCE SHEET (IN US$)

	U.S. GAAP	IFRIC 3	Current EU practice	Hungarian Accounting Act
Intangible assets	0	174,500	30,500	
Inventory	0	0	0	174,500
Emission obligation	0	224,000	30,500	0
Valuation difference in own capital	0	49,500	0	0

AN EXCERPT FROM THE PROFIT AND LOSS ACCOUNT FOR 2009 (IN US$)

	U.S. GAAP	IFRIC 3	Current EU practice	Hungarian Accounting Act
Revenue	0	144,000	0	0
Expense of Emissions	settled 3,500	as provision 224,000	as provision 30,500	0
Result	- 30,500	- 80,000	-30,500	0

AN EXCERPT FROM THE PROFIT AND LOSS ACCOUNT FOR 2010 (IN US$)

	U.S. GAAP	IFRIC 3	Current EU practice	Hungarian Accounting Act
Revenue	0	224,000	30,500	144,000
Expense of Emissions	0	174,500	30,500	174,500
Result	0	49,500	0	-30,500

In January 2010 Emisszió Zrt. could transfer 28,000 units by which it could meet its liabilities. Under the US GAAP and the EU practice when it produces accounting for relevant authorities, no result is realised because it was recorded in 2009. Under the IFRIC 3 the emission unit value change leads to the fact that the enterprise could meet its liabilities of $224,000 with assets of $174,500. *Therefore, only in consequence of the right or wrong value base selection, a result of $49,500 is realised.* The excerpt from the profit and loss account shows differing results, and reveals IFRIC 3 underlying contradictions. According to the standards of the US GAAP and EU, Emisszió Zrt. has an emission expense of $30,500 which under the IFRIC 3 is $80,000 and the latter is balanced with a $49,500 positive result emerged from valuation. Meeting the liabilities of the given fiscal year is realized in the next period so the net expense of $30,500 also affects two years. That is the direct consequence of the fact that under the IAS 20 allocated units free of charge have to be measured at fair value on the day they were received while the actual emissions on the balance sheet day under the IAS 37.

The solution deducted from the Hungarian standards imposes burden on result in an inadequate period, that is matching principles are violated.
The excerpt from the balance sheet shows it clearly that there are differences in the accounting standard treatment, and emphasises the differences emerged from gross profit accounting. The differences between results make it clear that reports cannot be compared. In the balance sheet there could be distortions of fixed assets, gearing ratios and data related to profitability which could misinform financial information users.
I draw your attention to the fact, on the one hand, that in the above-mentioned example only buying units and accounting for liabilities are presented, every other economic event (marketing, capital market operations) could complicate differences further, deepen them. On the other hand, as regards to the EU practice, the worked example contains a characteristic solution but as it could also be seen from the above-mentioned survey [6], the diversity of solutions could lead to differing values and results..
On the basis of the example it could be declared that the recognition of emission units in financial reports is contradicting, it does not provide an opportunity to compare and does not give relevant information to stakeholders. Information recognised could modify investment decisions, liquidation data and cash flows of the enterprise.

IV. A SUGGESTION OF THE EMISSION RIGHTS' ACCOUNTING TRANSFORMATION

A solution which meets the stakeholders' demands for information but also criteria for the principle-based and fair-value accounting can be derived from thinking over the current accounting standards.

Operating companies have to classify emission units on their disposal either as inventory or as intangible assets. Their classifications depend on what they are used for and how they are received. The valuation is a more difficult task. Applying the Acquisition Valuation Model and Revaluation Model could be appropriate but they have to be dependent on financial accounting related to actual emissions. If we rely on current guidelines, we have to make provisions in accordance with estimated or calculated value of emission units. The distortion of value could be avoided if there is equality between the provision value assigned and the book value of available rights. In that case no result is recognised, that is operating companies have no advantage of only selecting the right or wrong valuation. In my opinion, bearing some similarity to US GAAP guidelines, the best solution could be financial accounting related to actual emissions monthly or quarterly, so distortions of years also could be avoided. The financial statement could contain expenses related to the emission measurement period.

Units obtained under project based mechanisms could be regarded as end products of the given investment. Current regulations related to investments have to be completed by special rules related to that kind of transaction. Expenses incurred at investments aiming to reduce emissions do not differ from those at ones aiming to realize other assets, but the specified emission units' market value assigned as consideration value is special. The investors' emission reduction expenses have to be examined, and option pricing models have to be extended over investments. The realization period of the project covers many years, considering permit procedures and consultation processes. Not only current counterparty risks have to be taken into account but country risks as well, which are originated from different economical, social and political systems of host countries. The pull-out possibilities of a project and their expenses also have to be examined and analysed. All of those have influence on the market value of the possible emissions which are transmitted as consideration value and "can be taken home" [5].
For investors emission rights do not mean to be production factors but commodities like corn, gold or oil. In consequence, the International Accounting Standards Board's current standards can be applied to their principle-based and fair value accounting. Rights in possession of investors can be identified as inventory, but at the same time they have to be measured at fair value. Derivative transactions related to emission rights have to be divided. Delivery transactions have to be classified in the same way as cash transactions, so trading in secondary products is underway. In case of financial accounting transactions emission rights could be treated as financial instruments which do not aim to sell or buy units but behave as dependent variables. Measuring financial instruments has to be done at fair value.

V. CONCLUSION

After analysing standards, we could state that emission rights classifications and then their valuations could not be attained entirely on the bases of the current international accounting standards. Examined and accepted standards need to be changed in order their matching should be unambiguous. The most practical solution could be a new interpretation by the standard committee in which all the participants on the market could receive a clear guidance related to their different types of rights.

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THE CONTRIBUTION OF ACCOUNTING REGULATION TO ENVIRONMENTAL ISSUES – A COMPARATIVE APPROACH –

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Abstract: Until the end of the previous decade accounting defined itself to be the key information provider of stakeholders defined by the coalition approach. As soon as the 1960s, these shareholders were those players who are in interaction with the entity on wider terms. Until recent years this "wider term", however was limited to those who are having direct interest in the entity.

This paper examines how this approach was criticized, adjusted and applied over time putting emphasis on multi-purpose accounting theory, the dialogic approach of accounting and the recent researches of global accounting standard setters. The paper analyzes how these findings may contribute to environmental issues on the theoretical level. Namely: who is interested in environmental issues and if their needs should be acknowledged by the regulation.

The theoretical examination is based on literature review and also on a panel review done in 2009 for Hungarian entities. The paper seeks evidence if the classical stakeholders in Hungary are interested to fulfill those needs that are derived from environmental issues.

The research paper also deals with the practical side of the environmental issues. Both the international standards and the national regulation address some of the problems raised, however with different extent. The paper compares these scopes and regulative approaches of national and international standard setters and regulators. The analysis will identify and discuss the critical areas such as recognition of reserves, measurement of legal and constructive obligations, and application of accounting principles in the context of environmental issues.

The research paper deals with the currently hot topic of accounting for emission rights (recognition, measurement and issues of trading and holding those assets). Besides national and international regulation content, the paper seeks the reasons the regulation failure of the IASB (see IFRIC 3 Emission rights).

The pragmatic review is based on the analysis of the regulation and publicly available financial statements and supplementary related information of public and bigger private entities.

Keywords: accounting, regulation, environment, stakeholders, dialog approach, reporting

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ENVIRONMENTAL AND SOCIAL RESPONSIBILITY IN PURCHASING PROCESSES – CASE STUDY HANSEL LTD.

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I. BACKGROUND

Corporate Responsibility is a known term in global companies, but small and medium sized firms have not enough knowledge on the aspects that are included in the framework of Corporate Responsibility. Today, many stakeholders are interested in companies' procurement practices and in the way corporate responsibility is realized in them. Companies should apply corporate responsibility principles in the entire supply chain and all operations. Hansel Ltd is the central procurement unit of the Finnish Government. Its tasks and roles are defined in the Public Procurement Act and the State Procurement Strategy. Hansel Ltd is one of forerunning companies in Finland to define the criteria for sustainable procurement processes.

II. SUSTAINABLE PROCUREMENT

The transition to network economy has changed the global business environment permanently. Doing business has become increasingly complex as the networks of suppliers have expanded due to globalization. Because of this complexity, the dynamics of supply chains have become an integral part of modern-day sustainable management. Therefore, the focus of sustainability should shift from separate organizations and companies to company networks (Byerly 2005).
Sustainable procurement is often understood as the synonym of environmental friendly procurement, and the scope of social and financial aspects is forgotten. "Sustainable Procurement is a process whereby organisations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy, whilst minimising damage to the environment" (UNEP).

Sustainable procurement includes many challenges because of wide global supplier networks. The more suppliers there are, the more there are responsibility aspects that need to be observed in a company's procurement activities, and new challenges are emerging for managers to be aware of, related to all the information circulating in the supply chains. Supplier actions can affect companies in both negative and positive ways. If suppliers are not operating in a responsible manner, significant risks can appear in the supply chains, which may undermine the reputation of companies. On the other hand, if supplier responsibility is monitored, companies can control the risks and improve their reputation and overall responsibility performance.

In 2010, Hansel Ltd has developed the management systems of public procurements to fulfill the new challenges of sustainable development generated by stakeholders. Hansel Ltd defined the voluntary financial, environmental and social criteria in autumn 2010, and inquires about information on these criteria from the suppliers from 2011.

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MEASUREMENT AND EVALUATION OF ENVIRONMENTAL CRITERIA IN SUPPLIER ASSESSMENT

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Abstract: Supplier evaluation is one of the most important means of managing supplier relationships as it assists organisations in enhancing their performance and in improving their suppliers' operations in many dimensions. This is why supplier assessment is widely studied in the literature. Based on the former investigations our paper examines the extension of the vendor evaluation methods with environmental, green issues. The method of Data Envelope Analysis (DEA) has been used to study the extension of traditional weighted point supplier selection methods with environmental factors. The selection of the weights of this method can control the result of the selection process. Our goal is to choose such weights which affect the results of the selection process. In this method we divide the criteria in two manners: the traditional and environmental (green) factors. Then with the help of DEA we are searching a weight system with which the environmental criteria can influence the decision with a representation of the green factors.

I. INTRODUCTION

As environmental issues getting more recognition in business firms realise that it is not enough to consider only their own performance. In a supply chain context it is important to manage their supplier performance as well. The means of supplier management have gone through a major development over the last 20 years. Large number of studies was carried out which focus on supplier assessment, as the performance management of suppliers called for more sophisticated solutions for evaluation and measurement. This paper will be organised as follows. After providing a brief overview of literature on how the assessment criteria evolved and how environmental aspects were incorporated in the evaluation a case example will be analysed. The Data Envelopment Analysis is applied to investigate the effects of environmental criteria in decision making processes.

II. SUPPLIER ASSESSMENT AIM, CRITERIA, METHOD

The literature on supplier evaluation, vendor assessment and supplier certification is extensive [1]-[4] although terminology is not always defined how these terms relate to each other. The primary aim of assessment in the field of purchasing is to acquire information with to analyse and to manage relationships and supply situations. Within this aim Stannack and Osborn [5] identified three important objectives or purposes, some of which may be contradictory. They identified these as: assessment for selection (to choose the best supplier); assessment for control (management and planning) and assessment for development (supplier ranking is clearly useful as a motivational tool). Assessment for selection is perhaps the most commonly known form of assessment. [5]

Supplier assessment rests upon the development of criteria. These criteria will be embedded in the environment in which they are developed. Different purchasing situations (e.g. Kraljic matrix [6]) develop different criteria for performance. The most common assessment criteria have changed over time. According to Dickson [7] the most important categories in the 1960s were the quality, delivery, performance history, warranties and claim policies, production facilities and capacities, price, technical capability, financial position. A later study of Weber et al [8] ranked quality as of extreme importance, net

price, delivery, production facilities and capacity, technical capability, financial position, performance history and warranties and claims as of important criteria. It was just later that environmental factor as part of assessment criteria were discussed. Noci [9] suggested a preliminary framework that identifies 4 groups of measures for assessing environmental performance as green competencies, current environmental efficiency, suppliers's green image and net life cycle cost. Handfield et al [10] identified as the top 10 most important criteria to measure suppliers environmental performance as 1. public disclosure of environmental record, 2. second tier supplier environmental evaluation, 3. hazardous waste management, 4. toxic waste pollution management, 5. on EPA 17 hazardous material list, 6. ISO 14000 certified, 7. reverse logistics program, 8. environmentally friendly product packaging, 9. ozone depleting substances, 10. hazardous air emissions management. They have also ranked the top 10 most easily assesses criteria 1. ISO 14000 certified, 2. Ozone depleting substances, 3. Recyclable content, 4. VOC content, 5. On EPA 17 hazardous material list, 6. Remanufacturing/reuse activity, 7. Returnable or reduced packaging, 8. Take back or reverse logistics, 9. Participation in voluntary EPA programs, 10. Public disclosure of environmental record. Humphreys et al [11] also developed a framework for incorporating environmental criteria into the supplier selection process. In their construct they identified quantitative (e.g. environmental friendly material, environmental costs), and qualitative environmental criteria (e.g. management competencies, green image, design for environment). Narasimhan et al [12] proposes a methodology for evaluation to assist supplier development, with the help of DEA they identify supplier clusters. Bai and Sarkis [13] also aims to help supplier development by introducing a formal model using rough set theory to investigate the relationships between organizational attributes, supplier development program involvement attributes, and performance outcomes. In their model the performance outcomes focus on environmental and business dimensions.

The above studies support that researchers provided frameworks for comprehensive assessment of suppliers. These frameworks support supplier selection; however they can be used for control and development purposes as well.

Supplier evaluation methodology also receives substantial attention in literature. The incorporation of environmental criteria in supplier selection often calls for sophisticated methodology. Beside the classical supplier evaluation methods (the categorical method, weighted-point method) Noci [10], lists the matrix approach, vendor profile analysis and Analytic Hierarchy Process. Enarsson [14] used the fishbone diagram as an evaluation tool. Several assessment methods were developed to incorporate green aspects in supplier management decisions. Araz and Ozkarahan [2] developed a new multicriteria sorting method based on Promethee methodology, Liu et al [15] proposed a methodology for effective supplier performance evaluation based on data envelopment analysis technique. These frameworks intended to provide comprehensive solutions, however it is still the weighted points method, which is mostly used by practitioners. Beside the methodological weaknesses (as subjectivity of weights, incoherent measurement) weighted point method has several advantages from practical point of view: it is easy to understand the calculation, requires only basic mathematical knowledge, quickly provides output.

III. DEA FRAMEWORK FOR WEIGHT SELECTION

As the weighted point model because of its easy usage is of practical importance in purchasing management it is relevant to investigate its applicability. The selection of weights happens as part of a group decision; however very often reflect subjective judgement. One of the most important limitations of this method that weights for various supplier performance attributes used in the weighted, additive scoring model are arbitrary set [12]. Thus the final ranking of the supplier is heavily dependent on the assignment of these weights, which are often difficult to specify in an objective manner. In this section with the help of DEA we intended to develop a framework to assist the selection of the weights in a way to allow the control the result of the selection process. Our goal is to choose such weights which affect the results of the selection process.

The supplier selection model is formulated, as a decision making problem. Let us assume that the suppliers are evaluated along management and environmental criteria. The management criteria are the usual supplier evaluation criteria, such as trustworthiness, purchasing price, lead time, or quality of the supplied products etc. The environmental criteria are listed in the last section of this paper. We assume that the environmental criteria are the outputs of the examined model. A very common method is used to investigate the effects of environmental issues on the supplier assessment.

Let us assume that the purchaser evaluates p suppliers. The number of traditional management criteria is n and the number of environmental criteria is m. The evaluation of supplier i is defined with vectors $(\mathbf{x}_i,\mathbf{y}_i)$, where vector $\mathbf{x}_i$ is the value of the management criteria and vector $\mathbf{y}_i$ is the environmental criteria.

Method DEA is a general framework to evaluate suppliers in materials and supply management in the absence of weights of the criteria. The application of method DEA is based on the categories “inputs”, “outputs”, and, efficiencies. The basic method was initiated by Charnes, Cooper, and Rhodes [16] to determine the efficiency of decision making units (DMU). The model offered by them is a hyperbolic programming model under linear conditions. A general solution method of such kind of models was first investigated by Martos [17] who examined the problem as a special case of linear programming model. The aim of the DEA model is to construct the weights for the management (input) and environmental (output) criteria. The weights are vectors $\mathbf{v}$ and $\mathbf{u}$ for the management and environmental criteria.

Let us formulate the DEA model in the next form:

$$\mathbf{u}\cdot\mathbf{y}_i \,/\, \mathbf{v}\cdot\mathbf{x}_i \rightarrow \max \tag{1}$$

s.t.

$$\mathbf{u}\cdot\mathbf{y}_j \,/\, \mathbf{v}\cdot\mathbf{x}_j \leq 1;\ j = 1,2,...,n. \tag{2}$$

$$\mathbf{u} \geq \mathbf{0},\ \mathbf{v} \geq \mathbf{0}. \tag{3}$$

Model (1)-(3) is the basic model of the method DEA which can be reformulated in a linear programming model in the following form:

$$\mathbf{u}\cdot\mathbf{y}_i \rightarrow \max \tag{4}$$

s.t.

$$\mathbf{v}\cdot\mathbf{x}_i = 1, \tag{5}$$

$$\mathbf{u}\cdot\mathbf{y}_j - \mathbf{v}\cdot\mathbf{x}_j \le 0;\ j = 1,2,...,n. \quad (6)$$

$$\mathbf{u} \ge \mathbf{0},\ \mathbf{v} \ge \mathbf{0}. \quad (7)$$

Model (4)-(7) can be solved with commercial software, e.g. with Microsoft Excel Solver. Throughout the paper we apply this software to construct our numerical examples.

TABLE 1: DATA FOR NUMERICAL EXAMPLE

Management criteria	**1**	**2**	**3**
Lead time (Day)	2	1	3
Quality (%)	80	70	90
Price ($)	2	3	5
Environmental criteria			
Reusability (%)	70	50	60
CO2 emission (g)	30	10	15

In our numerical example two set of criteria were formulated: management (traditional purchasing criteria) and environmental criteria.

The linear programming model has the following solution.

TABLE 2: SOLUTION OF THE DEA MODEL

Lead time	Quality	Price	Reusability	CO2 emission
0.2583	0	0.24166	0.7829	0.3355

The weights vector suggests that the weight of quality aspect should be neglected in the evaluation of the suppliers. The reusability aspect received higher weight, than other criteria. In this evaluation situation the reverse logistic subsystem of the vendor should receive such a high weight to influence the selection decision.

IV. CONCLUSION

Environmental criteria are widely used in supplier selection systems. In this paper we investigated the influence of weights on the selection decision. Our contribution with the example is that in certain situation some criteria should be much over weighted to allow real influence on the selection process.

The used method of DEA is based on commercially available linear programming software packages such as Microsoft Excell Solver. As it was mentioned in the literature review theoretic models of supplier selection incorporating environmental criteria are too complex for practical application. This is why they are not widely used in management practice. Our model offers an easy decision support tool to develop criteria and weight system of supplier evaluation.

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CARBON FOOTPRINT FOCUSED ON ORGANIC PRODUCTS

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Abstract: ***Does the carbon emission of food products effect climate change? Is it possible to abate the nascent carbon emission during the process? Does these facts influence customers purchase habit? Research of the effects of production on the environment is a very complex challenge. In our case study we were looking for what kind of aspects and what types of data are needed for each step of the carbon footprint calculating methodology, presenting an example of an organic product.***

We used the standard of PAS 2050 (How to assess the carbon footprint of goods and services) and cooperate with a Hungarian company (Biopont Ltd.) producing wide assortment of organic food. Biopont is the leading producer and distributor of organic and healthy products on the Hungarian market; distributing its products all over Hungary from the organic shops to the well known super- and hypermarket-chains.

Carbon footprint calculating has a huge data claim. Building a process map as a first concrete step is also a serious procedure. The goal of this step is to identify all materials, activities and processes that contribute to the chosen product's life cycle. It is necessary to be in contact with the suppliers, for understanding the product's life cycle and for gathering data. Supplier engagement should be built into the overall project work plan, with roles, responsibilities and milestones clearly defined and understood. The process map includes all stages and potential emission sources from any activity that contributes also to the delivery or use of the product. Carefully checking boundaries, - what methodology doesn't include (e.g. immaterial emissions sources) - is also very important.

Collecting data is the most difficult part of the process and it depends on interviews and focuses on the most significant inputs first, and identifies their respective inputs, manufacturing processes, storage conditions and transport requirements. The quantification of the total amount of all materials into and out of a process is referred to as 'mass balance'. The mass balance step provides confirmation that all materials have been fully accounted for and no streams are missing. The equation of the product carbon footprint value is the sum of all materials, energy and waste across all activities in a product's life cycle multiplied by their emission factors. The calculation itself simply involves multiplying the activity data by the appropriate emission factors.

We introduce the idea of the Minimum Emission Product which could be used for comparison of the organic food with normal foods. Labelling products with this category could help producers and suppliers to show their environment friendly thinking, and also encourages the environmentally sound consumer to buy these products, giving them information about the manner of energy using abate. Marking allow companies to promote the environmentally sound processing. It also indicates the rate of the purchase sustainability. Consumers of organic products are more sensitive to healthy lifestyle, and to climate and environment friendly products, as well.

In this study we started calculation from wheat growing and follow the lifecycle of an organic wheat product until the costumer using and disposal. We introduce the process map of the organic bulata and show the benefits of organic farming and local growing of cereals. We intend to extend the calculations of carbon footprint of other products also, first of all to organic and healthy products on the Hungarian market in collaboration with the Biopont Ltd. Living under changing climate conditions, the regular use of the carbon-trademark as a comprehensive carbon emission measurement is very much needed.

I. INTRODUCTION

Carbon footprint is used to describe the amount of greenhouse gas (GHG) emission caused by a particular activity or entity, and thus a way for organisations and individuals to assess their contribution to climate change. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent. The term 'product carbon footprint' refers to the GHG emissions of a product across its life cycle, from raw materials through production (or service provision), distribution, consumer use and disposal/recycling. Calculating the carbon footprint is the

first step towards reducing it. A product carbon footprint could give benefits for both companies and product-level supply chain emission assessment. Quantifying the carbon emission sources will help to understand what impact is a company, a product or an organisation having on climate change [6]. It helps manage the carbon emissions and make reductions over time, furthermore it helps find and identify areas for reducing emissions, which will often result in cost savings as well. When choosing a product for footprint calculation we consider the goals of the project, so we identify which products best meet criteria of the company's GHG reduction strategy; for example, comparisons across product specifications, manufacturing processes, packaging options, distribution methods. The functional unit of product carbon footprint can be thought of as a meaningful amount of a particular product used for calculation purposes. The cooperation with suppliers is important for understanding the product's life cycle and for gathering data. Supplier engagement should be built into the overall project work plan, with roles, responsibilities and milestones clearly defined and understood. A British organisation called Carbon Trust [4] is a private company set up by the British government in 2001 to help UK businesses lower carbon emissions and reduce energy costs. It is taking steps to help consumers better understand the carbon footprint created by their food. Their carbon footprint label, clearly marked with the amount of grams of CO_2 created by the product, measures a product's emissions from source to shelf. The Publicly Available Specification [8] was commenced in June 2007 at the request of Defra (Department for Environment, Food and Rural Affairs) and the Carbon Trust. It contains BSI (British Standards Institution) Standards Solutions meeting method for measuring the embodied GHG emissions from goods and services and is used as a basis of product carbon footprint calculations.

II. MATERIALS AND METHODS

Building a process map

The first step for preparing the calculations for a chosen product is building its process map. The goal of this step is to identify all materials, activities and processes that contribute to the chosen product's life cycle. Developing a product process map starts by breaking down the selected product to its functional units and focusing on the most significant inputs first, then identifying their respective inputs, manufacturing processes, storage conditions and transport requirements. A service 'life cycle' therefore involves more than just inputs, outputs and processes: the process map will include all stages and potential emission sources from any activity that contributes to the delivery or use of the service.

TABLE 1: PROCESS MAP STEPS FOR PRODUCTS, 'BUSINESS – TO – CONSUMER' (SOURCE: PAS 2050)

Raw materials →	Manufacture →	Distribution/ Retail →	Consumer use →	Disposal/ Recycling

All inputs used at any stage in the life cycle. Includes processes related to raw materials.	All activities from collection of raw materials to distribution.	All steps for transport and related storage, retail storage and display.	Energy required during the usage phase.	All steps in disposal: transport, storage, processing. Energy required in this process and direct emissions due to it.

Checking boundaries is important, and means that the methodology does not to include immaterial emissions sources (which represent less than 1% of total footprint), human inputs to processes, transport of consumers to retail outlets, and animals providing transport.

Data types and collecting data

Two types of data are necessary for calculating the carbon footprint: activity data and emission factors. Activity data refers to all the material and energy amounts involved in the product's life cycle (material inputs and outputs, used energy, transport, etc.). Emission factors provide the link that converts these quantities into the resulting GHG emissions: the amount of greenhouse gases emitted per 'unit' of activity data (e.g. kg GHGs per kg input or per kWh energy used). Activity data and emissions factors can come from either primary or secondary sources: primary data refers to direct measurements made internally or by someone else in the supply chain about the specific product's life cycle. Secondary data refers to external measurements that are not specific for the product, but rather represent an average or general measurement of similar processes or materials (e.g. industry reports or aggregated data from a trade association).

Mass balance

The quantification of the total amount of all materials into and out of a process is referred to as 'mass balance'. The mass balance step provides confirmation that all materials have been fully accounted for and no streams are missing.

Calculating carbon footprint

The equation for product carbon footprint calculation is the sum of all materials, energy and waste across all activities in a product's life cycle multiplied by their emission factors (1).

$$\textit{Carbon footprint of a given activity} = \textit{Activity data (mass/volume/kWh/km)} \times \textit{Emission factor } (CO_2 e \textit{ per unit}) \quad (1)$$

The calculation itself simply involves multiplying the activity data by the appropriate emission factors.

III. CALCULATION OF CARBON FOOTPRINT, CASE STUDY

In this work we give an example of an organic wheat products carbon footprint. We introduce the calculation for a sample product "Bulata', an Extruded wheatgerm (Organic, 200 g) [3], which is a popular organic snack rich in B, E-vitamin, phosphorus, potassium, zinc and magnesium. The carbon footprint calculation consists of several steps illustrated on the products process map (Figure 1). First step of calculations is taking farming emission into consideration (as the production of raw materials). In this case it is wheat production emission, which we got from the emission factor database [8]. The next step of calculation is based on the transportation of raw materials to the location of production (mill), and then to manufacturing place.

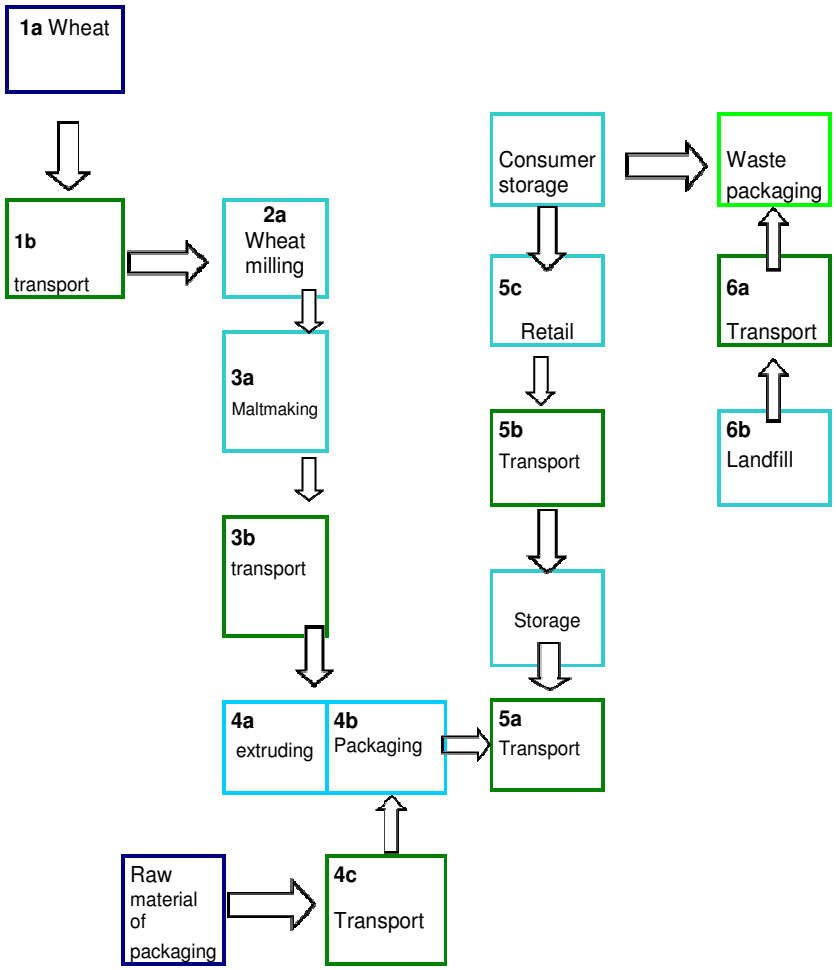

FIGURE 1: PROCESS-MAP OF BULATA

Packaging is a very important element of product carbon footprint calculation, as well. The next step of the products life cycle is transportation to storage centre and stores. At the end we have to bring into consideration the emission factors of retail, disposal and landfill decomposition. All the values were evaluated are given for a tonne of Bulata. The carbon footprint of a package of 200g was gained at the end of the calculation process. We took

into consideration as many factors as possible. Most of the data were given by the supplier through interviews, like locations of production process, transported and packaging material quantities, energy usage of the used machines, storage time interval, and location of stores of selling the product. The emission of transportation vehicles was calculated based on the emission factor database [2].

TABLE 2: FOOTPRINT ANALYSIS OF BULATA

Raw materials	Farming	Transport	Technology	Retail	Disposal	Total
wheat	**500**	**4**	**40** (milling)			
malt		**5.6**	**35** (malting)			
Bulata		**4.57**	**25** (extruding)	**225**	**0.0015**	
packaging material		**84.199**	**53** (packaging)		**0.0223**	
Total	**500**	**98.369**	**153**	**225**	**0.0238**	**976.3928**
	51.2%	***10.07%***	***15.66%***	***23.04%***	***0.0024%***	

Figures in Table 2. show the results of the footprint analyses and are given in kilograms per CO_2 emission per tonne Bulata (percentages are percents of the total emission). Based on our calculations the carbon footprint of a 200g package is **0.195 kg** CO_2**. The repartition (to farming, transport, technology retail and disposal) of the emission of this product is given in Figure 2.**

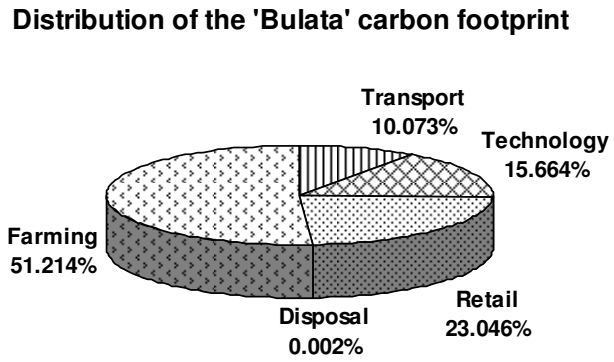

FIGURE 2: THE REPARTITION OF THE CARBON FOOTPRINT OF 'BULATA'

IV. DISCUSSION AND CONCLUSION

In this study we were searching for answers of whether it is possible to abate the nascent carbon emission during the process, and does these facts influence customers purchase habit? According to a Carbon Trusts study [9] two thirds of consumers are more likely to

buy a product if action is being taken to reduce its carbon footprint. Analysis of the EIPRO Study [5] defines different product categories according to their environmental impact; top ranking product groups are: cars, food, heating and house building. Beside other effects, studies are focusing on global warming, and consist of analysis and comparison of existing methodologies. The current state of research identifies products in the following three areas as having the greatest impact: food and drink, private transport, and housing; with no clear ranking as products in the three areas identified are of approximately equal importance. Together, they are responsible for 70 to 80% of the environmental impact of consumption (only food takes 20-30%), so cutting food miles is important but not enough.

Production of organic products is attentive to the environment, careful about where and how to produce (eg. no empty inbound journey in our example) [1]. This can be recognised by tracing the calculation of the given example. Product carbon footprint indicates the rate of the purchase sustainability, as well. Consumers of organic products are more sensitive to healthy lifestyle, so to climate and environment friendly products, too. We intend to continue our collaboration with the Biopont Ltd. Company [3] and extend our calculation to other products, as well. Introducing organic food as Minimum Emission Product encourages us to improve the methodology, and extend calculations for comparing product carbon footprint of organic and normal food products. For example, a bag of Walkers Crisps in Britain has a carbon footprint value of 75g for a 25g package [10] which means about three times more than for Biopont Bulata. The benefit of local growing and sustainable thinking is very important also in reducing the emission [7]. Labelling encourages companies to concentrate on environmentally sound processing and also encourages the environmentally sound consumer to buy these products giving them information about the manner of energy using abate.

There are many commercial benefits of product carbon footprinting. It helps companies to understand how products and supply chains are responsible for carbon emissions and helps companies identify the most effective ways of reducing them. It highlights the opportunities for greater energy efficiency, reduced waste, streamlined logistics and other efficiencies. It is critical to help cut costs, manage climate risks and enhance brand reputation. Labelling gives customers' access to better information about the potential impact of climate change of every product they buy, and hopefully initiate change as a result.

ACKNOWLEDGEMENTS

This work was supported by the "Research in excellence of Corvinus University of Budapest" stipendium, the TÁMOP 4.2.1.B-09/1/KMR-2010-0005 project and the „Research Assistant of Corvinus University of Budapest" fellowship.

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ANALYSIS OF COOPERATION IN A CLOSED-LOOP SUPPLY CHAIN IN A GAME-THEORETIC MODEL

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Abstract:

A closed-loop supply chain is investigated. The buyer uses a product ordered from a supplier (or vendor). The buyer faces with the problem that the used products must be disposed off for a high cost rate or collect them and ship back to the supplier that buys back these used item for a lower cost than that of disposal. The supplier is able to remanufacture the used products, and then to sell them to the buyer, as new products. The supplier satisfies the rest demand of the buyer with manufacturing of new products. The buyer decides about the order lot size and the vendor about buyback (collection) rate.

This situation leads to a relevant problem in closed-loop supply chains. To solve the problem there are two ways. The first solution concept is the non-cooperative game theory. In this case the participants try to maximize her own utilities, i.e. the profits or costs. The second solution concept was initiated by von Neumann and Morgenstern (1944), named cooperative game. In this concept the players follow a common utility and then distribute the gains. This problem is a part of supply chain coordination. The coordination mechanism is to choose the best contract to control the distribution schemes.

The ecological problem of the model is how to construct an incentive scheme which motivates the participants of the supply chain to save natural resources with reuse of items from the consumption process. The reuse of used items can contribute to the sustainable production with lower energy consumption and save resources.

Keywords: Joint economic lot size, Reverse logistics, Collection, Remanufacturing, EOQ, Closed-loop supply chain, cooperative games, Nash equilibrium, Supply chain coordination

ADAPTATION TO CLIMATE CHANGE: SCENARIOS OUTLINED WITH PARTICIPATORY METHODS

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Abstract: ***The goal of the WateRisk project (financed by National Technology Program 2009-2011 in Hungary) is to build a computerised model that could estimate the quantitative and qualitative parameters of water resources. This model will be able to diminish the instability cause by climate change. The output is a water resources management decision support system that offers alternative scenarios as output. To define scenarios we have used several methods, and the results have been integrated into a complex system of scenarios that have been outlined with forecasting and backcasting approach. The original IPCC, GEO-4 and SCENES climate scenarios were improved with local issues and modified with local specialties as forecasting. Participatory methods were used to include the opinion and attitude to the future of laymen into the analysis and used the results during the backcasting process. A survey was conducted in three pilot areas and the results showed how laymen's opinion and attitude was and would modify water usage in the present and in the future. Based on that we could connect international climate scenarios to our local areas, and bring them to details.***

Keywords: water resources, scenario method, participatory method

I. INTRODUCTION

The WateRisk project is carried out with the National Technology Program 2009-2011. The professional consortium is headed by Generalcom Engineering Ltd., affiliates of the Corvinus University of Budapest, Budapest University of Technology and Economics, MTA Research Institute for Soil Science and Agricultural Chemistry and the Alliance for the Living Tisza Association.

The goal of the WateRisk project is to build a computerised model that could estimate the quantitative and qualitative parameters of water resources. This model will be able to diminish the instability caused by climate change. As a water resources management decision support system besides its many other features it helps decision making with alternative scenarios as output.

II. THE RESEARCH APPROACH

By synthesising the latest scientific research results we developed an integrated water management decision support system, which allows on a widely user-friendly way the water management interventions, strategies, impact analysis. The IPCC results were used to forecast the physical parameters of water management scenarios. Alternative scenarios as results of WateRisk should refer to small regions containing economic and societal elements too, hence we also implemented the backcasting approach.

According to modern futures studies approach the mitigation of uncertainty in the present caused by the uncertainty of the future should be based on three main principles: complexity, alternativity and participativity. Participatory methods are ready to satisfy

these requirements as they include involvement of non-experts (laymen), apply complex approach of the research and the results could be used for articulation of alternatives as societal bifurcation points (where changes are the most expected) could be identified in laymen's answers.

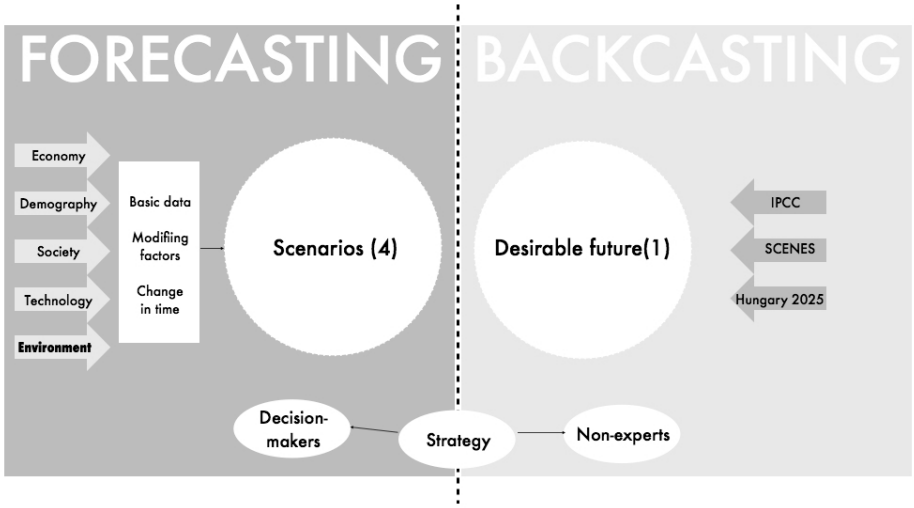

FIGURE 1: THE SCENARIO BUILDING PROCESS OF THE WATERISK PROJECT

Societal, demographical, economic, technological and some environmental elements of water demand management were determined as modifying factors that satisfies the principle of complexity. A survey was conducted for the exploration of those factors that determinate and modify water consumption. Based on the modifying factors we are able to estimate future water demand modified by societal and economic effects. This approach is in harmony with the participatory principle.

III. THE SURVEY

A survey was conducted in three pilot areas: Homokhátság, Nagykörű, Bereg). The survey consisted of three main parts: general attitude questions, questions on willingness-to-pay and questions referring to the future attitude and thinking.

The general attitude questions were referring to everyday water and environment usage habits, agricultural and free time activities, and extreme water-related environmental events from the past. Willingness-to-pay questions were referring to respondents willingness to pay for extending the local nature oriented territory. The questions referring to the future were about the world trends effecting Hungary in 2025, about the respondents' personal habits, about the probabilities and desired happening of environmental issues and about the future orientation of the respondents.

A Q questionnaire was also conducted in all three areas, that was focusing on non-experts' relation to their living area and to extreme fluctuations of the water level. The Q questionnaire was conducted in focus groups, while the survey was queried as personal interviews. The survey and Q questionnaire were conducted in May-June of 2010. From

the three pilot areas 325 persons were surveyed, and 318 of the responds were complete enough to include in the research.

IV. Analysing the results of the survey

The results were analysed with the PASW statistical program, conducting factor and cluster analysis. Based on the questions referring to the attitude and to the future the cluster analysis resulted 5 basic groups. These groups are the following:

A) "Biders": they do not believe that great catastrophes would happen, but expecting a worsening situation for the future, they have lack of activity for the future.
B) "Mainstream thinkers": they think that future life quality would be worse than in the present, but they could realise that new life situations – technological change, climate change etc. – could bring change in their life, even though that they would not be involved in the proactive part of changes.
C) "Self-confidently conscious": they do not think that any catastrophe would happen in Hungary, but they expect the raise of life quality and new possibilities, and they would be actively take part of the bottom-up changes.
D) "Stability seekers": they think catastrophes would avoid Hungary and the life quality would not be worsening, but they are on the safe side instead of being actively part of the changes, and refuse changes that are not yet evolved and contain uncertainties.
E) "Stow aways": they are doubtful with new life circumstances, but a little believe that catastrophes would happen or life quality would worsen, and not participating actively in building the future.

Possible bifurcation points (where the societal-economic-technological trends could have a break) could be identified based on the answers. Later these could be used as alternative formulating issues. For example the willingness to active civil participation is not homogenous, thus there could be differences when climate change would cause more serious effects; adaptation to changes would be possible in communities or alone, and respondents are divided; and respondents are having two main groups with different opinion about the regulation of the use of natural elements (whether the State should control the regulation or not). According to these differences the bifurcation points show the possible changes of adaptation to the climate change.

VI. Outline of WateRisk scenarios

The WateRisk scenarios are outlined based on other scenario analysis and the results of the WateRisk survey. The IPCC and SCENES project scenarios refer to the possible adaptation to different levels of change of the climate, while the Hungary 2025 scenarios do show how Hungarian society would change within the possible space of behaviour outlined by societal and economic changes. The clusters created within the analysis of the WateRisk project match the scenarios of the other projects.

WateRisk scenarios do focus on local areas as they are based on the local water problems, but naturally have global considerations too. To be able to determine environmental, economic, societal parameters, we have selected 25-30 parameters to further analysis. A group of experts were discussing the possible changes of these

parameters, and estimated their possible future state using IPCC scenarios as starting point. Hence new alternative scenarios were outlined for small areas of Hungary, and water demand could be more exactly estimated adding future attitude as modifying elements.

VII. Outline of the desirable future

The desirable future could be outlined matching the results of the different scenario analysis. The desirable future is not only based on scientific considerations, but also includes laymen's desires, their hopes and fears, their willingness to do something or their refuses. In this way we can ensure that not only experts' opinion is present while shaping the future, but also those people's opinion, of whom future we are dealing with. Creating a strategy in this way decision makers can assure that they follow a democratic way while making decisions.

Comparing the desirable scenario with the WateRisk scenarios we can see what strategy is required in order to achieve certain goals. These outputs are not certainly normative, but naturally show a required direction for possible further actions.

VIII. Conclusions

Today climate change is an important issue in which all people should be involved as their attitude is crucial in the adaptation process. When building scenarios with participatory methods we can achieve thus futures that bear not only the support of scientists, but also of non-experts. With the articulation of the desirable future and its comparison to alternative scenarios a complex model could offer support in decision making not only in a quantitative, but also in a qualitative was. This is very important when the changes happen fast and preparatory work is essential in society to adapt to these changes.

The project's main objective is developing a software product and consulting at the same time, reporting the preparation work for the period after the completion of the project. We are planning on the long-term basis. Our goal is that after the completion of the project, we send advanced water management researches within the WateRisk system to a broad range of local stakeholders with continuous scholarly support, to successfully take up the fight with 21 century challenges.

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EMA, MFCA AND CO2 AUDITS - ALL ABOUT SYSTEM BOUNDARIES

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Abstract:

The Austrian law for qualification of auditors under the EU CO2-Emission Trading Scheme explicitly requires a team of an engineer, a chemist and an accountant to jointly verify the CO2 emission declaration. in other countries the links between accounting and CO2 emission reporting are less well established. Environmental Management and Material Flow Cost Accounting provides the basis for establishing a consistent and auditable input output balance on a corporate and process level. with increasing efforts to also offset the CO2 footprint of products, corporate cost accounting needs to be even further refined. the lecture will highlight experience from working as a CO2 auditor in Austria

CALCULATING THE CARBON COST VULNERABILITY OF SECTORS USING INPUT – OUTPUT ANALYSIS

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Abstract:

Carbon costs are usally associated with big emitters of CO2 like energy industry, aviation, etc.
Big purchasers of carbon intensive sectors, however, are also impacted by carbon costs more than they might realise at first sight. Input prices may rise due to increasing carbon costs or increasing demand for carbon neutral subsitutes.

An environmentally extended input-output analysis may offer advantages of capturing spillover cost impacts throughout the industry. The paper will define new indicators for assessing the carbon cost vulnerability of sectors, including:

- input cost vulnerability index
- emission cost vulnerability
- overall cost volnurability index

based on the environmentally extended onput output model and quantify them for sectors. This kind of analysis may offer advantages not shared by conventional supply chain analysis as it is able to indicate spillover impacts of carbon policy on more downstream industries like furniture, printing etc.

EXPLORING THE CORPORATE PRACTICE OF SUSTAINABILITY ACCOUNTING

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Abstract: Much of the present literature on corporate sustainability accounting is represented either by philosophical debates and conceptual approaches which have been developed independently of current practice, or by case studies of innovations in practice which are often of experimental or ad hoc nature. Although valuable as a source of ideas and inspiration in developing environmental management accounting (EMA), these publications provide only limited insight on the actual development of the practice of corporate sustainability accounting.

However, as sustainability accounting becomes increasingly more established, systems and procedures can be expected to evolve and companies' accounting functions to be increasingly involved. The Institute of Chartered Accountants in England and Wales (ICAEW) therefore funded an exploratory empirical study which followed a grounded theory research approach. The project´s aim was to receive insight how practice is developing in leading companies, what role the accountants have, and what challenges are being encountered. This paper reports on the process and results of the project.

I. INTRODUCTION AND MOTIVATION FOR RESEARCH

The term "sustainability accounting" is used here to refer to the process of the collection, analysis and communication (either internally or externally) of sustainability-related information [4, 6, 7]. This can be considered to be any information that is needed for or that is related to corporate sustainability management, which can include both new types of information and also some information which may already have been generated and used for some time (e.g. for legal compliance) before the term 'sustainability' became common usage. For the current status of the discussion on the topic see [7] and [4].

The notion of sustainability accounting has emerged from a combination of philosophical discussions on the nature of accounting [5, 7] and conceptual developments in accounting. [7] It can be perceived as either a new development based on an entirely new system of accounting or as an extension of conventional management accounting [3], depending in part on who within a particular company is responsible for its sustainability accounting, and the type of information that is collected. The basis for the emergence of sustainability accounting seems to be that on one side environmental and social aspects seem to play an ever larger economic role for organisations and on the other side that in most companies present accounting and other information systems do not or only inadequately recognise the environmental and social aspects of their business. As a result sustainability issues may often not be taken into account in decision-making and assessing performance.

The type of information that is considered to be sustainability-related can vary widely depending on several factors. The most important is the particular company's main sustainability-related objectives, including how far these derive from external stakeholder pressures and therefore drive a need to generate information to be reported externally, as opposed to an intrinsic motivation to manage sustainability performance as part of the company's overall business strategy for conventional business reasons of profitability and corporate value.

Companies differ not only in the objectives they adopt but also in the means by which they choose to pursue these objectives and their preferred approach to management control,

with some companies being 'managed with numbers' more than others. This is likely also to depend on the stage to which a company's sustainability management has developed. Results-based control systems pose challenges at several levels: defining objectives and therefore desired performance, devising appropriate indicators, and then generating these to an acceptable standard of quality, within reasonable cost limits (cf. [2]). As these take time to be developed, a reliance primarily on behavioural and social controls can be expected in the early stages of a company's sustainability management. However, with a further development of corporate sustainability management these information and accounting systems may increasingly be supplemented with results-based controls. [7, 4]

This empirical research project was designed to fill a gap in the existing literature by exploring developments in the practice of sustainability accounting in a number of leading companies in Germany and the UK. The focus is on sustainability management accounting, i.e. the generation and use of information to support managerial decision making. However, it is also recognised that companies generate information not only for internal purposes but also to report externally, which may have a significant influence of what information is generated.

II. RESEARCH APPROACH AND METHODS

In view of the absence of an adequate background theory on sustainability accounting practice grounded theory was judged to be an appropriate method for this project. Thus the theories are "grounded" in the observable patterns of behaviour and experiences and the researchers add their own insight into why these processes, approaches and experiences may exist. In essence, grounded theory attempts to achieve a theory or conceptual understanding through stepwise, inductive process. Thus, findings based on this method are initially only indicative and need further testing before they can be formulated in a more definitive manner.

A number of sixteen companies, eight leading companies in Germany and eight in the UK were chosen for this empirical project. These include companies from different economic sectors, from multinationals to charities and public sector organisations, and with varying motivations for sustainability management. Since the aim of the investigation was not to try to develop a representative picture of practice in general but to identify emerging practices and trends, those companies were considered which were expected to be among the leaders in sustainability accounting. These companies are likely to provide early examples of what may develop as a more general corporate practice in the future.

The first interview was invariably with the initial contact in each company, who was usually that company's sustainability manager, who identified what he or she perceived to be the key sustainability issues in that company. From that point, information flows were traced in both directions, upstream and downstream, and further appropriate interviewees were identified. Subsequently, the outputs from the interviews were repeatedly analysed to identify references by interviewees to aspects of interest.

Among the key questions on which the interviews focused were:

- Who is involved in sustainability accounting? Who collects physical and monetary sustainability information? Who provides the information and who receives it? To what extent are they involved?
- What kind of information is collected and for what purposes?
- What is the accountant's role in the sustainability accounting process?
- Etc.

For the analysis of the generated research information from the interviews we analysed it in the light of a number of theories which are already widely applied to help to explain and understand practice in accounting, economics and management. These theories include Agency Theory, Legitimacy Theory, Contingency Theory and Transaction Cost Theory.

III. RESULTS

This section presents a selection of the results of the research (for the detailed results see [1]). The results are presented in accordance with the exploratory nature of the project. Thus we start with who is involved in providing information. After the collectors and providers are identified, we present what information they provide and why they provide it. Subsequently we analyse the users (addressees) of the information and the way the sustainability accounting processes are organised. Last but not least the deployed sustainability accounting tools are presented.

Who within the company is involved in the process of sustainability accounting?

Very different observations could be made with regard to who collects sustainability information. A wide variety of different individuals and functions can be involved in a company's sustainability accounting. It was apparent from the interviews that this variety reflected both differences between different companies, and also within a single company. One example of differences between companies which was observed in a number of cases was in generating social performance indicators such as the effects of corporate responsibility programmes on employee motivation, which in some companies were generated by the human resources function, in others by the sustainability department.

What kind of sustainability information is generated?

One aspect of the sustainability information properties was their time frame and generation frequency, based on the EMA framework [5] which distinguishes four decisive information properties: type of information (physical or monetary), time frame (future orientated or past orientated), length of time frame (short or long term) and routineness of information gathering (ad-hoc or routinely generated).
The distinction between physical and monetary information did return a notable difference, physical information often reported as being essential for sustainability management activities. The investigated companies often reported both types of information, yet a clear focus on physical over monetary information was seen. One example where the significance of physical information was obvious was carbon emissions. Whereas many companies collected detailed physical sustainability information especially on their emissions (e.g. emissions due to heating, lighting, IT, travel, etc.) monetary sustainability information was predominantly created in an aggregated form (if at all). Other examples were reported as impossible to be expressed in monetary terms, although they are known to have impact on the financial performance of the company. Examples include employee satisfaction and motivation, or impacts on the natural environment that are not yet internalised (e.g. number of species engaged due to corporate activities).

Why is the sustainability information generated?

One of the aspects the project looked into was why the involved parties (functions, departments) collect or used the sustainability information and what the benefit from the availability of sustainability information is. The granularity of the data allows a two-step differentiation as to the usefulness of the data: nice to have and essential, with examples of both, as Table 1 reveals.

Importance of sustainability related information	Nice to have	Essential
No. of cases in the sample companies	10	12

TABLE 1: PERCEIVED IMPORTANCE OF SUSTAINABILITY INFORMATION (BY ALL INTERVIEWEES IN EACH COMPANY). THE NUMBERS TOTAL TO 22 AS IN SOME COMPANIES BOTH OPINIONS WERE REPRESENTED STRONGLY.

Table 1 reveals that interviewees did not necessarily consider all available information absolutely vital for fulfilling their responsibilities. This was often explained e.g. with the limited informational value of the collected data (e.g. are five cases of child work much or little?) or with the comparability of the information (e.g. what does a decrease in the number of law suits really mean?). The contribution of sustainability information to supporting decision makers was considered to be positive, but in many cases rather as nice to have then as essential.

Who uses sustainability information?

After gaining an overview of who collects what information and for what reasons and purposes, the question for who the information is collected was approached.
The large diversity of information providers also applies to information users, although somewhat more limited as Table 2 shows.

Primary addressee	Sustainability manager	Higher management	General management	Others
	12	5	7	3

TABLE 2: FOR WHOM IS SUSTAINABILITY INFORMATION COLLECTED?

Several contemplations can be inferred from Table 2. On the one hand, the direct engagement of the higher management appears striking and suggests that (considering the non-longitudinal nature of this research) quantifying sustainability might be gradually gaining importance at the top. Top managers appear interested in assessing sustainability performance and various sustainability activities.
Another major observation is that information from providers reaches sustainability managers but does not always go back to the providers (who are often users). Despite the usefulness of putting the provided information into a larger sustainability context and discussing its usefulness with the providers sustainability managers do often keep the information and only pass it on to higher management. Nevertheless, several examples were identified for the cases were information was sent back to the providers, revealing the actual advantages.

How are data collection and information creation organised?

Closely related to the centralisation is the use of a single information management system to manage all sustainability information. Such systems were not rare (Table 3) in the researched sample. Yet, a distinction needs to be made. In two cases a single information management system was observed, in companies which only dealt with a few sustainability aspects and three other companies had also adopted a single information management system, although these were dealing with a broader range of sustainability issues. In five cases several sustainability information systems were in place, whereas in six it was done by means of many sustainability information and accounting systems.

Number of systems	Single (few aspects tackled)	Single (many aspects tackled)	several	many
Companies	2	3	5	6

TABLE 3: NUMBER OF DEDICATED INFORMATION MANAGEMENT SYSTEMS

Companies with centralised approaches (single systems) reported that the approach greatly facilitates the exchange and use of sustainability information for both, the information providers and the users. Subsequently it would also require fewer resources to input and retrieve data from it, therefore making it more efficient in comparison to dealing with several systems in parallel. Furthermore, it was reported that using a single system is more likely to result in relating various aspects to each other and thus revealing linkages between sustainability issues. A further advantage was reported to be the provision of a quick overview of what information is available and who it has been provided by.

A major disadvantage of deploying a central information management system appears to be the resources (including time) required to modify existing systems or develop and implement new ones. Furthermore, such systems were assessed by the interview partners to be less flexible for future changes, since reflecting the needs of one user might require the consent of others as they are imminently affected by these changes. For this reason the companies in the sample that had adopted such a centralised system reported to be using further tools for information presentation such as excel spread sheets as an interim solution until changes are integrated.

What sustainability management accounting tools are used?

When the corporate representatives explained the characteristics of the information which they created and forwarded as part of their sustainability accounting activities they also described the decision situations for which the information is targeted. Given this exploratory information, these decision situations can be structured in terms of the EMA framework which distinguishes past- and future-oriented information, monetary and physical information, short- and long-term information, and ad hoc and routinely generated information.

The examples presented in the interviews revealed that most of the possible decision situations distinguished in the EMA framework had occurred in the companies. Thus, on an aggregate level a quite equally spread distribution between the four dimensions of the framework can be observed. However, on a company level, as opposed to the aggregated level of all investigated companies, typically only a small selection of environmental and

sustainability accounting tools had been applied and given a thought to support decision making.

IV. CONCLUSION AND RECOMMENDATIONS

Numerous conclusions can be drawn from the results of the project. On the one hand, the internal corporate perspective can be addressed, i.e. what could or needs to be improved based on the empirical results presented in the previous section? These recommendations are primarily directed at sustainability managers, general managers and accounting professionals involved in sustainability information management and use. For example, involving existing providers of other (i.e. non-sustainability) information, rather than delegating the task to sustainability officers only, offers various benefits (e.g. that sustainability issues are considered in more departments, the quality of sustainability information may be increased when the provider knows what the information is used for, etc.). Furthermore, given the interdisciplinary character of corporate sustainability and the creation of sustainability information, collaboration is a key element of any sustainability accounting processes. The added value of doing this is likely to pay off and apart from increasing the process efficiency also likely to result in more effective measures being implemented.

On the other hand, the research project also delivers recommendations that focus on the development of sustainability management accounting outside companies. As the main body of literature identifies insufficient involvement of the accounting professionals in sustainability activities (cf. [1]) and the results of this project suggest that the actual contribution of the accounting professional can be considerable, we address the wider framework that stimulates and supports educating accountants for sustainability. Although reports such as this one may draw attention to the issue, the total involvement of sustainability issues in accounting curricula is still limited to date. Only very few accounting organisations offer an integrated approach to accounting and sustainability, despite the increasing importance outlined throughout this report. Therefore, we raise the attention of accounting institutes towards the integration of sustainability-related aspects in conventional accounting.

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ACCOUNTING FOR CLIMATE CHANGE: WHO SHOULD DO THE MEASURING?

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Abstract:

This paper deliberately focuses on the politics of who should do the measuring in climate change accounting, as a necessary complement to understanding 'what' and 'how' to measure (and, indeed, 'why' we are measuring in particular ways and not others). Over the past twenty years, climate change accounting has evolved from a fringe activity conducted by a handful of specialist economists and scientists, to a highly diversified set of practices, some more specialist, others approaching mainstream, carried out by numerous actors belonging to several distinct communities. It has become clear that the stakes are high, with the investment required to stabilise greenhouse gas concentrations in the atmosphere estimated by the IEA at around US$10 trillion over the next twenty years, turnover in carbon markets reaching US$120 billion in 2009, and the Copenhagen Accord promising developing countries financial assistance to the tune of US100 billion/year by 2020 (IEA, 2009; Kossoy and Ambrosi, 2010; United Nations, 2009). Consequently, it is hardly surprising that we can discern, within the field of climate change accounting, emerging tensions between different communities over the limits and boundaries of professional 'expertise', control over the content and process of standards development, and attempts to link new forms of climate change accounting to existing areas of professional practice. The paper builds on work by Michael Power in relation to environmental audit and David Guston on boundary organizations. It first provides an overview of the major ways in which climate change accounting has historically been framed as a matter of professional expertise by scientists, politicians, economists and accountants, as well as by new communities of practice in the carbon markets. It then focuses on the development of standards as a mechanism for defining who carries out an activity, as well as what the activity is and how it should be done. The relationships between apparently very different standards such as IPCC Guidelines on National Greenhouse Gas Inventories (IPCC, 1996) and industry codes such as the GHG Protocol or Voluntary Carbon Standard (WRI/WBCSD, 2004; VCSA, 2008) are explored. Finally, the paper reviews the emergence of professional accreditation schemes for climate change accountants, showing that an active and currently unresolved contest is underway in the definition and ownership of relevant expertise.

ENVIRONMENTAL MANAGEMENT ACCOUNTING ADOPTION: AN EMPIRICAL STUDY ON CONTINGENT FACTORS SIZE, ENVIRONMENTAL SENSITIVITY AND TOP MANAGEMENT COMMITMENT TO ENVIRONMENTAL MANAGEMENT

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Abstract: ***Environmental management accounting (EMA) is management accounting that explicitly addresses environmental information pertaining to costs, savings and revenues. Drawing upon the contingency theory of the organization, we identify three firm characteristics and examine how they influence EMA adoption levels. The three factors identified are size, environmental sensitivity and top management commitment to environmental management (TMC). Using survey data from a sample of 74 manufacturing companies in Malaysia, the results of multiple regression analysis indicate that the level of EMA adoption is positively and significantly associated with the level of TMC. Contrary to our expectations, our findings reveal no significant association between (i) EMA adoption level and size, (ii) EMA adoption level and environmental sensitivity. Next, semi-structured interviews were conducted with four interviewees to supplement the survey findings. Our study provides evidence from Malaysia concerning the understanding of the relationships between firm characteristics and EMA adoption. More importantly, it contributes to management accounting, particularly in the context of a sustainable business environment in emerging economies.***

I. INTRODUCTION

Of late, there has been increasing concern regarding corporate responsibility and sustainability reporting. At the forefront of this progress is the recognition of the need for environmental information for business decision making and performance benchmarking [2] [51]. In addition, there is interest in putting in place formal systems and databases that integrate procedures and processes where the focus is on environmental performance information [54]. Such developments demand that more serious attention be given to environmental costs among business organizations.

Traditionally, environmental costs such as the cost of waste and emissions are mostly recorded in the overhead accounts [36]. However, the recently developed environmental management accounting (EMA) explicitly identifies, generates, and analyses environmental- related financial information [6] focusing on both planning and control [63]. Several studies have explored the adoption and benefits of EMA, mostly from the perspective of developed or Western countries [69], [45], [35], [24], [44], [68]. Accordingly, the focus has mainly been on how EMA is employed [69], [24], [44], as well as its advantages in supporting environmental management activities [45], [35]. Nonetheless, the question as to what factors influence EMA adoption has never been explored. Although, it has been argued that the application of EMA tools can be matched to cater for a specific task or to solve a certain problem, depending on the type of information desired by the managers [10], little has been discussed concerning the contingencies that influence EMA adoption.

Contingencies are contingent factors that reflect the situation of the organization. These could be both environmental and organizational specific factors [9], [50], [8]. The contingency theory literature advocates that the appropriateness of a control system is dependent upon the setting of the organization [31]. Waterhouse and Tiessen (1978) [70]

and Otley (1980) [60] call for the application of contingency theory in studying management accounting system issues in organizations. Based on the premise that 'there is no universally appropriate accounting system which applies equally to all organizations in all circumstances' but 'particular features of an appropriate accounting system will depend upon the specific circumstances in which an organization finds itself', Otley (1980) [60] suggests that contingency theory is useful in identifying 'specific aspects of an accounting system which are associated with certain defined circumstances and demonstrate an appropriate matching' [60](Otley 1980: 413). Thus, contingency theory typically examines how contingencies relate to the design of effective management control systems (MCS) in organizations [28] and [15].

The objective of this study is to identify the extent to which contingent factors influence the EMA adoption level. Accordingly, the three categories of contingent factors examined are size, environmental sensitivity and top management commitment to environmental management (TMC). In this study, we follow the tradition, arguing that size is a factor associated with the design of management accounting systems [8], [37], [56], particularly in relation to newly developed management accounting practices [46], [3], [66] and [1]. Furthermore, in response to Chenhall's (2003) [15] suggestion concerning the need for contingency-based research to give some attention to emerging issues related to specific attributes of the environment, including environmental ecology, the current study focuses on the contingent variable environmental sensitivity. The third contingent factor observed in this study, i.e. TMC is a specific characteristic of organizational culture. Organizational culture is an important variable in the design of the control system [32], while the top management of the organization has been consistently viewed as an important party in ensuring proactive management accounting practices [13], [65].

The remainder of the paper is organized as follows. The next section provides a review of the relevant literature, which leads to the development of the proposed hypotheses. This is followed by a discussion about the methodology utilized. Next, the paper then continues with the presentation of the study's findings. The paper concludes with some discussion on the results, implications, limitations and areas for future research.

II. LITERATURE REVIEW AND DEVELOPMENT OF HYPOTHESES

Environmental management accounting is a sub-area of accounting that specializes in environmental issues. It is the part of management accounting that gives discrete recognition to the environmental impact relating to business activities [10]. The adoption of EMA gives attention towards the environmental aspects of company activities. This is because EMA links a company's environment-related activities with its past, present and future financial stocks and flows [10], hence, providing more precise data regarding environmental costs and revenues. For example, the generation of cost and revenue data on waste, energy and packaging enables the identification of the type and location of the environmental costs in the business manufacturing process. As a result, a company becomes more informative in successfully finding cost-effective ways to minimize some of its environmental impact [26]. In essence, EMA is management accounting that addresses the issues of environmental costs and improvements. As part of the management accounting systems (MAS) of the organization, EMA fosters better decision making by

providing information that distinctly highlights the effects of the organization's environmental activities [63].

Contingency theory initially arose from the organization theory literature. Early studies of contingency theory primarily focused on the relation between organizational structures and the surrounding environmental conditions [9], [72], [50]. To date, most of the studies relating to effective management control systems (MCS) have adopted a contingency-based framework [55], [27], [30]. The term 'effective' is a broad term that encompasses the ability of an organization to attain the goals set by itself, or by its ability to function well as a system, or by its ability to satisfy its stakeholders [28]. The type of effectiveness explored in prior studies includes efficiency, performance, profitability, employees' satisfaction and innovation rate.

Likewise, the main focus when using contingency theory is the 'fit' between various organizational characteristics and contingent variables [28]. A 'fit' leads to higher performance whereas a 'misfit' leads to lower performance [28]. The concept of 'fit' refers to three levels of approach, i.e. selection approach, interaction approach and systems approach. The selection approach is the simplest approach, which assumes 'fit' as the adaptation of the design of an organization with its context in order to survive or be effective. Bearing in mind that EMA is a considerably new research area, the present study relies upon the selection approach. The selection approach assumes that rational managers will likely use accounting systems that do assist in enhancing performance [29]. The present study proposes that contingent factors may influence the EMA adoption level. Although there is a wide set of potential contingency variables that may be considered, this study only focuses on size, environmental sensitivity and top management commitment to environmental management (TMC). Drawing from the contingency theory, the present study developed three hypotheses to be empirically tested. Size is a common contingent variable while environmental sensitivity and top management commitment to environmental management (TMC) are contingency variables that are relatively new.

The management accounting literature has connected large size with more formalized [8], [55], sophisticated [41], [1], [3], [11], and contemporary [46], [65], management accounting practices. Despite the fact that mixed results have been found concerning the relationship between size and management accounting practices, it is reasonable to expect that larger firms will be more likely to adopt EMA practices than smaller firms. Factors such as the availability of financial and human resources [46], [1], economies of scale [1], [11], as well as the exposure and complexity [50], [46], [74], [49], that surround large size firms, suggest that larger size firms are more in need of, as well as equipped, to adopt EMA practices. Moreover, a prior study on EMA has revealed the influence of size on the integration of environmental performance measurement into the companies' management accounting and financial information systems [21]. Based on this reasoning, the following hypothesis is proposed:

H1: There is a positive relationship between EMA adoption level and size.

Environmental sensitivity relates to the impact of company's activities on the environment. The operations of environmentally sensitive companies have a significant

impact on the ecological conditions of the physical environment. Naturally, the activities of these companies are usually bound by strict environmental legislation and regulation [5]. Furthermore, due to the visibility of their environmental impact, the activities of environmentally sensitive companies will normally receive more attention from stakeholders such as customers and society [5]. All the above mentioned reasons contribute to a higher level of environmental uncertainty faced by environmentally sensitive companies. Environmentally sensitive companies have long recognized the need to manage their high environmental uncertainty. One way that could be adopted by these companies is by considering a broader scope of information type [17], [38], [39], [20], [21], for instance, those that are environmental-related, in their management accounting systems.

Another way is by demonstrating their commitment to good environmental efforts via environmental reporting. Prior studies have positively associated environmentally sensitive companies with a higher quantity of environmental disclosure [26], [34], [12], [4], [19]. Ideally, information that is provided in the companies' environmental report will originate from the companies' internal accounting and management systems such as EMA [34]. In other words, environmental-related information generated by the companies' management accounting systems such as EMA, will provide support for the companies' environmental disclosure. Thus, there is a possibility that environmentally sensitive companies will have a higher level of EMA adoption in comparison with non-environmentally sensitive companies. Studies by Frost and Wilmshurst (2000) [34], Collison et al. (2003) [21] and NorSyahida (2008) [57] provide some evidence concerning the relation between EMA and environmental sensitivity. Based on the above discussion, the following hypothesis is proposed:

H2: There is a positive relationship between EMA adoption level and environmental sensitivity.

More companies have now begun to realize that good environmental management is no longer solely about complying with environmental regulations but may provide business opportunities and competitive advantage [42]. Consequently, the management of environmental issues has now become increasingly important [71], hence, deserving more attention from top management. Top management plays a critical role in supporting environmental management efforts [7], [71]. They are the authority that determines and shapes the culture of the organizations, thus, they have substantial influence at every operational level [59]. Accordingly, the top management is also regarded as an important party within the field of accounting. Prior literature has related the role of top management to the success of management accounting initiatives such as ABC [65], results oriented performance measures [13] and TQM [47]. This is because the commitment shown by top management will not only ensure the availability of resources but, more importantly, induce acceptance and obligation from the employees [65], [13], [47].

Based on the discussions above, it could be argued that the commitment of top management is vital in supporting any proactive effort relating to management accounting practices. Top management commitment to environmental management (TMC) reflects the environmental management efforts taken by top management to achieve the environmental objectives of their organizations [71]. Since EMA is the part of management accounting systems that distinctly takes into account the environmental

impact related to company activities [10], it is posited that TMC influences the adoption level of EMA PEMA). Thus, the hypothesis below is proposed:

H3: There is a positive relationship between EMA adoption level and top management commitment to environmental management (TMC).

III. RESEARCH METHOD

The unit of analysis in this study is the organization, specifically, the manufacturing companies in Malaysia. The selection of the manufacturing industry was motivated by the fact that it is a substantial source of economy for Malaysia in terms of export and labour employment [43], [52]. More importantly, it is an industry that generates obvious environmental impacts [14]. The first phase of the study started with a postal survey of accountants from manufacturing companies randomly selected from the FMM Directory 2006. Enclosed in the mail survey package was a covering letter explaining the purpose of the study as well as the confidentiality of the answers, a copy of the survey inclusive of a page describing EMA and a support letter from the Department of Environment Malaysia encouraging the accountants' participation. No follow-ups were made to those who did not respond since the study strictly preserved the anonymity of the respondents.

The overall usable response rate of the survey is 6.9 per cent, where only 74 respondents returned the completed and usable survey form. Although the response rate is relatively low, it is perceived as inevitable for research conducted in Malaysia on emerging accounting issues, such as EMA [33], [18]. The sector of operation, company type and annual sales turnover of the sample analysed are presented in Table 1. Companies comprising the sample come from various sectors and 30 (40.5 per cent) of them are environmentally sensitive companies. In terms of annual sales turnover, 24 companies (32.4 per cent) had an average of RM10 million to RM20 million. Only 8 companies had an annual sales turnover above RM100 million (10.8 per cent), while 12 (16.3 per cent) companies had an annual sales turnover below RM10 million.

TABLE 1: SECTOR OF OPERATION, COMPANY TYPE AND ANNUAL SALES TURNOVER

Description	Range	Frequency	Percentage
Sector of operation	Chemical and wood	14	18.9
	Plastic, rubber & metal	16	21.6
	Electrical & electronics	6	8.1
	Automotive & machinery	5	6.8
	Building materials	4	5.4
	Food & Tobacco	8	10.8
	Others	15	20.3
	No information	6	8.1
	Total	74	100
Company type	Non-environmentally sensitive company	38	51.4
	Environmentally sensitive company	30	40.5
	Missing	6	8.1
	Total	74	100
Annual sales turnover	< RM10 million	12	16.3
	RM10 – 20 million	24	32.4
	RM21 – 50 million	14	18.9
	RM51 – 100 million	16	21.6

Description	Range	Frequency	Percentage
	Above RM100 million	8	10.8
	Missing	nil	nil
	Total	74	100

Next, the second phase continued with semi-structured interviews with four accountants from the postal surveys that agreed to participate in the interviews. Two of the companies represented by the interviewees are from the chemical sector while the other two are from the electronics sector. Additionally, the companies represented by the interviewees ranged in EMA adoption from low to moderate level.

The dependent variable – EMA adoption

The degree of EMA adoption was measured based on the EMA framework, as proposed by [10]. Respondents were asked to record their agreement, ranging from "1" (none at all) to "5" (very much), as to whether their companies utilise the following EMA tools; environmental cost accounting; environmentally induced capital expenditure and revenue; post assessment of relevant environmental costing decisions; environmental life cycle costing; environmental target costing; post investment of individual environmental projects, monetary environmental operational budgeting; monetary environmental capital budgeting; environmental long term financial planning; relevant environmental costing; monetary environmental project investment appraisal; environmental life cycle budgeting; environmental life cycle target pricing. The principal component analysis reveals one construct, which explains 79.138 of the variance for EMA. Additionally, the Cronbach's alpha reliability estimates for variable EMA reveal high reliability with a Cronbach's Alpha value of 0.978.

The independent variables- Size, Environmental Sensitivity, Top Management Commitment to Environmental Sensitivity (TMC)

Similar to prior management accounting studies [41], [3], [11], the current study uses annual sales turnover to represent the variable company size. Although company size can be estimated using various indicators, it is vital to match the measurement of size with the research context [15]. Since the current study examines the adoption of EMA, annual sales turnover is deemed appropriate. Measures of sales and assets are often perceived as indicators of the scope of the company's operations and its power to influence the nature of the industry structure [48]. By using Ruzita (2006) [63] as a guideline, a scale from 1 (small) to 5 (very large) is used to designate the size of companies.

Past studies have determined environmentally sensitive industries through various methods such as survey [26], review of the literature [40], [34] and referring to the SIC[8] code [22], [61], [62], [19]. In the current study, using a dichotomous yes/no coding scheme, the respondents were separated into environmentally sensitive companies and non-environmentally sensitive companies based on the type of industry that they operated. By using [62], [19] as guidelines, companies in the chemical, wood, plastic, rubber and metal industries were identified as environmentally sensitive companies. Whereas, companies in the electrical, electronics, automotive, machinery, building materials, food, tobacco and others were identified as non-environmentally sensitive companies.

[8] SIC or Standard Industrial Classification is a classification of industries in USA by code.

The instrument used to measure TMC was established by [71]. Although the instrument is newly developed, it has been previously tested for the electronics and chemical manufacturing companies in Singapore, which, to a certain extent, offers a similar environment to that of the present study. Moreover, the established reliability and validity rates are also satisfactory (i.e. Cronbach's alpha 0.9506) [71]. Using a five-point Likert scale ranging from "1" (not at all) to "5" (very large extent), respondents were asked to indicate their view concerning the practice of their companies in terms of the top management involvement for various environmental-related matters such as environmental responsibility, environmental policy, environmental performance, environmental issues' communication, environmental planning, environmental funding, environmental programmes, and environmental objectives. The principal component analysis resulted in identification of only one construct of TMC explaining 72.707 per cent of the variance for variable TMC. The Cronbach's Alpha value is 0.970, demonstrating high reliability.

IV. RESULTS

A test for non-response bias was conducted using the 'time-trend extrapolation test'. The test compared the average responses of the ten latest and ten earliest respondents. The independent samples t-test revealed that there were no significant differences in the equal variance estimates between the early and late respondents ($p>0.05$) for variables EMA and TMC. As for the variable environmental sensitivity,[9] the chi-square test for independence produced insignificant results. Thus, no interpretation could be done for any differences or indifferences between the early and late respondents for the variable environmental sensitivity. Overall, no non-response bias was observed.

Descriptive statistics are given in Table 2. The mean score pertaining to EMA implies low EMA adoption. Consequently, the interview data suggest that most accountants are comfortable with their current management accounting practices and do not benchmark with their competitors when it comes to environmental-related issues in management accounting. Next, the mean score for TMC indicates that the respondents believe that their top management do commit to environmental management at a moderate level. The subsequent interviews reveal some examples of the related top management commitment, for instance, by complying with the headquarters' policy, involvement in environmental-related programmes, alertness concerning environmental regulations and support for consistent environmental monitoring.

TABLE 2: DESCRIPTIVE STATISTICS OF VARIABLES

Variables	Actual Range*		Mean	Median	S.D.
	Min	Max			
EMA	1.000	5.000	2.3297	2.308	1.014
TMC	1.140	5.000	3.182	3.179	0.947
Size	1.000	5.000	3.230	3.000	1.439

Table 3 shows the results of correlation analyses demonstrated by the Pearson correlation coefficients. Subsequently, table 4 displays the results of the regression

[9] Since the measure of environmental sensitivity uses the categorical (nominal) scale, the chi-square test instead of t-test is employed to test for independence between early and late respondents.

analyses. The regression model is significant ($p<0.01$, $F=15.119$) with an adjusted R^2 of 38.7 per cent.

TABLE 3: PEARSON CORRELATIONS

	1	2	3	4
1. EMA	1.000			
2. Size	0.061	1.000		
3. Environmental Sensitivity	0.121	0.008	1.000	
4. TMC	0.616	0.335	0.022	1.000

TABLE 4: RESULTS OF REGRESSIONS

Hyp.	Independent Variable	Coeff.	Std. Value	Std. Error	t	Prob.
H1	Size	β_1	-0.163	0.072	-1.611	0.112
H2	Environmental sensitivity	β_2	0.108	0.194	1.133	0.261
H3	TMC	β_3	0.668	0.109	6.584	0.000
Equation: $Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3$ (1) Adjusted $R^2 = 0.387$, $F = 15.119$, prob. < 0.01						

EMA and Size

The results of the regression equation reported in table 4 indicate that there is not enough evidence to support any association between EMA adoption and size. Thus, H1 is not supported. The issue of the relationship between EMA adoption and size was further probed during the post survey interviews. Three out of the four interviewees (A2, A3 and A4) mentioned that environmental-related costs are not cheap, thus, big companies do have the advantage in terms of spending power on environmental-related efforts. However, further queries indicate that three interviewees (A1, A3, A4) felt that company size is not a strong factor in influencing environmental-related efforts. Accordingly, A1 stated:

"Our environmental-related practices are strongly influenced by directives from HQ and what the market wants."

Although the norm is that the public expect big companies to perform better in terms of environmental performance, the interviewees felt that the link between size and environmental-related efforts is less direct. Consequently, two interviewees pointed out the issue of cost. For example, A4 mentioned:

"If the environmental costs are felt as significant, we will get directives from our corporate side to put it under a separate heading of its own."

The findings from the interviews did not support the posited positive relationship between company size and EMA adoption. It can be observed here that factors such as environmental-related costs as well as the company's policy are perceived as stronger motivators of EMA adoption than company size.

EMA and Environmental Sensitivity

The results of the regression equation reported in table 4 indicate that there is not enough evidence to support any association between EMA adoption and environmental sensitivity. Hence, H2 is not supported. However, the post survey interviews revealed that all four interviewees support the view that the type of industry they are in plays a major role in their management accounting practices including EMA adoption. Two of the interviewees (both are in the chemical sector and, hence, belong to environmentally sensitive industries)

highlighted the link between the industry they are in and the risk that comes with their operation and products, which subsequently leads to EMA adoption in their management accounting systems. Interestingly, another two interviewees (where both belong to a non-environmental sensitive industry) gave contradictory views on the influence of industry type (non-environmental sensitive or environmental sensitive type of company) and EMA adoption. One of the interviewees, A2 stated:

"We are in the electronics industry; we use a lot of copper and gases so our accounting system must be able to support our company policy on environmental issues."

In contrast, A4, who represents another electronics industry manufacturer stated:

"In our business, the environmental costs are small…insignificant… so I don't see any influence of the industry type on our management accounting practices."

Overall, the interviews' findings lead to the understanding that although the type of industry (non-environmental sensitive and environmental sensitive) can influence EMA adoption, what is more important is how each company weighted their environmental-related risks. At the end of the day, a company's decision to adopt EMA will eventually depend on its management's perceived cost and benefits of EMA adoption to the company.

EMA and TMC

The results of regression reported in table 4 indicate that EMA adoption is significantly associated with TMC ($p<0.01$). Thus, H3 is supported, where for each unit increase of TMC, EMA adoption increases by 0.668. Consistent with the findings of the survey, all four interviewees agreed that it is easier to adopt EMA when the top management is committed to environmental management effort. However, distinct differences can be seen in the descriptions of TMC (top management commitment to environmental management) in firms with very low EMA adoption compared to firms with moderate EMA adoption. For example, when A1 was asked what has been done by his company's top management that has directly influenced EMA adoption, his reply was rather brief, focusing on compliance with ISO certification requirements:

"We have our own quality policy and we also adopted ISO14001. Our accounting side takes into account what is needed (information and investment) by the quality policy and ISO14001."

Similarly, the response by A4 was also brief, focusing on compliance with governmental regulations. However, the descriptions of TMC by A2 and A3 are quite detailed, reflecting more familiarity and involvement on their part pertaining to the environmental-related issues of their company. Both A2 and A3 elaborated on the active role of their top management in ensuring that a certain standard of environmental performance is achieved within their organization. However, different circumstances are observed in terms of funding received and dominancy of decision making on environmental-related financial matters. A3 informed that:

"Funding for environmental-related matters is from our headquarters in Australia (headquarters in Australia but holding company situated in Japan). Twice a year I will go to Japan for a meeting on financial matters including those that are environmental related."

In contrast, A2 mentioned:

"There is no financial assistance (on environmental-related issues) given by our Japanese top management. At our site in Malaysia, we do our own planning on environmental-related investment or other environmental-related financial issues that we face."

In short, the findings of the interviews provide support for the positive relation between EMA adoption and TMC. The commitment of top management on environmental management largely influences the perceptions of the accountants towards the company's environmental-related issues. Consequently, the accountants tend to be more conscious about their accounting practices when they observe strong interest from their top management, particularly in relation to environmental issues.

V. CONCLUSION

This study looks at the adoption of EMA in manufacturing companies in Malaysia by drawing from the contingency theory approach. In general, the findings from the interviews provide support for the survey results of H3 (i.e. TMC as an antecedent of EMA). The findings from the interviews also suggest some explanation concerning the unexpected survey results obtained for H1 (i.e. size as an antecedent of EMA), as well as for H2 (i.e. environmental sensitivity as an antecedent of EMA). Furthermore, this study also highlights the following issues:

- Given the increased interest by companies and the community at large concerning environmental issues, surprisingly, there is still very limited involvement of accountants in Malaysia with environmental management issues. The considerably low resource costs in Malaysia, as well as the mind-set that focuses solely on cost implications, has somewhat deterred the embracing of environmental issues as valuable business information. Nevertheless, the fact that the field of accounting has now broadened to include social and environmental data should not be ignored [53]. Indeed, accountants in Malaysia should exercise some effort towards identifying the potential role of accounting for both cost and environmental management improvements.

- Insufficient evidence was found concerning the influence of size on EMA adoption level. Despite the fact that strong financial support and skilled human resources normally provides opportunities for proactive efforts including EMA, factors relating to environmental cost appear to be more influential.

- The results suggest that when a company operates in a non-environmentally sensitive industry, proactive efforts relating to environmental issues may be largely influenced by how important environmental-related issues are perceived by its top management.

- The present study also reveals evidence regarding the influence of top management commitment to environmental management (TMC) concerning the level of EMA adoption. The abovementioned findings call for a more aggressive

promotion of EMA by the policymakers in Malaysia, particularly aiming at the top management.

The contribution of this study is mainly from its exploration of contingent factors that influence EMA adoption. While numerous studies have concentrated on the employment of EMA tools, the present study sheds some light on the influence of organizational factors that may influence EMA adoption. Likewise, the findings of the study provide support for the contingency theory proposition that organizational culture may influence the design of MCS [15], by specifically recognizing the new contingent factor TMC as an important driver of EMA adoption.

This study has certain limitations. First, data collected from the survey and interviews are due to subjective responses and not publicly available, hence, there may be obvious socially desirable bias. Second, this study concentrates on one single industry, thus, generalization is limited since its findings might not reflect the general situation in all types of industries. Furthermore, caution must be taken when interpreting the results of this study as no differentiation is being made concerning the differences between EMA adoption and EMA usage. Although there might be possibilities of behavioural differences between adoption and usage [67] of EMA among companies, the approach undertaken by the present study is similar to prior studies that focus on new management accounting practices where no distinction was made between management accounting adoption and usage [16], [58], [73], [23]. Finally, this study only investigates three selected motivating factors for EMA adoption. There is always a possibility that other antecedents such as technology and strategy may have a strong influence on the level of EMA adoption. Future studies may also want to use a cross-industry sample and explore a higher level of the 'fit' concept [29] by looking at the interaction between EMA with many contingent factors and performance criteria.

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A CASE STUDY OF CONTROL SYSTEM IN A GREEN HOTEL

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Abstract: More hotels are starting to recognize and espouse sound Environmental Management Practices (EMP) in response to growing concerns for sustainable tourism products. An appropriate management control systems (MCS) play a predominant and significant role in ensuring that employees give their support and commitment towards achieving the hotel's environmental targets. As such, this paper discusses how the management control system (MCS), i.e., the action, personal and cultural control and also results control, are used in a green hotel in Malaysia to support the hotel Environmental Management Practices (EMPs). In addition, the factors that pushes hotel to implement EMPs and gained support and commitment from their employees are also discussed in this paper.

I. INTRODUCTION

The hotel industry is one of the service industries that is categorized under tourism and is considered as a people oriented industry. From an economic perspective, the tourism industry is a major contributor to the world economy, and is continually growing at 4 to 4.5% annually (UNEP 2003). It generated an estimated gross output of US$3.5 trillion and employed 207 million people in 2001 and is expected to further increase to US$7.0 trillion of gross output and employ 260 million people by 2011 (World Travel and Tourism Council, 2006). Even though Malaysia is a relatively new entrant into tourism activities as compared to its ASEAN neighbours, the industry has grown tremendously over the years.

The sustainability of the hotel industry depends to a large extent on the preservation of its natural environment. However, most hotels and resorts are located in areas of outstanding natural beauty such as, national parks, wildlife or biological reserves, coastal and marine areas, which make the locations more vulnerable to unmanageable domestic and hotel waste practices. In addition, the nature and characteristics of the hotel industry are such that if hotels excessively consume substantial quantities of energy, water, and non-durable products it will have a detrimental impact on the air, water, and soil (Mensah, 2004; Trung & Kumar, 2005).

For these reasons, the hotel industry is no longer able to ignore its environmental responsibilities and is required to act in a more environmentally friendly manner in its daily operations and policy setting. In addition, numerous pressures and concerns for hotels to be greener have been voiced by various parties, such as governments, NGOs', and the customers themselves (Bohdanowicz, 2006; Mensah, 2006). Thus, more hotels are starting to recognize and espouse sound Environmental Management Practices (EMP) in response to growing concerns for sustainable tourism products as a result of the impact of tourism on the environment (Kirk 1995; Kirk, 1998; Gil et al., 2001; Henderson, 2007; Zografakis, N et all., 2011).

However, changes in operational processes and systems are not good enough to reduce the environmental impact. Thus, besides implementing proper environmental management practices, changes in human behaviour are believed to be necessary since it is widely acknowledged that the resolution for the environmental dilemma not only depends on technological change but also on a change in the attitudes and behaviours of people (Steg & Vlek, 2009; Weigel & Weigel, 1978). Thus, in order to change attitudes towards

greater environmental awareness, an appropriate management control systems (MCS) play a predominant and significant role in ensuring that employees give their support and commitment towards achieving the hotel's environmental targets. Thus, MCS work as internal control techniques to ensure that the implementation of environmental management practices have the support of employees and have gained sufficient commitment from both operational and management personnel (Anthony et al., 1992)

However, research that examine how MCS techniques, especially how the three control mechanisms (result controls, action controls and personnel and cultural controls), are used in supporting the environmental management practices within the hotel sector is limited. As such, the purpose of this paper is to discuss how the management control system (MCS) of a green hotel in Malaysia is used to support the hotel Environmental Management Practices (EMPs). In addition, the factors that pushes hotel to implement EMPs and how the hotel gains support and commitment from their employees are also discussed in this paper.

The first section of this paper starts with a discussion of previous literatures regarding the conceptual background of management control systems and it narrowing to the subject of three types of control systems (i.e. results control, action control, personnel/cultural controls). Followed in same section is a past literature about environmental management systems and the application of management control systems in supporting (EMPs). Then, the research design is explain followed by the case findings and analysis. .

II. LITERATURE REVIEW

The wave of concern regarding 'global warming' from the public, governments and NGO's over the years has provided more space to the environmental management platforms to grow and replace the conventional and non-environmental practices. In conjunction with ecological concerns, Environmental Management (EM) emerged as a guideline to the industry in shifting its paradigm from normal non-environmental concepts of practices to environmentally friendly practices.

In a broader concept, Environmental Management (EM) refers to all technical and organizational activities run by the company with the aim of reducing the environmental impact caused by business operations (Cramer, 1998), whereas Environmental Management Systems (EMS) is a set of six main elements in environmental management: policy, planning, procedures and controls, training, communication and review and continual improvement of environmental potential and threats (e.g. ISO 14000 series or EMAS standards) (Savely et al., 2007; Bansal and Hunter, 2003). Finally, environmental management practices (EMP) incorporate environmental policy, develop procedures for establishing environmental objectives, select and implement environmental practices, set corporation-view internal standards, and undertake internal environmental audits (Klassen and McLaughlin, 1996; Anton et al., 2004).

From the hotel perspective, environmental management practices (EMP) refer to the combination of initiatives of the hotel to enhance its efficiency for the purpose of protecting the environment (Cespedes-Lorente et al., 2003). The same notion of environmental management is conceptualized by Mensah (2006), and Middleton and

Hawkins (1998), as a process of the adoption of environmental management systems, by which a hotel's activities are monitored and suitable programmes and activities are formulated to reduce the negative environmental impact. Therefore, from the definitions, two essential themes can be extracted in characterizing environmental management practices; *first*, the implementation of suitable programmes or activities and *second*, the aims of those activities is to reduce the negative ecological impacts.

Normally, waste management, energy saving and water conservation are the main concerns in environmental management for hotels because the nature of the industry consumes substantial quantities of energy, water, and non-durable products (Trung and Kumar, 2005). Hence, hotel initiatives such as implementing energy, water and waste management programmes assist in conserving and protecting the environment (Tari, J.J et all., 2010; Azorın, J.F.M. et all, 2009; Iwanoski and Rushmore, 1994). However, usually the hotels that adopt environmental management practices such as energy saving and water conservation practices mainly practice it to reduce the cost of production (Forte, 1994; Rondenelli and Vastag, 1996; Siti Nabiha et al., 2010) and leveraging the EMPs as competitive advantage (Hart & Ahuja 1995; Kirk, 1998; Bohdanowicz, 2005). Therefore, the implementation of EMPs was viewed as a corporate responsibility and as a tool for cost control.

One of the internal systems to support a hotel environmental friendly practices and management is the management control system. There are four types of management control alternatives that could be used. They are the result controls, action controls, personnel controls and cultural controls (Merchant and Van der Stede (2007). How control systems is used to support environmental management practices depend in how the MCS in the organisation is designed and executed

In general, management control systems research in the hotel industry is limited. Most of the researches focus on budgeting practices of lodging firms (Brown, 1994). The well known budgeting research in the hotel industry is conducted by Schmidgall & Borchgrevink (1996), which compares the operations budgeting practices of lodging firms in the United States with lodging firms in Scandinavia and found that the majority of hotel chains in both the US and Scandinavia use a bottom up approach to budgeting. Moreover, the budgets are used for control purposes by the vast majority of hotels in the US and Scandinavia. The same deployment of research strategy was used by Jones (1998) in the UK who found that a similar pattern of budget techniques used in UK hotels.

The similar pattern of MCS research in the hotels context primarily looks into budgeting control systems, for instance, the research that focussed on aspects of budgeting in small companies that discovered the benefits of budget, budget participation, and the effect of budget on training the personnel (Kosturakis and Eyster, 1979); cover elements of budgeting in motivating and the factors involved in budget participations among the workforce (Ferguson & Berger, 1986); and the research that focused on identifying budgeting and forecasting planning financial control (Schimidgall and Ninemeir, 1986, 1987; Schmidgall et al., 1996; Schmidgall and Defanco, 1998; Jones, 2008)

Besides the budgeting systems, management accounting researchers also examined the performance measurement systems in the hotel industry, which generally focuses on developing a measurement framework and structure and key performance indicators (Philip, 1999; Brignall & Ballantine, 1996; Neely, 1995; Winata, .L & Mia,.L, 2005; Ming-Hsiang Chen, M.H.,2011). For instance, Philip (1999) constructed a conceptual performance model by refining the works of Brignall and Ballantine, (1996) and Neely et al. (1995), and produced a multidimensional contingency model of hotel

performance that consists of seven dimensions: 1) Inputs; 2) Process; 3) Outputs; 4) Markets; 5) Outcomes; 6) Environmental Characteristics; and 7) Strategic Orientation.

In another extensive study, Maktanir & Harris (2005) used the case study method to in exploring and explaining the practices of performance measurement in a single independent hotel setting in Northern Cyprus. From that study they identified six main themes, which are grouped under business dynamics and overall performance, employee performance, customer satisfaction, financial performance, and innovative activities performance measures.

Even though balance scorecard is a popular technique used by business, there is limited research on the hotel sector (Nigel, 2005). In general, there are two well-known field studies that investigate the implementation of the balanced scorecard in the hotel industry. The fieldwork by White Lodging Service and Hilton found the BSC a generally useful tool in linking a coherent business culture and performance measures (Huckestein & Duboff, 1999; Denton & White, 2000). In these studies, the characteristic of individual hotels was used to determine the elements and measurement according to the four perspectives of the BSC (financial, customer, internal business process and learning and growth).

Thus, most of the MCS research, especially concerning the hotel industry, are quantitative based research and frequently focus on the technical aspects of MCS, such as budgeting technique, balanced scorecard and performance management systems.

III. RESEARCH DESIGN

A case study approach is used in this research. The Legend[10][11], a resort selected as the case is one of the well-known green hotels in Malaysia and has won many national and international green awards. The resort is situated on a nearly 3 hectares site and located along 400 meters of beachfront in in northern Malaysia. The resort has 103 staffs and it was formerly a foreign owned resort. In the early 2000's, the resort's is taken over by Malaysian businessman with the total acquisition value of around RM 18 million. Another RM 5 million was spent on upgrading the resort. The resort is not under professional management company. It is managed by the owner who came to the hotel monthly.

The resort now has 117 room bungalows and villa styled accommodation and is managed by 130 staffs including 11 management level personnel that run the whole entire hotel movement. With the upgrading, the resort now has gained a four star status. Most of the resort guests are from European countries such as Sweden, Russian, German and Switzerland. They also received guests from Middle East and a small number of local visitors. The average occupancy rate for low season (April and May) is around 60%. During the peak season (November to February) the resort has nearly 100% occupancy rate.

The visits to the hotel were made in April 2009 and also from July to August 2010. Twenty one people the various organizational levels were interviewed. The people interview is listed in Appendix 1. Semi-structured interviews were undertaken so that similar issues could be addressed with different organizational members. All interviews were conducted with employees in their offices and their places of work. Besides interviews, documentary reviews were also undertaken. Various internal and external documents were reviewed such as the hotels standard operating procedures, the internal

[10] The name of the hotel has been changed to ensure confidentiality

memos, and press releases. Observations of the hotels practices, especially the environmentally friendly practices were also done.

The management accounting control framework of Merchant (1998, pg. 69-131) and Merchant and Van der Stede (2007, pg. 23-134) were used as the main reference in understanding the functions of these three controls mechanisms (results control, action controls, personnel and cultural control) in motivating and governing employees actions. These three control system instruments offer the approaches and system that can be used to support environmental management practices (EMPs).

In addition, an analysis of the resort's control systems (result, action, and personnel and cultural control) tightness or looseness was also undertaken, this is because as described by Merchant and Van der Stede (2007), the benefit from control systems can be expressed by their tightness (or looseness), Tight MSC increases the chances that employees will take actions desirable by the organization.

In this research, whether a results control is tight or loose depends on the characteristic of the definition of environmental core values, green performance measures, and the reinforcement or incentive provided. According to Merchant and Van der Stede (2007, pg. 118-119), for management control to be considered tight in a result control systems, the result elements must be harmonious with the true organizational objectives; the performance target must be specific; the desired result must be effectively communicated and internalized by those whose behaviours are being controlled. For result control systems to considered as a tight control, the green performance measures should be precise, objective, timely and understandable. Meanwhile, the rewards and punishments should be directly or indirectly linked to the employees achievement in obtaining the desired targets (Merchant Van der Stede, 2007). Action control systems can be considered tight if the employees achieve organization's desired actions or targets and do not perform the undesirable actions. There prominent types of action systems such as, behavioural constraint, preaction reviews and action accountability (Merchant and Van der Stede, 2007).

IV. FINDINGS AND ANALYSIS

A. Environmental Management Practices

The hotel has received several local and international recognitions and awards due to its environmental friendly practices and has marketed itself as a green hotel. The resort owner is the key player and driver behind the hotel green practices. He is very active in attending and presenting papers at conferences and seminars pertaining to environmental practices. Due to his effort in promoting eco-tourism locally and internationally, he had been appointed to hold posts in tourism associations. He also sits in various committees including the Sustainable Tourism Committee of those associations. He used the knowledge gained from attending conferences and from his visits to other green hotels in the implementation of green practices at his resort. As such, most of the practices are based on green practices of other hotels. In addition, his employees also searched for information from the internet, such as the rain water harvesting techniques, food composting, and recycle program. Thus, most of the resort green practices are not implemented systematically with inputs from experts. Some of the practices are done on a trial and error basis.

However, the resorts has managed operationalise the concept of green hotel in their day to day practices They reduce purchased which is partly done through reused and recycle of old or discarded materials such as old carpet are reused as soundproof between rooms, coconut husks as ashtrays and coconut shells as flower pots. In addition, natural products are used to reduce chemical usage, for instance using coconut trunk as termite trap, neem leaves as pesticides and rearing guppy fish at ponds to control mosquitoes

The resort has taken several actions to reduce solid and liquid waste. Kitchen and garden wastes plus leftover foods are used for composting organic fertilizer. For composting tool, old bathtubs are used as composting container and old wooden flooring is recycled as container lid. Meanwhile, food waste was collected from staff cafeteria and was reused to feed the free-ranging ducks and chicken at the farm within the hotel site. The hotel also has wetland for discharged treated grey water.. Rainwater harvesting is used in the resort by using 20 units of 880 gallons water tanks. The rain water from these tanks are channeled to taps located around the resort area The harvested water is use for irrigation, toilet and laundry purposes. Besides that, resort also utilizing underground water from three wells located at their organic farm and to water fruit trees and vegetables at the farm. The resort also has a policy on energy conservation and has trained their staffs on methods to save energy. For example, security staffs assist in switching off compound lighting at dawn and housekeeping staffs assist in switching off unnecessary switch and electrical appliance after room cleaning and unnecessary electrical appliance in office and resort compound. Besides that, solar panels are installed to replace boilers for supplying hot water to rooms and kitchen.

The resort has an appointed manager in charge in environmental management practices. The manager duties are to facilitate and monitor the progress of green practices. In order to gained staff support and commitment, a *green team* was formed in the resort where every department has one representative in the team. The team responsibilities are to contribute and seek for ideas to improve the current practices and also to conduct an eco-friendly training classes. Thus, the staffs are trained to be eco-friendly. In addition, Green Champion Award (GCA) competition had been setup to encourage and give recognition to department with the most effort in green practice. The green champion competition consists of three areas: departmental organic garden contest, creation of handicraft made from recycled items, and presentation contest and the winner will receive a token in a form of money, recognition and award. The advantage of implementing these green practices is that the hotel is able to reduce their average energy, water, and food consumption. More importantly, the green hotel concept obviously is used as marketing tool in promoting and branding of the hotel.

B. Management Control System

(i) Action control

To control by policies and procedures are bureaucratic way of organizing the processes and behavior of the organization and its members. This form of controls includes having standard operating procedures and practices (S.O.Ps) as well as rules and policies. At the hotel, all departments have their own operating procedures and practices. However, SOP is more essential for the departments that are related to providing key services and operations such as the Food and Beverage, Pool and Landscape, Maintenance and Environment, Housekeeping Department to follow the S.O.Ps. These departments have green practices as well as the main departments carrying out major tasks in the resort. For example, the

housekeeping department ensures they are constantly practices energy saving by designed their S.O.Ps to instruct the maids to switch off all the electric appliances in the rooms. The same method is used in other departments (Landscape and pool, Maintenance, and Sustainable) in ensuring their staffs follow the resort green guidelines. Moreover, most of S.O.Ps focused on three main activities which are energy saving, water conservation, and waste management as explained by the GM

> *"My strategic planning is to ensure product which our rooms' are in line with green values or beliefs…To reduce energy and water consumption and to make sure F&B department reduce and reuse their kitchen and food wastes. The focus more on using more natural items."*

The head of Environment Department also explained the focus of his responsibility as follows:

> *"I have to overseen all the performances of the resort, the green performance and operation performance in term of energy, water, resources and management and try to find out what the possible areas of reduction."*

However, the resort does not have formal policies and procedures on green practices put in place. Only four departments, i.e., the maintenance department; housekeeping department; environment department; Landscape, pool and sustainable department incorporated or mentioned green elements and practices in their S.O.Ps. The other departments, the F&B, front office, account, sales and marketing, Spa, and security, have S.O.Ps that do not incorporate green elements and practices. Moreover, in those four departments, there are only few instructions pertaining to the green concept and practice. Since the turnover of managers is high, the hotel did not compile their S.O.P. The human resource department, in charge of compiling the SOPs, did not received support from other departments as commented by the administrative secretary:

> *"...many departments do not submit their S.O.Ps...because most of them take for granted in doing it...they dont respond when we asked about it. ...There are a few departments that do not complied and respond with our demands...lots of excuses were given...some of the H.O.Ds have good relation with top management, so when we raised this issue they will used the connection so they can be discharged from the blame. We should have proper S.O.Ps...when new comers start working in the resort, they know what they should do and what they cannot do...the guideline is very important"*

Action control means employees are told what to do and how they should do it (e.g. by rules and procedures) and it difficult to exercised this type of control when rules and procedures are not fully optimize or clearly formulated (Merchant and Van der Stede, 2007), as in the case of the resort where the employees received only verbal instructions from their managers.

Action control can be considered as tight only when the employees consistently perform the desired actions and not engaged in undesired action. These can be achieve through three types of action control which are; behavioural constraint (physical or administrative); preaction reviews; and action accountability (Merchant and Van der Stede, 2007). At Legend resort, due to the bureaucratic style of management, more administrative constraint and preaction reviews are done. Decisions especially pertaining to green practices, such as how to dispose dysfunctional machines or what type of green product to be purchase, must be communicated to higher levels management and it must be supported with a proper proposal and financial consideration before it can be approved.

The tightness of the action accountability controls depends on characteristic of the definitions of desirable (and undesirable) actions, the effectiveness of the action-tracking system and reinforcements (rewards and punishments) (Merchant and Van der Stede, 2007). The employees actions were closely supervised by their supervisor and manager. Legend resort has ten departments and each has their own manager and fellow supervisors. A reinforcement mechanism used in this resort is group rewards such as departmental recognition and token cash reward to groups that proposed innovative environmental friendly initiatives for the resort. Thus, the Legend resort uses loose action control in their administration systems especially pertaining to their policies and procedures.

(ii) Personal and Cultural Control

The use personnel control means careful selection of employee. In the case Legend resort, the owner claimed that new employees, especially for the management level, are carefully selected to fit the image of the resort:

> *"…and I employed a graduate from university that understand what I am doing…and tell them "you all work within the department and pushing the agenda"…because the younger people understand…today I am having all these graduate student specialist in sciences (to do research on environmental studies and calculate the green performance)."*

Thus, most of management level staffs were interviewed by the owner himself as he requires them know how important the green values for the resort and shared his vision as he elaborate

> *"maintenance and housekeeping have green practices as compare to other departments)…but everyone is involved…when you said I.T department…Again, every single thing such as energy saving, paper saving, now, instead of buying new printer cartridge we used recycle cartridge…we refill it…in minimum amount they still can do it…that why is not only one department, it should be everyone."*

The same view was also expressed by the head of environment department:

> *"Yes, the owner came to my university and looking for the people and the faculty pushed me up…he just tell me his vision and asked me one thing…"do you share the same vision?"…and I replied "Yes, I do".*

However, education level and other criteria were not the most important thing in hiring new employees. This is proved by many employees do not have higher educational background. For example, the front office manager, residence artist, F&B cost controller, purchasing officer, housekeeping executive, Landscape, pool, and sustainable executive have diploma qualification or high school/secondary level qualification. The experience, personality, what type of person you are and which values you have are more important for the resort:

> *"…he asked me about my interest on environmental education."* (Educational officer)

> *"I already 18 years in this industry…started as a receptionist…10 years experience as a manager…diploma in hotel management…and being exposed in different management styles…during the interview with (G.M) nothing really much question about green practice…because we basically know each other…before we actually accepted you as a staff (new staff for front office department)…I will asked "what are you think about green concept?"…"do you know you coming into a green resort?"…and I explained it, what are the 4R's concepts to them and ask them again," What you think?"…they need to know what are resort's core values,*

what will be the hotel goal…then it be easier for them to work rather than they don't know what they are getting into…because you need to hire a right people for a right job". (Front desk manager)

Motivation is another important aspect to make personnel control workable; managers have to keep their employees constantly motivated. Legend resort engaged with training, further work related education, and different types of rewards to improve employee motivational level. To show a commitment to the organization stated core values of holistic human resource development and strong teamwork, one in charged of environmental education program for employees at the resort was employed in the sustainable department. Among in-house trainings given are eco-walk program and environmental information classes. Both trainings were aimed to give exposure and explained to staff resort's environmentally friendly practices and other green information:

"*…We take them around the resort and tell them what we are doing, why we are doing…because if they know "ok, we collecting air-cond water", that it. They don't know why we collecting air-cond water…why we using recycled items…thus, we bring them around and tell them why we are doing all those green practices…so, they can understand and when somebody ask, they can explain it better…after the eco-walk done, I had questionnaire for them to answer. To know either they understand what I was told them before."* (Educational officer)

Legend resort also sends their staff to other hotel to learn about best practices. In addition, several staffs were sending to attend local and international exhibitions:

"…for example, I went to Singapore to learn how to treat waste…the exhibition was focused more to industrial waste treatment, but I gained lots of input and exposure from that exhibition…moreover, we also send our maids to other hotel…hotels that with higher star rating than us…they will learn how to perform better room services…for kitchen department, we send our chefs to famous seafood restaurants and learned from their chefs…for my department (landscape), we send our gardeners to agricultural center to learn how to propagate, grafted, and the correct way to use fertilizer." (Landscape, pool, and sustainable executive)

The owner of Legend resort, a man with the values and spirit of green concept, has a huge influence on the resort. His values are also expressed in the strategic focus of Legend resort, which is *"to establish our positioning as a high end 4 'star' boutique Resort in our island*[12] *and Asia Pacific Region with a niche identity as an eco green Resort".* Moreover, he also emphasized his ambitions and beliefs in resort's eight core values e.g. 1) the priority of customers satisfaction; 2) the important of innovation in enchaining productivity; 3) sustainable environment; 4) invest in holistic human resource development; 5) build up strong teamwork foundation ; 6) adopt, preach and practice same organization behavior and culture throughout the organization; 7) develop and embed powerful mindset and habit which is to be : Self Driven, Pro Active, Innovative, and Collaborative; 8) inculcating and enriching honesty and transparent values. These core elements were embedded within resort's rules, procedures, manuals and policies. In the other words, the tone of the top or commitment and support from the resort's owner and top level management shaped the resort culture and its working environment as explained by the front desk manager:

"…because the believes of the owner…it trickle down to all departments and reached down to all staffs…it trickle down from top to bottom…the believe of the owner has been

[12] The name of the island was undisclosed due to confidentially agreement

preached down from H.O.Ds to the staffs…they don't follow the order but their followed the beliefs… he beliefs in keeping the environment…to sustain the environment."

The owner also elaborates his views:

"…you see, in business is how we positioning ourselves…I just position what I am doing for all my life…when you look up on sustainability you should look for long term…that wet land (the place functioning as a biological system in treating grey water and as pond for fishes and ducks) when can I get back the return from it? We are renting that piece of land and the owner of the land want to sell it for four millions…when can I get back the return from it?...four millions by using my water treatment system, ducks and chickens? I never get it back…but because my commitment to keeps the environment green, I do it…it was a belief of given it back."

As mentioned earlier, the personnel/cultural control systems are rarely tight, except in organizations whose corporate cultures are strong (Merchant and Van der Stede, 2007). Legend resort culture includes strong tone of the top (top management level) support and strong team spirit. These values are significant and supported by their strategic focus and core values. In addition, all employees is aware of the owner's vision to be green. Most of the employees strongly support and are commitment to ensure that the resort can achieved the target to a *high end 4 star boutiques resort with a niche as an eco green resort*. Besides that, resort's teamwork spirit is very strong and each staffs regardless their position will help any department when those departments faced shortage of manpower:

> *"...in fact, we help each other...we are under one roof...so, let say peak season, housekeeping department don't have enough staff...we send our people to help them up in the morning session...every departments in this resort understand...inter-helping concept...we go for "gotong-royong"[13]...they are very cooperative."* (Maintenance manager)

However, the resort is facing a serious problem since they have high staff turnover especially at managerial level. Up until last interview were conducted, they still do not have financial controller (account department), senior account manager (account department), sales and marketing director (sales and marketing department), sales manager (sales and marketing department). Furthermore, the human resource, sustainable and housekeeping departments have manager only those at the executive levels. Many managers were new and have worked least than a year at Green Resort. For example, the G.M has been in the resort for ten months, and both the front desk manager and IT executive have worked in the resort for only two months.

(iii) Result Control

The most predominant results control mechanism in Legend resort was cost controls. Cost control becomes the heart of control mechanism in controlling employees' activities and measuring resort performance as illustrates from the following comments

> *"For example, if I want them to practice use sodium bicarbonate and vinegar (to clean bathroom)…So, I just need to check the amount of chemical purchased…you cannot only instruct them to behave…You must look what the amount of usage. If they used less, that indicate their change the behavior and attitudes to use more organic."* (Resort's owner)

[13] Local dialect for helping each other

*"We exercised meeting reading (for electricity) everyday...The TNB main meter reading…So, all the implementation is for the cost saving." (*Maintenance Manager)

"We calculate whatever can be calculated…Why? We want to show to people we do have saving…lot of commercial peoples want to know and lots of academia also want to know…Anything not measurable are not accepted." (Resort's Owner)

Beside energy consumption, the resort also monitored their water, waste and food production monthly. For example, every fruits, fishes, ducks and chickens harvested or obtained from the organic farm were weighed by the gardeners and the figures will be send to account department and the cost controller will valued it based on market price and it will be updated monthly. Control of was based on total of recycle items that were collected and the amount of organic fertilizer produced from organic and garden wastes. From the monthly and yearly cost saving data (energy, water, waste, and food production), resort is able to measure their green performances and manage employees' behaviors and attitudes.

Another results control used by the resort to achieve their green objective is by motivating the employees with rewards for performing well and punishing them when they violated the rules. Moreover, salary increment, bonuses, best performance reward, and recognition were given to the staffs when the staff well-performed and or when the resort achieves their sales target:

"We give incentive to good workers…We have 'best employee' reward for every month…It is open to every departments…So, I give chance to all my staffs even though he or she did not perform well because when he/she received the recognition, I figuratively tell them that you are good worker and the words open their heart and make them realized that the management appreciate them and as a result they will not repeat the previous misbehaviors…The winner will received RM100…We also have salary increment and bonuses…The better you performance the faster increase in salary." (Landscape, pool, and sustainable executive)

"The previous the hotel management has give salary increment but they not follow the scale rate and it was irregular…But, Legend resort follow the scale rate…I received huge increment". (Senior gardener)

If employees violated any rules or do not following the instructions, they will receive a warning letter. Certain department implements will fine employees who violate the resort's rules and regulations:

"When there is a case of violation of duties, the punishment starts from the department itself…Then, the Head of Department (H.O.D) will report to H/R department … It is up to department heads to take disciplinary action or not…Either it was a verbal warning or not…The punishment report must be submitted to H/R as a record and we compile it… After three consecutive warning letters were given, then H/R will take the action." (Admin secretary, assisting G.M and H/R)

"I imposed a fine of RM50 to one of my staff for failing to close the tap…This punishment only subject to our department alone…And, to those who did not trash the recycle items at the place provided will be fined 10 cent for each items dumped." (Landscape, pool, and sustainable executive)

As mentioned earlier, according to Merchant and Van der Stede (2007) a tight results control system must consist result dimensions/elements that are congruent with the

organizations exact objectives, specific performance targets, short time feedback, and effective communication. The measures that the resort uses seem to be congruent with resort's objective and focus since they measure environmental costs such as energy and water consumption, wastes (including kitchen and garden waste and recycle items collected) and foods production consistently every months:

> *"We calculate whatever that can be calculated…Why? We want to show to people we do have saving…lot of commercial peoples want to know and lots of academia also want to know…Anything are not measurable are not accepted."* (Resort's Owner)
>
> *"...the ultimate idea is to improve green performances and green practices of the resort in such way it can be shown into monetary benefits...most likely, direct benefits...or cost benefits...cost saving measures."* (Head of environment department).

The resort also uses non-financial performance such as the customer satisfaction feedback report which enables them to measure guest's acceptance towards their green practices and initiatives. Since customer satisfactions were taken into consideration, the resort was able to decrease customer complaints. The resort has a feedback control since the environmental performances are communicated on a monthly basis and such as customer complaints and urgent agenda were communicated on daily basis when every morning all heads of department will have a brief meeting with G.M to resolve or update resorts daily operational activities.

Merchant and Van der Stede (2007) argued result control is likely to be tighter if rewards (or punishment) are directly linked to the accomplishment (or non-accomplishment) of the desired result. The resort partially meets the characteristic mentioned by Merchant and Van des Stede (2007). The salary increment systems used is partially link to their performance on the desired target (e.g. sales target; awards and recognition target). Thus, in summary, the results control system of the resort can be consider as moderately tight.

V. CONCLUSION

The purpose of this paper was to analyze the use of control systems in supporting the hotel environmental management practices. The results of the study showed that the hotel EMPs was supported by MCS through three types of control mechanisms (result controls, action controls, and personnel and cultural control). In result controls mechanism, the findings revealed that the hotel's used reward and punishment systems to increase extrinsic or intrinsic 'green' motivational values by increase the salary, give bonuses, promotions, job security, job training, freedom, and recognition to the employees. Meanwhile, the hotel's tight rules and procedures in energy, water and waste practices served as action controls mechanism in ensuring the employees continue to perform green practices and prevent them to deviate from hotel's green objectives and targets. Moreover, the hotel's three personnel controls systems (selection and placement of employees, training, and job design and provision of necessary resources) help to build up employees' natural tendencies to continuously control and/or motivate themselves in-line with the hotel's 'green' concepts and practices. Three important methods have been used by the hotel in shaping 'green' cultures which are: 1) codes of conduct, 2) group-based rewards, and 3) tone at the top.

Furthermore, the evidence reveals the various factors influence the hotel to implement EMPs. First, the hotel's owner beliefs and commitment in green concept pushed hotel to

change and implement green practices. Second, economical and financial factors also drive the hotel to implement green concept and practices. Most of the green practices were initiated mainly for cost saving purposes and as a marketing tool. The resort does not have proper policies and procedures for environmentally friendly operations for all departments. The shortage of staff especially in vital departments such as account department, sales and marketing and housekeeping department does not lead to effective control mechanisms. In addition, the results showed that the owner's commitment (tone at the top concept) help to gain employees support and commitment in practicing green practices.

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REMANUFACTURING OF USED PRODUCTS IN A CLOSED-LOOP SUPPLY CHAIN

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Abstract: ***In the paper an extended joint economic lot size problem is studied in which the return flow of repairable (remanufacturable) used products is incorporated. A supply chain of one supplier and one buyer is considered. The supplier ships the products ordered by the buyer to him. The latter uses the products according to his demand and he collects the remanufacturable items after use. The products are shipped from the supplier to the buyer according to the production lot sizes by a transport vehicle which brings back the collected used products from the buyer to the supplier for remanufacturing and for serving partly the buyer in the next order cycle. For satisfying the total demand the supplier manufactures new products or remanufactures used products shipped from the buyer. For given demand, productivity, collection rate, disposal cost, setup cost, order cost, holding cost for serviceable and nonserviceable products at the supplier as well as the buyer the lot size (order size) for the supplier (buyer) has to be found which minimizes the total cost.***

The ecological problem of the model is how to construct an incentive scheme which motivates the participants of the supply chain to save natural resources with reuse of items from the consumption process. The reuse of used items can contribute to the sustainable production with lower energy consumption and save resources.

Keywords: Joint economic lot size, Reverse logistics, Collection, Remanufacturing, EOQ, Closed-loop supply chain

1. INTRODUCTION

The economic lot size problem was investigated by Banerjee (1986) and Goyal (1977). In this paper which combines the basic model with the case of reverse logistics studied in the model of Richter (1994, 1997).

Let us assume that there is a supplier and a buyer. We analyze the coordination of the order lot size of the participants of this supply chain. The basic model of Banerjee (1986) has not examined the collection and remanufacturing of the used products so far.

In this paper we assume that the buyer collects the remanufacturable used products. These used products at the end of the production cycles are taken back to the supplier. The supplier (vendor) remanufactures these used products, and stored them as new products, i.e. as serviceable products. Since the quantity of remanufactured products will not satisfy the total demand of the buyer, so the supplier produces new products as well.

The question is which lot size has to be determined to minimize the system wide costs. It is known from the model of Banerjee (1986) that the optimal strategy of the supplier/buyer is not optimal for the buyer/supplier. In the supply chain literature it is an important problem to find the best contract that minimize the relevant costs of the members of this supply chain.

In this paper we investigate whether the reuse process helps to coordinate the functioning of a supplier and buyer supply chain. The paper is organized as follows. In the second section we present the model and construct the cost functions of the paper. Section 3 optimizes the partial models of buyer and vendor in dependence on the lot sizes. We determine in this part of the paper the optimal decisions of the participants of the reverse supply chain. The next part of the paper provides the optimal collection and reuse rate of the models. Section 5 contains the "reverse" joint economic lot size of the analyzed model with the joint lot size and with the optimal collection rate. In the next section we illustrate the results of the paper with numerical examples. Section 7 summarizes the results of the paper and supplies some possibilities for extension of the examined model.

2. THE MODEL

Parameters of the model:

- D demand of the buyer per time unit,
- P_M manufacturing productivity of the supplier, $P_M > D$,
- P_R remanufacturing productivity of the supplier, $P_R > D$,
- s_b setup cost of an ordering of the buyer,
- h_b holding costs of the new products of the buyer,
- u_b holding costs of the used products of the buyer, $h_b > u_b$,
- d_b disposal costs of the used and disposed products of the buyer,
- s_v setup cost of an ordering of the supplier,
- h_v holding costs of the new products of the supplier,
- u_v holding costs of the used products of the supplier, $h_v > u_v$,
- t^c length of a cycle.

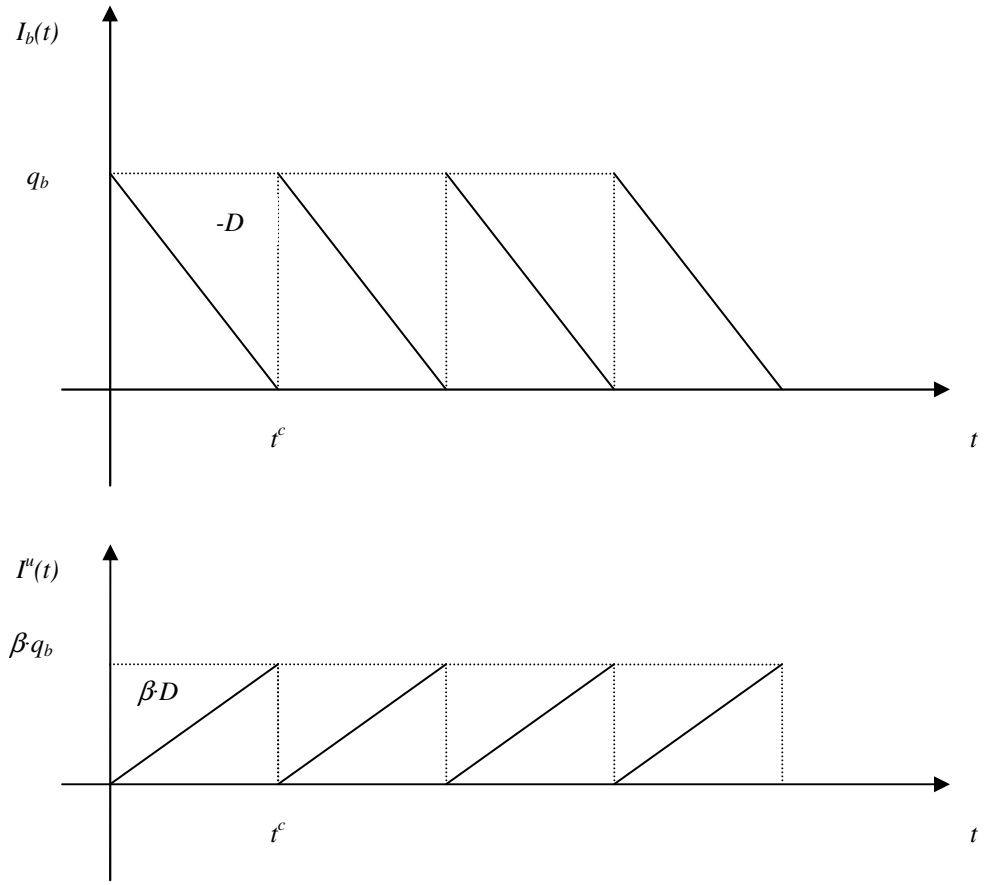
Decision variable of the model

- q_b joint lot size (order level) of the buyer,
- q_v lot size (order level) of the supplier,
- β collection rate of used products, between zero and one,
- q joint lot size (order level) of the system.

In the model we use the traditional assumption of the economic order quantity model (Banerjee (1986), Goyal (1977))**.** The costs of the supplier and buyer consist of setup cost and holding cost of used and new products. This classical cost function is extended to the buyer who is collecting used products and who is bearing the disposal costs. The buyer must decide whether to dispose off the used products on the market price, or to have collected and transported them back to the vendor who has the appropriate technologies to remanufacture the used, but remanufacturable items. The demand which cannot be satisfied by remanufacturing is covered by item manufactured by the JIT principle, i.e.

there is no inventory holding of raw materials for the newly manufactured products. This simplifying assumption guarantees that we can disregard the inventory holding cost with respect to the manufacturing of the new products. We assume additionally, that the order in which remanufacturing and manufacturing is executed has no impact on the cost. This assumption means that there are only one setup costs for the supplier in a manufacturing/remanufacturing process. The inventory levels of the buyer of the supply chain are shown in figure1.

FIGURE 1 INVENTORY LEVELS OF THE BUYER



The structure of the vendor inventory levels is more complicated. A manufacturing-remanufacturing cycle of the supplier consists of three intervals. Due to the higher productivity P_M, $P_R > D$ with respect to the demand the manufacturing and remanufacturing processes do not have to start later at the beginning of the cycle. When one of these processes has to start the question is which of them should be the first. It will be seen that the sequence of the activities depends on the cost and productivity parameters. We will prove an appropriate proposition later.

In figure 2 and 3 we present only one cycle to show the functioning of the mechanisms. Figure 2 presents the case if the remanufacturing is the first activity and after that manufacturing follows. Let us compare the strategies in decision process about the sequence of the manufacturing and remanufacturing. The costs of the first depicted

strategy is equal to the areas of figure 2 weighted with the cost parameters. In this case the manufacturing happens first and then the remanufacturing. Cost A_{MR} is

$$A_{MR} = h_v \cdot \left[\frac{(1-\beta)\cdot q_v}{2} \cdot t_2 + \frac{(2-\beta)\cdot q_v}{2} \cdot t_3 \right] + u_v \cdot \left[\beta \cdot q_v \cdot (t_1 + t_2) + \frac{\beta \cdot q_v \cdot t_3}{2} \right] =$$

$$= \frac{q_v^2}{2} \cdot \left\{ h_v \cdot \left[(\beta - 2) \cdot \beta \cdot \left(\frac{D}{P_M} - \frac{D}{P_R} \right) + \frac{D}{P_M} \right] + u_v \cdot \left(2 \cdot \beta - \beta^2 \cdot \frac{D}{P_R} \right) \right\} .$$

FIGURE 2 INVENTORY LEVELS OF THE SUPPLIER, FIRST MANUFACTURING

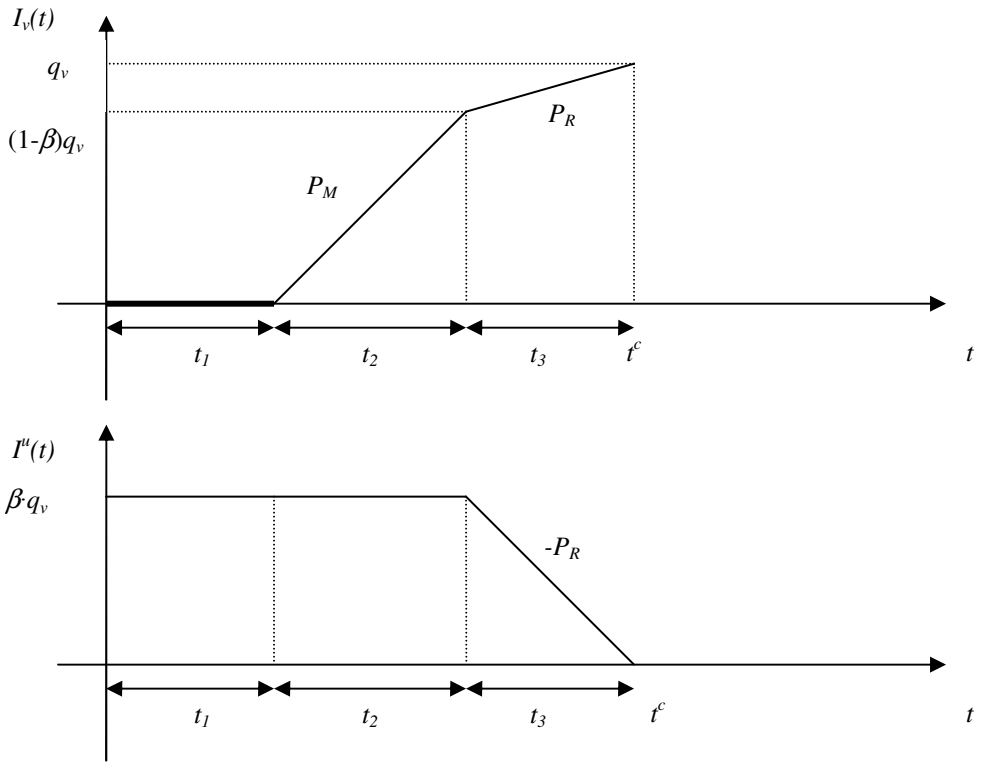
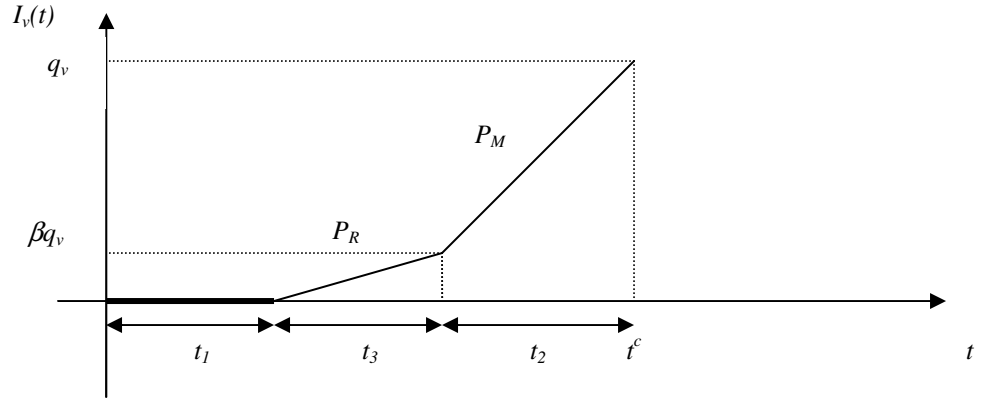
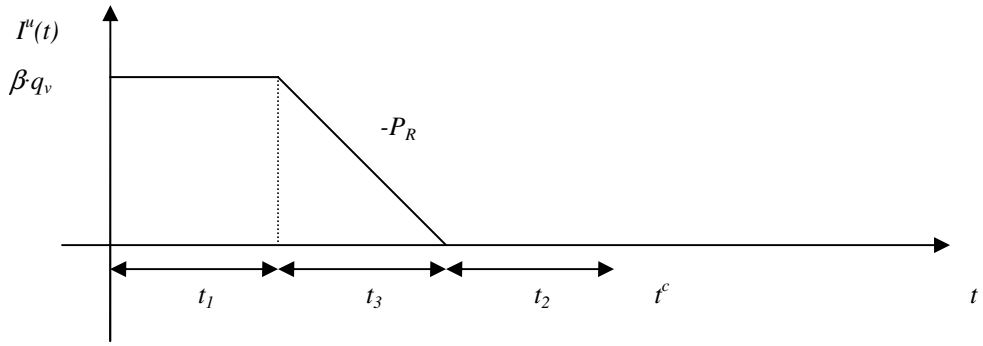


FIGURE 3 INVENTORY LEVELS OF THE SUPPLIER, FIRST REMANUFACTURING





This last expression is the holding cost of the supplier in case of the strategy when manufacturing is the first activity followed by remanufacturing. We can introduce a new holding cost rate of the vendor in dependence on the collection rate β:

$$h_{MR}(\beta) = \beta^2 \cdot \left[h_v \cdot \left(\frac{D}{P_M} - \frac{D}{P_R} \right) - u_v \cdot \frac{D}{P_R} \right] - 2 \cdot \beta \cdot \left[h_v \cdot \left(\frac{D}{P_M} - \frac{D}{P_R} \right) - u_v \right] + h_v \cdot \frac{D}{P_M}$$

After this expression we calculate the second strategy with remanufacturing first.

Cost A_{RM} has the next form

$$A_{RM} = h_v \cdot \left[\frac{\beta \cdot q_v}{2} \cdot t_3 + \frac{\beta \cdot q_v + q_v}{2} \cdot t_2 \right] + u_v \cdot \left[\beta \cdot q_v \cdot t_1 + \frac{\beta \cdot q_v \cdot t_3}{2} \right]$$

$$= \frac{q_v^2}{2} \cdot \left\{ h_v \cdot \left[\beta^2 \cdot \left(\frac{D}{P_R} - \frac{D}{P_M} \right) + \frac{D}{P_M} \right] + u_v \cdot \left[\beta^2 \cdot \left(2 \cdot \frac{D}{P_M} - \frac{D}{P_R} \right) + \beta \cdot \left(2 - 2 \cdot \frac{D}{P_M} \right) \right] \right\}.$$

For this case let us introduce the following holding cost coefficient:

$$h_{RM}(\beta) = \beta^2 \cdot \left[(h_v - u_v) \cdot \left(\frac{D}{P_R} - \frac{D}{P_M} \right) + u_v \cdot \frac{D}{P_M} \right] + 2 \cdot \beta \cdot u_v \cdot \left(1 - \frac{D}{P_M} \right) + h_v \cdot \frac{D}{P_M}$$

Let us now extract the costs A_{RM} and A_{MR}. If this difference is positive, then manufacturing has to start before manufacturing. If it is negative, then the other sequence is best. In the case of equality both sequences can be applied. It is known that

$$A_{RM} - A_{MR} = \left[(h_v - u_v) \cdot \frac{D}{P_M} - h_v \cdot \frac{D}{P_R} \right] \cdot \beta \cdot (1 - \beta) \cdot q_v^2.$$

From the above considerations follows the next lemma.

Lemma 1.

If $(h_v - u_v)\cdot\frac{D}{P_M} < h_v \cdot \frac{D}{P_R}$ then it is optimal first to remanufacture, and the inventory holding cost coefficient is

$$h_{RM}(\beta) = \beta^2 \cdot \left[(h_v - u_v)\cdot\left(\frac{D}{P_R} - \frac{D}{P_M}\right) + u_v \cdot \frac{D}{P_M} \right] + 2\cdot\beta\cdot u_v \cdot \left(1 - \frac{D}{P_M}\right) + h_v \cdot \frac{D}{P_M}.$$

In other case, i.e. $(h_v - u_v)\cdot\frac{D}{P_M} \geq h_v \cdot \frac{D}{P_R}$, then the first activity is the manufacturing and then the remanufacturing. The inventory holding coefficient is

$$h_{MR}(\beta) = \beta^2 \cdot \left[h_v \cdot \left(\frac{D}{P_M} - \frac{D}{P_R}\right) - u_v \cdot \frac{D}{P_R} \right] - 2\cdot\beta\cdot\left[h_v \cdot \left(\frac{D}{P_M} - \frac{D}{P_R}\right) - u_v \right] + h_v \cdot \frac{D}{P_M}.$$

Let us now give an analysis of the cost of the participants of the supply chain.

Remark. Let us interpret the assumption for the first case. The inequality $(h_v - u_v)\cdot\frac{D}{P_M} < h_v \cdot \frac{D}{P_R}$ can be reformulated in the next way: $1 - \frac{u_v}{h_v} < \frac{P_M}{P_R}$. Let us introduce the following new variables: $\frac{u_v}{h_v}\cdot 100 = vcr$ is the percentage of the residual value of the product, if inventory cost is percentage of the product value, and the value conservation rate $1 - \frac{u_v}{h_v} = vlr$ is percentage of value loss from use, i.e. value loss rate. $\frac{P_M}{P_R}\cdot 100 = mpr$ is the percentage of manufacturing productivity (with respect to remanufacturing), i.e. manufacturing productivity rate. The above formula is true (remanufacturing before manufacturing) if the value loss rate does not exceed the manufacturing productivity rate, i.e. $h_v \cdot \left(\frac{1}{P_M} - \frac{1}{P_R}\right) > \frac{u_v}{D}$, and $\frac{D}{P_M} > \frac{D}{P_R} + \frac{u_v}{h_v}$, where coefficients $\frac{D}{P_M} = mur$ and $\frac{D}{P_R} = rur$ are manufacturing and remanufacturing utilization factors. The above formula is true if the manufacturing utilization factor exceeds the sum of the remanufacturing utilization factor and the value conservation rate.

The cost function of the buyer is

$$TC_b(q_b,\beta) = s_b \cdot \frac{D}{q_b} + \frac{q_b}{2} \cdot \left(h_b + \beta \cdot u_b\right) + d_b \cdot \left(1-\beta\right) \cdot D\,.$$

The cost function of the supplier is the following in dependence of cost parameters

$$TC_v(q_v,\beta) = \begin{cases} s_v \cdot \frac{D}{q_v} + \frac{q_v}{2} \cdot h_{RM}(\beta), & \left(h_v - u_v\right) \cdot \frac{D}{P_M} < h_v \cdot \frac{D}{P_R} \\ s_v \cdot \frac{D}{q_v} + \frac{q_v}{2} \cdot h_{MR}(\beta), & \left(h_v - u_v\right) \cdot \frac{D}{P_M} \geq h_v \cdot \frac{D}{P_R} \end{cases}$$

The next section gives the optimal solution for the buyer and vendor problems.

3. THE OPTIMAL LOT SIZES AND COLLECTION RATES OF THE PARTIAL MODELS

Banerjee (1986) has investigated the development of the costs for both participants of the supply chain. His conclusion is that the total system costs can be reduced with cooperation. However, he did not discuss how to divide the cost savings. Sucky (2006) has offered a bargaining model which gives a solution to this problem. Our model is an extension of model of Banerjee (1986) with reverse logistics. We summarize the partial and system wide solution of the extended model.

3.1. Optimal decision of the buyer

The buyer's problem is a simple EOQ model. The optimal solution for the lot size is

$$q_b^o(\beta) = \sqrt{\frac{2 \cdot s_b \cdot D}{h_b + \beta \cdot u_b}}\,,$$

and the optimal costs

$$TC_b(q_b^o(\beta),\beta) = \sqrt{2 \cdot D \cdot s_b \cdot \left(h_b + \beta \cdot u_b\right)} + d_b \cdot \left(1-\beta\right) \cdot D\,.$$

This last cost function of the buyer is concave in the collection rate β. In concave minimization problems the optimal decision variables are on the rand of the attainable set of variables. In our case it means that the buyer either collects all used products and takes back to the supplier ($\beta_b^o = 1$), or disposes off all outside ($\beta_b^o = 0$).

The optimal lot size of the buyer is

$$q_b^o = \begin{cases} \sqrt{\dfrac{2 \cdot s_b \cdot D}{h_b + u_b}}, & \beta_b^o = 0 \\ \sqrt{\dfrac{2 \cdot s_b \cdot D}{h_b + u_b}}, & \beta_b^o = 1 \end{cases},$$

and the optimal costs are

$$TC_b(q_b^o, \beta_b^o) = \begin{cases} \sqrt{2 \cdot D \cdot s_b \cdot h_b} + d_b \cdot D, & \beta_b^o = 0 \\ \sqrt{2 \cdot D \cdot s_b \cdot (h_b + u_b)}, & \beta_b^o = 1 \end{cases}.$$

This solution we can denote as a bang-bang solution, because the optimal collection rate either zero or one. In the next subsection we solve the problem of the supplier without coordinated lot size.

3.2. Optimal lot size and collection rate of the supplier

As shown before the solution of the supplier's problem depends on the sequence of the manufacturing and remanufacturing activities.

$$q_v^o(\beta) = \begin{cases} \sqrt{\dfrac{2 \cdot D \cdot s_v}{h_{RM}(\beta)}}, & (h_v - u_v) \cdot \dfrac{D}{P_M} < h_v \cdot \dfrac{D}{P_R} \\ \sqrt{\dfrac{2 \cdot D \cdot s_v}{h_{MR}(\beta)}}, & (h_v - u_v) \cdot \dfrac{D}{P_M} \geq h_v \cdot \dfrac{D}{P_R} \end{cases}$$

and the cost function

$$TC_v\left(q_v^o(\beta), \beta\right) = \begin{cases} \sqrt{2 \cdot D \cdot s_v \cdot h_{RM}(\beta)}, & (h_v - u_v) \cdot \dfrac{D}{P_M} < h_v \cdot \dfrac{D}{P_R} \\ \sqrt{2 \cdot D \cdot s_v \cdot h_{MR}(\beta)}, & (h_v - u_v) \cdot \dfrac{D}{P_M} \geq h_v \cdot \dfrac{D}{P_R} \end{cases}$$

Let us now optimize the costs of the supplier in the collection rate. Let us investigate the two separate cases using the newly introduced holding cost coefficients $h_{MR}(\beta)$ and $h_{RM}(\beta)$. These functions are unit inventory holding costs of the supplier.

We will examine the properties of these functions on the possible rates of collection, i.e. $0 \leq \beta \leq 1$.

1) $(h_v - u_v) \cdot \dfrac{D}{P_M} < h_v \cdot \dfrac{D}{P_R}$

Let us differentiate function $h_{MR}(\beta)$. The function is the following:

$$h_{MR}'(\beta) = 2 \cdot h_v \cdot \beta \cdot \left(\frac{D}{P_R} - \frac{D}{P_M} \right) + 2 \cdot u_v \cdot \left[\left(1 - \frac{D}{P_M} \right) + \beta \cdot \left(2 \cdot \frac{D}{P_M} - \frac{D}{P_R} \right) \right].$$

We will analyze whether this function is positive on interval [0,1]. It is satisfactory to investigate the differential function in points zero and one:

$$h_{MR}'(0) = 2 \cdot u_v \cdot \left(1 - \frac{D}{P_M} \right) > 0, \text{ and } h_{MR}'(1) = 2 \cdot (h_v - u_v) \cdot \left(\frac{D}{P_R} - \frac{D}{P_M} \right) + \cdot 2 \cdot u_v > 0.$$

The first inequality holds because demand rate is smaller than the manufacturing rate. The second one follows from the set of parameters.

This result means that the unit holding costs for these parameters are increasing functions of the collection rate. The optimal strategy of the supplier for this case is not to remanufacture used products, i.e. $\beta_v^o = 0$. If there is no remanufacturing then it is the classical joint economic lot size problem.

2) $(h_v - u_v) \cdot \frac{D}{P_M} \geq h_v \cdot \frac{D}{P_R}$

Now we differentiate the second holding cost function:

$$h_{RM}'(\beta) = 2 \cdot h_v \cdot (1 - \beta) \cdot \left(\frac{D}{P_R} - \frac{D}{P_M} \right) + 2 \cdot u_v \cdot \left(1 - \beta \cdot \frac{D}{P_R} \right).$$

Let us examine again the function in point zero and one:

$$h_{RM}'(0) = 2 \cdot h_v \cdot \left(\frac{D}{P_R} - \frac{D}{P_M} \right) + 2 \cdot u_v, \text{ and } h_{RM}'(1) = 2 \cdot u_v \cdot \left(1 - \frac{D}{P_R} \right) > 0.$$

For this case the differential function is increasing in one, i.e. it is not economical all returned product to remanufacture.

Let us analyze the function in point zero. We see that in some cases function $h_{RM}(\beta)$ can monotonously decreasing in point zero. If it is so, then there exists an optimal collection rate in the interval [0,1].

These results can be summarized in the following lemma.

Lemma 2.

If $(h_v - u_v)\cdot\frac{D}{P_M} < h_v \cdot \frac{D}{P_R}$ then the optimal collection rate is zero, i.e. it is better not to remanufacture and the model is a classical joint economic lot size model. In other case, i.e. $(h_v - u_v)\cdot\frac{D}{P_M} \geq h_v \cdot \frac{D}{P_R}$, there is a remanufacturing activity optimal if and only if $h_v \cdot \left(\frac{D}{P_M} - \frac{D}{P_R}\right) - u_v > 0$. In other case it is optimal not to collect and to remanufacture.

Remark. If the last assumption of the lemma holds, then optimal collection rate is

$$\beta_v^o = \frac{h_v \cdot \left(\frac{D}{P_M} - \frac{D}{P_R}\right) - u_v}{h_v \cdot \left(\frac{D}{P_M} - \frac{D}{P_R}\right) - u_v \cdot \frac{D}{P_R}},$$

and the optimal cost function is

$$TC_v\left(q_v, \beta_v^o\right) = s_v \cdot \frac{D}{q_v} + \frac{q_v}{2} \cdot h_{RM}\left(\beta_v^o\right),$$

and the optimal lot size of the supplier is

$$q_v^o = \sqrt{\frac{2 \cdot D \cdot s_v}{h_{RM}\left(\beta_v^o\right)^2}}.$$

The optimal costs are a simple expression

$$TC_v\left(q_v^o\right) = \sqrt{2 \cdot s_v \cdot D \cdot h_{RM}\left(\beta_v^o\right)^2}.$$

TABLE 1. THE USE OF REMANUFACTURING IN DEPENDENCE OF THE PARAMETERS FOR SUPPLIER

	$(h_v - u_v)\cdot\frac{D}{P_M} < h_v \cdot \frac{D}{P_R}$	$(h_v - u_v)\cdot\frac{D}{P_M} \geq h_v \cdot \frac{D}{P_R}$
$h_v \cdot \left(\frac{D}{P_M} - \frac{D}{P_R}\right) \leq u_v$	No remanufacturing	No remanufacturing
$h_v \cdot \left(\frac{D}{P_M} - \frac{D}{P_R}\right) > u_v$	No remanufacturing	*Remanufacturing*

Throughout the paper we will assume that $(h_v - u_v) \cdot \frac{D}{P_M} \geq h_v \cdot \frac{D}{P_R}$, i.e. the used products are collected at the supplier and there is remanufacturing at the supplier and $h_v \cdot \left(\frac{D}{P_M} - \frac{D}{P_R} \right) - u_v > 0$. This last inequality secures that the collection rate is positive. Let us summarize the results of our investigations in table 1.

These results hold if and only if there is no joint lot size between the participants of the supply chain. The next section presents the joint lot size and the optimal collection rates.

5. THE JOINT ECONOMIC LOT SIZE FOR THE CLOSED-LOOP SUPPLY CHAIN

Of course, it is suboptimal if buyer applies the optimal lot size of the supplier, and the other case is no optimal, i.e. if the supplier uses the optimal lot size of the buyer. The system wide costs are optimal, if the participants of the supply chain minimize the total costs. In this case they must solve the following problems.

The determination of the optimal reverse joint economic lot size will be calculated for two types of the models in dependence of the parameters, as we have done before.

1) $(h_v - u_v) \cdot \frac{D}{P_M} < h_v \cdot \frac{D}{P_R}$

The total cost function of the buyer and vendor is now

$$TC_{RM}(q, \beta) = (s_b + s_v) \cdot \frac{D}{q} + \frac{q}{2} \cdot [(h_b + \beta \cdot u_b) + h_{RM}(\beta)] + d_b \cdot (1 - \beta) \cdot D .$$

In this first step we calculate the optimal joint economic lot size:

$$q_{RM}(\beta) = \sqrt{\frac{2 \cdot (s_b + s_v) \cdot D}{(h_b + \beta \cdot u_b) + h_{RM}(\beta)}},$$

and the optimal cost function is

$$TC_{RM}(\beta) = \sqrt{2 \cdot (s_b + s_v) \cdot D \cdot [(h_b + \beta \cdot u_b) + h_{RM}(\beta)]} + d_b \cdot (1 - \beta) \cdot D .$$

Let us determine the optimal collection rate. The problem is difficult to solve because function $TC_{RM}(\beta)$ is restricted on interval [0,1] and it is a square function of β. We differentiate the function and investigate the function in zero and one.

The differential function of the problem is the following

$$\frac{\partial TC_{RM}}{\partial \beta}(\beta)=\sqrt{\frac{(s_b+s_v)\cdot D}{2}}\cdot\frac{u_b+h_{RM}'(\beta)}{\sqrt{(h_b+\beta\cdot u_b)+h_{RM}(\beta)}}-d_b\cdot D$$

Now the values o the functions in the mentioned points are

$$\frac{\partial TC_{RM}}{\partial \beta}(0)=\sqrt{\frac{(s_b+s_v)\cdot D}{2}}\cdot\frac{2\cdot u_v\cdot\left(1-\frac{D}{P_M}\right)+u_b}{\sqrt{h_b+h_v\cdot\frac{D}{P_M}}}-d_b\cdot D$$

and

$$\frac{\partial TC_{RM}}{\partial \beta}(1)=\sqrt{\frac{(s_b+s_v)\cdot D}{2}}\cdot\frac{(2\cdot u_v+u_b)+2\cdot(h_v-u_v)\cdot\left(\frac{D}{P_R}-\frac{D}{P_M}\right)}{\sqrt{(h_b+u_b)+(h_v-u_v)\cdot\frac{D}{P_R}+2\cdot u_v}}-d_b\cdot D$$

Because of the monotony of the total cost function there are three cases to investigate.

a) $$\frac{\partial TC_{RM}}{\partial \beta}(0)=\sqrt{\frac{(s_b+s_v)\cdot D}{2}}\cdot\frac{2\cdot u_v\cdot\left(1-\frac{D}{P_M}\right)+u_b}{\sqrt{h_b+h_v\cdot\frac{D}{P_M}}}-d_b\cdot D\geq 0,$$

b) $$\frac{\partial TC_{RM}}{\partial \beta}(0)=\sqrt{\frac{(s_b+s_v)\cdot D}{2}}\cdot\frac{2\cdot u_v\cdot\left(1-\frac{D}{P_M}\right)+u_b}{\sqrt{h_b+h_v\cdot\frac{D}{P_M}}}-d_b\cdot D<0$$ and

$$\frac{\partial TC_{R}}{\partial \beta}(1)=\sqrt{\frac{(s_b+s_v)\cdot D}{2}}\cdot\frac{(2\cdot u_v+u_b)+2\cdot(h_v-u_v)\cdot\left(\frac{D}{P_R}-\frac{D}{P_M}\right)}{\sqrt{(h_b+u_b)+(h_v-u_v)\cdot\frac{D}{P_R}+2\cdot u_v}}-d_b\cdot D>0,$$

c) $$\frac{\partial TC_{RM}}{\partial \beta}(1)=\sqrt{\frac{(s_b+s_v)\cdot D}{2}}\cdot\frac{(2\cdot u_v+u_b)+2\cdot(h_v-u_v)\cdot\left(\frac{D}{P_R}-\frac{D}{P_M}\right)}{\sqrt{(h_b+u_b)+(h_v-u_v)\cdot\frac{D}{P_R}+2\cdot u_v}}-d_b\cdot D\leq 0\cdot$$

In the case a) the optimal collection rate is zero, i.e. not to collect and not to remanufacture. The next case contains a solution inside of the possible collection rates, i.e. between zero and one. The last inequality is the case when all used products are collected and remanufactured. The results of the last inequalities we can summarize in the following lemma.

Lemma 3.

If inequality $(h_v - u_v)\cdot\frac{D}{P_M} < h_v \cdot \frac{D}{P_R}$ holds, then the optimal solution is one of the next cases:

1) If $\frac{\partial TC_{RM}}{\partial \beta}(0) \geq 0$, then $\beta^o = 0$.
2) If $\frac{\partial TC_{RM}}{\partial \beta}(0) < 0$, and $\frac{\partial TC_{RM}}{\partial \beta}(1) > 0$, then $\beta^o \in (0,1)$.
3) If $\frac{\partial TC_{RM}}{\partial \beta}(1) \leq 0$, then $\beta^o = 1$.

The optimal solution for the second case can be calculated with solving the next equality:

$$\sqrt{\frac{(s_b + s_v)\cdot D}{2}} \cdot \frac{u_b + h_{RM}'(\beta)}{\sqrt{(h_b + \beta \cdot u_b) + h_{RM}(\beta)}} - d_b \cdot D = 0 \cdot$$

The ecologically best solution is when the optimal collection (reuse) rate is one. With the magnitude of the disposal cost this goal can be achieved.

2) $(h_v - u_v)\cdot\frac{D}{P_M} \geq h_v \cdot \frac{D}{P_R}$

The cost function for the joint economic lot size for this case is

$$TC_{MR}(q,\beta) = (s_b + s_v)\cdot\frac{D}{q} + \frac{q}{2}\cdot[(h_b + \beta\cdot u_b) + h_{MR}(\beta)] + d_b \cdot (1-\beta)\cdot D$$

The reverse joint economic lot size is

$$q_{MR}(\beta) = \sqrt{\frac{2\cdot(s_b + s_v)\cdot D}{(h_b + \beta\cdot u_b) + h_{MR}(\beta)}},$$

and the cost function for these parameters is

$$TC_{MR}(q_{MR}(\beta),\beta) = \sqrt{2\cdot(s_b + s_v)\cdot D\cdot[(h_b + \beta\cdot u_b) + h_{MR}(\beta)]} + d_b \cdot (1-\beta)\cdot D$$

Let us this cost function differentiate as well.

$$\frac{\partial TC_{MR}}{\partial \beta}(\beta)=\sqrt{\frac{(s_b+s_v)\cdot D}{2}}\cdot\frac{-\left[2\cdot h_v\cdot\left(\frac{D}{P_M}-\frac{D}{P_R}\right)-(2\cdot u_v+u_b)\right]+2\cdot\beta\cdot\left[h_v\cdot\left(\frac{D}{P_M}-\frac{D}{P_R}\right)-u_v\cdot\frac{D}{P_R}\right]}{\sqrt{(h_b+\beta\cdot u_b)+h_{MR}(\beta)}}-d_b\cdot D$$

The values of the differential function in point zero and one are

$$\frac{\partial TC_{MR}}{\partial \beta}(0)=\sqrt{\frac{(s_b+s_v)\cdot D}{2}}\cdot\frac{(2\cdot u_v+u_b)-2\cdot h_v\cdot\left(\frac{D}{P_M}-\frac{D}{P_R}\right)}{\sqrt{h_b+h_v\cdot\frac{D}{P_M}}}-d_b\cdot D$$

and

$$\frac{\partial TC_{MR}}{\partial \beta}(1)=\sqrt{\frac{(s_b+s_v)\cdot D}{2}}\cdot\frac{u_b+2\cdot u_v\left(1-\frac{D}{P_R}\right)}{\sqrt{(h_b+u_b)+(h_v-u_v)\cdot\left(\frac{D}{P_R}-\frac{D}{P_R}\right)+2\cdot u_v}}-d_b\cdot D$$

Because of the monotony of the total cost function there are three cases to investigate.

a) $\frac{\partial TC_{MR}}{\partial \beta}(0)=\sqrt{\frac{(s_b+s_v)\cdot D}{2}}\cdot\frac{(2\cdot u_v+u_b)-2\cdot h_v\cdot\left(\frac{D}{P_M}-\frac{D}{P_R}\right)}{\sqrt{h_b+h_v\cdot\frac{D}{P_M}}}-d_b\cdot D\geq 0$,

b) $\frac{\partial TC_{MR}}{\partial \beta}(0)=\sqrt{\frac{(s_b+s_v)\cdot D}{2}}\cdot\frac{(2\cdot u_v+u_b)-2\cdot h_v\cdot\left(\frac{D}{P_M}-\frac{D}{P_R}\right)}{\sqrt{h_b+h_v\cdot\frac{D}{P_M}}}-d_b\cdot D<0$ and

$\frac{\partial TC_{MR}}{\partial \beta}(1)=\sqrt{\frac{(s_b+s_v)\cdot D}{2}}\cdot\frac{u_b+2\cdot u_v\left(1-\frac{D}{P_R}\right)}{\sqrt{(h_b+u_b)+(h_v-u_v)\cdot\left(\frac{D}{P_R}-\frac{D}{P_R}\right)+2\cdot u_v}}-d_b\cdot D>0$,

c) $$\frac{\partial TC_{MR}}{\partial \beta}(1) = \sqrt{\frac{(s_b + s_v)\cdot D}{2}} \cdot \frac{u_b + 2\cdot u_v\left(1 - \frac{D}{P_R}\right)}{\sqrt{(h_b + u_b) + (h_v - u_v)\cdot\left(\frac{D}{P_R} - \frac{D}{P_R}\right) + 2\cdot u_v}} - d_b \cdot D \le 0 \cdot$$

For this problem we can apply the method used in the last section. a) The optimal collection rate is zero, i.e. not to collect and not to remanufacture. The next case contains a solution inside of the possible collection rates, i.e. between zero and one. The last inequality is the case when all used products are collected and remanufactured. This solution is ecologically the best solution. With the disposal cost this goal can be achieved.

The results of the last inequalities we can summarize in the following lemma.

Lemma 4.

If inequality $(h_v - u_v)\cdot\frac{D}{P_M} \ge h_v \cdot \frac{D}{P_R}$ holds, then the optimal solution is one of the next cases:

1) If $\frac{\partial TC_{MR}}{\partial \beta}(0) \ge 0$, then $\beta^o = 0$.
2) If $\frac{\partial TC_{MR}}{\partial \beta}(0) < 0$, and $\frac{\partial TC_{MR}}{\partial \beta}(1) > 0$, then $\beta^o \in (0,1)$.
3) If $\frac{\partial TC_{MR}}{\partial \beta}(1) \le 0$, then $\beta^o = 1$.

The optimal solution for the second case can be calculated with solving the next equality:

$$\sqrt{\frac{(s_b + s_v)\cdot D}{2}} \cdot \frac{u_b + h_{MR}'(\beta)}{\sqrt{(h_b + \beta\cdot u_b) + h_{MR}(\beta)}} - d_b \cdot D = 0 \cdot$$

Let us now compare the optimal solution of the partial models and the joint lot size solution. We assume that the optimal inventory holding policy of the supplier is to remanufacture first, i.e. $(h_v - u_v)\cdot\frac{D}{P_M} < h_v \cdot \frac{D}{P_R}$. The other case can be handled similarly.

It is known that the partial cost functions have higher costs with the joint lot size, but the joint costs of the supplier and buyer are lower:

$$TC_b(q_b^o, \beta_b^o) < TC_b(q_{RM}^o, \beta_{RM}^o), \text{ and } TC_v(q_v^o, \beta_v^o) < TC_v(q_{RM}^o, \beta_{RM}^o),$$

but

$$TC(q^o_{RM}, \beta^o_{RM}) = TC_b(q^o_{RM}, \beta^o_{RM}) + TC_v(q^o_{RM}, \beta^o_{RM}) < TC_b(q^o_b, \beta^o_b) + TC_v(q^o_b, \beta^o_b) = TC(q^o_b, \beta^o_b)$$

,

and

$$TC(q^o_{RM}, \beta^o_{RM}) = TC_b(q^o_{RM}, \beta^o_{RM}) + TC_v(q^o_{RM}, \beta^o_{RM}) < TC_v(q^o_v, \beta^o_v) + TC_v(q^o_v, \beta^o_v) = TC(q^o_v, \beta^o_v)$$

,

It shows that the optimal inventory strategies of the participants result in a higher cost than that of the joint inventory strategy. The division of the cost savings are left for a next paper.

6. NUMERICAL EXAMPLES

Let us first investigate a model with the next data:

D = 1,000 piece/year,
P_M = 2,500 piece/year,
P_R = 1,200 piece/year,
s_b = 100 $/ordering,
h_b = 5 $/piece/year,
u_b = 1 $/piece/year,
s_v = 1,000 $/ordering,
h_v = 3 $/piece/year,
u_b = 1 $/piece/year
d_b = 1 $/piece.

Let us first control the sign condition of expression: $\frac{h_v - u_v}{P_M} - \frac{h_v}{P_R} \approx -0.0017$. The first model has to be used for this model. We can compute the values of $\frac{\partial TC_{RM}}{\partial \beta}(0) \approx -344.748$ and $\frac{\partial TC_{RM}}{\partial \beta}(1) \approx 129.042$. This shows that a minimum is and β^o = 0.65396. The optimal joint economic lot size of the model is $q_1(0.65396) \approx 518.589$, and the total costs are $TC_1(q_1(0.65396), 0.65396) \approx 4588.32$. The costs of the buyer are value 2004.91, and the vendor has costs of 2598.45.

Let us analyze another model with next data:

D = 1,000 piece/year,
P_M = 1,200 piece/year,
P_R = 2,500 piece/year,
s_b = 100 $/ordering,
h_b = 5 $/piece/year,
u_b = 1 $/piece/year,
s_v = 1,000 $/ordering,

h_v = 3 $/piece/year,
d_b = 2 $/piece/year.

The sign condition of this problem: $\frac{h_v - u_v}{P_M} - \frac{h_v}{P_R} \approx +0.00047$, so the second model is used. The optimal collection rate is β^o = 1, i.e. all used product must be collected and remanufactured. The joint economic lot size is 519.668. The total costs are $ 4,400. The costs of the participants are the next. The buyer's costs are $ 1,751.43, and the vendor's costs are $2,648.57.

7. CONCLUSIONS AND FURTHER RESEARCH

In this paper we have combined the results of the paper of Banerjee (1986) and Richter (1994, 1997) with respect to reverse logistics activities. We have shown that the optimal joint economic lot size can be calculated for this case as well. The optimal collection rate formula looks rather complicated, but its determination by software packages such as Mathematica or Mathcad 14. it is rather straightforward.

Another extension of the approach could be the examination of the bargaining situation of the problem.

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COMBATING THE EFFECTS OF EXTREME WEATHER PHENOMENA IN SMALL AREAS

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***Abstract:** One of the most important consequences of global climate change is expected to be the joint appearance of extreme weather phenomena, namely flood, inland inundation and drought. Human population living along rivers is most seriously affected by those phenomena. In the frame of the WateRisk-project (financed by the National Research and Technology Office of Hungary), we focused on the small communities living along the river Tisza, exploring the most acceptable possible solutions in their opinion, regarding water-related problems. Their conformity – also called as willingness of adaptation – has been analyzed by two survey methods. The questionnaire contained several questions on water-related issues, including the willingness to pay of respondents for increasing the proportion of natural and nature-close areas. The value system and priority setting of inhabitants towards water-related problems, local patriotism, community relationships, economic opportunities and the natural environment have been assessed via Q-methodology [1] [2]. This latter method is suitable for identifying respondent groups (called factors here) which show clear consensus in some of their behavioral features and opinions while significantly differing in other features. With the help of Q-methodology, value- and attitude-based behavioral profile of inhabitant groups will be shaped and the willingness as well as capability of adaptation is going to be evaluated. Our first findings show that despite the impacts of extreme weather phenomena respondents tend to insist on their residence and community, they do not want to move from the area even if they are not satisfied with the local opportunities. Their risk aversion is reflected in the high attached value to real estate insurance. They agree on shared responsibility in managing water-related problems but they have diverse opinion their own contribution. The preference order and the behavior profile of respondents include several inconsistent elements which will be described and discussed in the paper.*

I. INTRODUCTION

Extreme water-related weather phenomena like flood, inland inundation and drought have been relevant risk factors for several small areas and communities in Hungary for a long time but global climate change obviously makes the relating problems more serious. Adaptation to climate change can be achieved through various tools including (1) primarily technical solutions elaborated in the Water Catchment Area Plans of countries according to the referring Water Framework Directives [3]-[5] and (2) activities of inhabitants generating the spread of behaviour features which may counterbalance unfavourable impacts of climate change like increasing frequency and gravity of floods or negative consequences of water shortage.

The following study reports about two parallel conducted research which were aimed to explore the opinion and attitudes of inhabitants living along the Hungarian part of river Tisza and in an area heavily exposed to drought about the perceived and assumed consequences of extreme water phenomena and their willingness to adapt to those changes. Two methodologies were applied during the research: (1) contingent valuation which is suitable to estimate the economic value of non-market goods via questionnaire-based survey targeted at the inhabitants, as well as (2) Q methodology to explore the value system and priority setting of inhabitants. The research was conducted in the frame of the project called "WateRisk: Efficient and sustainable alternatives of extreme area-specific water stock-related risks in a medium term and in longer run" [6].

II. RESULTS OF THE WILLINGNESS TO PAY ANALYSIS

Regarding extreme water stock management risk reduction can be achieved by the persuasion of the inhabitants as well. However, little is known on what people think about flood, inland inundation and drought as well as on what they would be willing to make for reducing the damage as a consequence of those phenomena. A manifestation of residential activity is supporting the increase of the proportion of natural or nature-close areas in the region, thus facilitating the diversion of water overflow in the case of severe floods and contributing to the moderation of water shortage in dry periods.

Our aim was to analyse the willingness to pay (WTP) of the inhabitants living in such exposed regions towards a program which would increase the proportion of nature-close areas. A questionnaire-based survey was conducted in May and June 2010 among the inhabitants of three small regions called Nagykörű, Bereg and Homokhátság. With the help of contingent valuation, preferences of 325 respondents were analysed in a hypothetic market (for a detailed description of the method see [7] and [8]). The questionnaire consisted of four main parts: general attitudes, questions related to willingness to act and pay, as well as social, economic and environmental attitudes for the presence and the future. The only difference between the three questionnaires referred to the area-specific features of the hypothetic program.

In the total sample, the average age of respondents was 44.5 years, about 3 people live in a household on average; every second family has a child under the age of 18 and there were more women in the sub-samples than men. The average income of the total sample is HUF 153 000 per month but there is a significant difference considering the region of Homokhátság (where the reported income was definitely higher) as opposed to Bereg and Nagykörű (where this amount was lower and almost the same on average). The sample is not representative in a sense that both the share of people with only primary education (17%) and those with higher education (22%) is over the society average which shows a polarization. 35% have high-school graduation and 23% attended vocational school.

The program offered in the questionnaire first included a short description on the contemporary features of property management. Second, we proposed a program of change in the use of the landscape which would be implemented with the help of a so-called "Tisza Development Centre". The new landscape would more look like a mosaic, there would be less drought, frequency and gravity of floods would decrease There would be more nature-close areas. Implementation would be supported partly by the state and the local inhabitants.

According to the results, 83% of respondents would support the program, 11% would not and 6% said "I don't know". For the concrete willingness to pay, the following question was formulated:

> "What would be the maximum amount which your household would be willing to pay 10 years thru in order to achieve a balanced system of water management in the region of Nagykörű/Homokhátság/Bereg with a change in landscape use? Please consider that you have the option to spend your income for several other purposes."

First step of analyzing average WTP is the evaluation of respondents with zero bids. The 92 persons mean 29% of the total sample which is quite a high rate. Theoretically, invalid answers should be screened where the reason of zero bids is not that the program is not

worth paying a penny for (possible reasons were explored in a separate question). Excluding respondents with invalid answers would distort the results upwards therefore we decided not to differentiate between valid and invalid answers in this case. 60% of respondents with zero bids reasoned their choice with low income ("we cannot afford to pay for the program") which is a valid zero WTP. Other reasons were mentioned in much less proportion. The annual willingness to pay per household is HUF 8 738 in the total sample which is 0.547% of the average net annual income. However, there are differences between the average WTPs in the three regions (see Figure 1). Inhabitants of the Homokhátság region would pay HUF 11 211 on average annually per household which is a significantly higher amount than the average WTP of inhabitants from the other two regions (HUF 7 347 in Nagykörű and HUF 6 612 in Bereg).

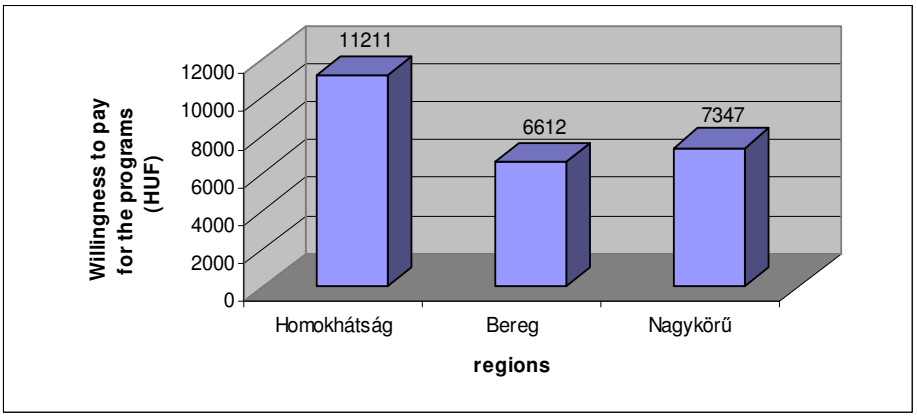

FIGURE 1: WILLINGNESS TO PAY OF THE ANALYSED REGIONS (HUF/YEAR/HOUSEHOLD)

The significant difference disappears when the income-related proportions are compared (although the order remains the same). Inhabitants from the Homokhátság region would offer 0.62% of their income for the increase of the proportion of nature-close areas and the program aiming at the change in landscape use; this rate is 0.50% in Nagykörű and 0.49% in Bereg.

III. RESULTS OF THE Q-METHODOLOGY ANALYSIS

The parallel part of the research aiming at exploring the opinions of inhabitants towards the management of water-related problems in the region was conducted via the so-called Q-methodology. Q-methodology, developed by Stephenson [9] classifies respondents according to the similarity or diversity of their opinions into relatively homogeneous groups and highlights the factors judged by respondents in a very similar or a very different manner. Q-methodology actually serves as bridge between qualitative and quantitative research methodologies, combining the advantages of both research traditions [1]. The main objective of Q-methodology is to typify opinions related to a given issue by means of quantitative analytical techniques. In reality this is a "reverse" factor-analysis, which instead of creating latent variables from variables classifies respondents into various factors – into so-called opinion-groups –, based on the similarity or divergence of their opinions. The qualitative nature of the methodology is due to the fact that it requires neither a certain sample size as precondition for reliable quantitative analysis, nor

representativeness. The methodology by generating typical opinions assists the researcher in shape recognition, but it is not suitable for generating representative types. The methodology has been used in value system- and preference-related research works, including the issues of sustainability, environmental management as well as marketing [10]-[12].

Q-methodology uses a special technique for data collection called the "Q-sort technique". The essence of the technique is that participants rank statements according to their individual preferences. In the application of Q-methodology the careful formulation of statements to be ranked is of outstanding significance, in order that respondents are able to establish their own rank-ordering by comparing the statements in pairs.

Statements were formulated along the following issues:

- attachment of inhabitants to their residence, habitation
- attitudes of the respondents to local cooperation, integration, property and living conditions,
- opinions regarding issues of local agriculture,
- attitudes towards the natural environment,
- willingness to act and perceived responsibility in order to achieve the goals regarding water-related problems and to preserve conditions of the area,
- perceived risks and threats regarding future living and natural conditions,
- time horizon of thinking
- possible solutions to water-related problems.

During the research we applied the so-called "forced distribution" technique, which means that we predetermined the exact number of statements that could be assigned to the elements of an eleven-degree scale from -5 to +5, based on the respondents' agreement or disagreement (Table 1).

TABLE 1: SORTING OF STATEMENTS BASED ON FORCED DISTRIBUTION

	Fully disagree					**Neutral**					**Fully agree**
Scale value	-5	-4	-3	-2	-1	0	1	2	3	4	5
Nr. of statements to be sorted	2	3	4	5	6	6	6	5	4	3	2

The applied software [2] compared each individual preference ranking in pairs and determined their correlations. From the inter-correlation matrix typical Q-sorts (actually, factors) were generated, based on the similarities and differences of individual Q-sorts. After a Varimax rotation, the main features of the factors – containing respondents with very similar preferences – became more clearly interpretable.

A. Analysis of the Bereg region

In the Bereg region, Q-method was conducted with 18 respondents who could be sorted into 4 factors, based on the similarities and differences of their opinions. Explained variance is 65%, there are 4-5 people in each factor.

Factor 1: Positively thinking people

Respondents in this factor can be characterised by their positive attitudes towards the natural environment. They consider nature and nature preservation important and valuable although they like making use of opportunities given by nature (except the unrestricted use of the water of their own well which they reject). They live in local integrity, support cooperation among farmers and prefer buying local products. Primarily, they prefer shared responsibility in decision making but they tend to shift off their personal responsibility in flood-related issues. They appear to lack information about the environmental impacts of applied water management techniques. However, opposed to the other groups, they heavily reject dams and emergency reservoirs as solution for flood problems.

Factor 2: Pessimistic but responsible people

Members of this factor can be featured by their pessimistic attitudes towards their environment and future. They precisely perceive risks and threats but they do not believe in cooperative solutions. They agree with their individual responsibility in action and are the most eager to take individual sacrifice for solving water-related problems but they are very sceptical towards the actions of other people and the community. In the opinion of this group people are not well informed about local problems which may be one reason behind their passive behaviour when it comes to collective efforts. The time horizon of their thinking is rather short term-focused. They might have bad experience with loans because they are rather pessimistic in this issue as well.

Factor 3: Local patriots

Members of factor 3 have very high attachment to their surrounding and heavily vote for taking local interests into consideration in decision making and for preserving property (e.g. parcels around the settlement) for inhabitants of the settlements. They support local cooperation and integration. Although their view on environmental problems is realistic they have an indifferent attitude towards water-related problems and there are not willing to take personal responsibility in action. In agriculture, they vote for natural farming, refusing modern technology. Their way of thinking is basically future-oriented which is reflected in their accordance with solutions paying back in the long run. They are the only ones who consider tourism as an opportunity for the region.

Factor 4: Future-oriented people

Members of this group are the most future-oriented people in the Bereg sample. Their thinking is nature-focused as they respect nature very much and do not want to make use of it for their own purposes. They are inspired by collective solutions, believe in community and are willing to participate in cooperative actions. They are the only ones who strongly believe that farmers in the region help each other in work and in trouble; they are ready to help accordingly. They are not so negative regarding loans and their opinion is rather neutral in the issue of agricultural technologies.

Factors show consensus in some statement which are the following:

- Insurance is important for both crop and real estate;
- Wood and natural resources are important;
- No satisfaction with local opportunities referring to living;
- Neutral opinion regarding the statement: “Those who have the opportunity to live in this region can be happy”;

- Considering their region not too specific but
- Local patriotism, local commitment is very strong, people do not want to move from their home;
- People do not want to spend their holidays far away from home (the reason behind is most probably their determined lifestyle and low income);
- Most respondents prefer short term benefits;
- Rejection of taxation as solution for better water management;
- Acknowledging the importance of shared responsibility (the state is not the only one which is responsible for taking action to solve the problems).

However, future orientation was only characteristic in Factor 3 and 4.

B. Analysis of the Nagykörű region

In the Nagykörű region, Q-method was conducted with 39 respondents who could be sorted into 6 factors, based on their preferences. Variance is 62%. Members of the factors are usually 5-7 people, except Factor 1 with 12 members and Factor 3 with only 3 members.

Factor 1: Future oriented people

The future orientation of these 12 people is reflected in their opinion that forestation takes the first place in their preference order (on average) even if their grandchildren will be the ones who can enjoy its benefits not them. Integrity and involvement into local decision making is very important for them. They prefer collective action in solving flood-related problems and they try to adapt their everyday activities to the given landscape circumstances. Nature represents very high value for them which reflect in their respect towards nature. They clearly see risks and the problems of the region. This group is more or less satisfied with local living opportunities.

Factor 2: Local patriots

The members of this factor are highly committed to their home. The statement "Those who have the opportunity to live in this region can be happy" is highest ranked in their preference order (on average). Although living in this area is important for this group and they prefer spending free time in the region they seem to suffer from drought because they consider moving from the region if years with drought are getting more frequent. Apparently, they are neither consistently informed about water supply problems nor about the environmental impacts of various agriculture techniques. They support local involvement into decision making and complex, cooperative solutions in water management.

Factor 3: Risk averse people

For the 3 members of this factor security and status quo is the most important. Although insurance is important for everyone, they specifically stressed its importance. They believe in traditional technologies in farming, they are averse to loans as well. They are full-time attached to their home and region even if not satisfied with living conditions and opportunities. They do not believe in the effectiveness of cooperation and they reported to be indifferent towards the involvement of local people into the decision making.

Factor 4: People with explicit ideas

Members of this group are determined and purposeful. Nature is reported to be important for them but they follow rather egoistic behaviour as they prefer to utilise the benefits of nature for their purposes. They are fully aware of risks but they do not believe in cooperation and do not prefer the involvement of the local community into decision making. They radically reject modern technologies in agriculture. On the other hand, they consider tourism as potentially beneficial for the region in the future.

Factor 5: Environmentalists

Environment protection is most characteristic for this factor where members are action-oriented and conscious. They attach high importance to local decision making, cooperative solutions and subsidiarity, meaning that they consider bottom up decisions and action more effective and efficient. Their opinion is neutral regarding farming technologies, insurance and tourism.

Factor 6: Ambivalent respondents

The members of this group have ambiguous view on the analysed issues. They want to preserve and utilise nature at the same time, call for the involvement of local people but expect water-related solutions from experts. In water management issues, they prefer mainstream technical solutions like making higher dams, building emergency reservoirs, channelling, etc. They seem to be indifferent regarding statements on local commitment.

Like in the case of Bereg region, some statements have shown consensus in the factors of the Nagykörű region as well:

- People living in the area usually like this region and like spending their free time and holidays here as well;
- Respondents prefer cooperative solutions in flood management as opposed to individual solutions;
- All respondents reject taxation;
- Future orientation is important, people think about future generations and would like their grandchildren to stay and live in the same region;
- Respondents do not necessarily want to enjoy the benefits of forestation now; and
- Nature seems to represent very high value for the sample.
- Due to water-related problems, people prefer to take out insurance for the crop.

On the other hand, respondents in consider some issues extremely different. Whose responsibility is to be conscious about risk management options when it comes to water-related problems? Who is responsible to provide solution: experts, the state, the community, individuals? Opinions differ very much here. Furthermore, some people are well-informed about relevant environmental problems and risks; some have no information at all. Opinions on the utilization of nature also move on a wide scale.

IV. CONCLUSION

The paper aimed to report on two research analyses regarding the attitudes of exposed inhabitants towards extreme water-related weather phenomena as a consequence of climate change. Two methodologies were used: (1) contingent valuation to explore willingness to pay of the inhabitants in the analysed regions for water management program with change

in the landscape; and (2) Q-method to sort people according to their preference order regarding their attitudes towards nature, cooperation ,decision making, responsibilities, local patriotism, water-related problems, water management solutions, agriculture and way of living.

Results suggest some conclusions and policy implications. WTP analysis made clear that if we want public support for better water management in exposed regions, willingness to pay should be supplemented by ability to pay to mobilise action and commitment of inhabitants. The proportion of zero bids was quite high, reasoned basically by low income of the household, not the worthlessness of the formulated program. The average amount of positive offered bids reflects the value of nature and the gravity of water-related problems, however, the significant difference between regions disappeared when the absolute amounts (bids) were related to income data.

Furthermore, results of the Q-methodology analysis help highlight some features in respondents' preferences which are worth considering in policy making process, related to water management issues in the future. Consensus statements have shown the high commitment of respondents to their region and home settlement which can be mobilised both in decision making and in collective action. Policies can build on the respectful attitude of local people towards nature, but definitely more information is necessary about the local problems as well as the effectiveness and environmental impacts of the various water management solutions in order to make right decisions. Benefits and drawbacks of agricultural technologies also have to be made clear for local farmers in order to make better choices from environmental point of view as well. The need for security and high perceived responsibility also makes a successful involvement of local inhabitants into cooperative action possible. Future orientation should be strengthened while clear and consistent preferences are necessary regarding preservation and utilisation of nature and natural resources.

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CARBON FOOTPRINT IN THE PASSENGER AIR TRANSPORT INDUSTRY: A CASE STUDY OF A GERMAN LOW COST CARRIER

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Abstract: ***The airport industry causes about three percent of human induced global warming and due to an industry's growth of approximately five percent per year the share is likely to rise up to 15 percent by 2050. Thus, the passenger air transport industry will be obligated to participate in the greenhouse gas emission trading scheme starting in 2012. Therefore this industry sector is being forced to measure their carbon footprint (CF). Moreover, through a growing public awareness on climate change the CF approach has increased in importance. Calculating the CF of an airline represents an extensive assessment due to the high interdependence within the industry's supply chain, so that support through industry-specific calculations tools becomes necessary.***

This paper develops a proposal for a standardized procedure of carbon footprinting in the passenger air transport industry. This proposal is based on a literature review and on the widely applied "Greenhouse Gas Protocol". The standard differentiates direct and indirect emissions within scope 1, 2 and 3 examinations. After the development of industry-specific questionnaires for each scope a case study within an European low cost carrier was conducted in order to test the proposal. The questionnaires emphasize the particular situation of the selected airline, but could easily be adjusted for the utilization at other airlines.

The total global warming potential of the selected airline is approximately 700 kilotons CO_2e and 111.9 grams of CO2e per passenger kilometre. About 90 percent of the generated GHG emissions are caused by direct emissions; the indirect emissions represent only a small share of the airline's emissions. In comparison to reported benchmarks of competitors the calculated emissions are in the mid-range.

The calculation of the CF and its comparison to competitive European airlines shows that a standardized assessment procedure is essential to enable comparability. This article can provide a basis for such a standardized method.

Main contents of the Keywords: carbon footprint, air transport industry, case study

I. INTRODUCTION

The air transport industry causes about 3 percent to human induced global warming. [1] But with an industry's growth of approximately five percent per year, the share is likely to rise up to 15 percent by 2050 [1], [2]. Thus, the passenger air transport industry will be obligated to participate in the European greenhouse gas emission trading scheme (EU ETS) starting in 2012 [3]. Therefore this industry sector is being forced to measure their climate change impact which can be examined through a life cycle consideration that comprises all climate relevant activities along the firm's supply chain.

Life Cycle Assessment (LCA) is a systematic analysis of environmental impacts of products, processes or services during their entire life cycle. This method collects and evaluates all input (material and/or energy) and output (products and undesired by-products) streams during production, use and disposal phase and the related upstream and downstream processes (e.g. production of raw materials and supplies).

The carbon footprint (CF), as a specific method of LCA, assesses the emissions of carbon dioxide (CO_2) or greenhouse gases measured in CO_2-equivalents (CO_2e), which are caused by human activities [4]. The method, which is based on the concept of „ecological footprinting" of Wackernagel and Rees [5], can be regarded as a subset of LCA that is limited to the single impact category "global warming potential" (GWP) [6]. Even though

the concept has been used for many years [7], its definition remains subject to discussion (see [4]) and is not yet acknowledged as a generally accepted indicator [8]. In spite of the current lack of legal regulation, a growing number of international, national and sectorial institutions work towards standardizing the measurement and assessment of greenhouse gases in general or specific guidelines and calculation tools [9]. These works are in particular the "greenhouse gas protocol (GHG protocol)" [10], as well as the guidelines of the Carbon Trust [11], the „UK Department for the Environment, Food and Rural Affairs" [12], and the International Organization for Standardization (ISO) [13]. The CF has gained relatively large publicity as public awareness on climate change and corresponding demand on climate relevant information increasingly forces manufacturers to declare the climate impact of their products and services [7], [14]. Thus, specific calculation tools are necessary [9]. The relatively simple approach can serve as a facilitator to further increase the utilization of life cycle approaches in organizations and decision making contexts [15], [7].

But also the globally operating air transport industry works on its own industry standards through various European and international associations. The "International Air Transport Association" (IATA) developed a strategy that targets "carbon-neutral growth" from 2020 and "zero-carbon-growth" from 2057 [16]. The "International Civil Aviation Organization" (ICAO) coordinates standardization and initiatives globally and developed a range of standards, policies and guidance material in order to address climate change in technological and operational improvements. The organization regularly reports advances in the industry [17]. The "Advisory Council for Aeronautics Research in Europe" (ACARE) aims to coordinate research activities for aeronautics in Europe and has laid down its emissions reductions goals in the "Vision for 2020" [18]. The British organization "Greener by design" seeks for operational, technological, economic and regulatory options for limiting aviation's environmental impact. They develop innovative technology and design concepts to reduce emissions and provide best practices on technological standards [19].

The CF approach itself has been frequently applied in the aviation industry. Most analyses focus on the impacts of jet fuel (kerosene) burning. Moreover, the internationality of the industry complicates the allocation of greenhouse gas emissions as emissions are not bounded by national borders [20]. Therefore, many papers examine aviation emission on a global perspective. In 1999, the IPCC evaluated the impact of aviation to climate change. These findings mostly represent the basis for current research and discussions. The main issues of current research relate to efficiency improvement potentials for the reduction of greenhouse gas emissions (see the works of [20], [2], [21], [22], [23]), the allocation of CO_2 emissions from aviation (e.g. [24], [20]), specific calculation methods (e.g. [25], [26]), comparisons within the transport sector (e.g. [27]), and the role of airports and tourism in combination with air travel (e.g. [28]). The Global Emission Model for Integrated Systems 4.5 (GEMIS) provides average CF value for air transport processes [29]. The Carbon Disclosure Project (CDP), which reports GHG emissions of about 3,000 participants in various industries, also contains information of major airlines from around the world. The CDP-reports of airlines with similar operations show that all of them report scope 1 emissions but only a few present scope 3 emissions.

Scope 1 to 3 emissions

Climate relevant life cycle inventory data of an organization stems from direct emissions through internal on-site activities as well as indirect emissions through external off-site activities in pre- or post-processing of the respective goods and services [4]. For an airline, climate relevant activities comprise the operation of aircrafts, as well as the handling of passengers and freight on the ground and in the air, and administrative service and air traffic management (cf. [20]). For a clear calculation of the CF the organizational and operational boundaries have to be assessed. The operational system boundary specifies which material flows and emissions are covered in the analysis [13]. This boundary is characterized by the level of corporate influence and is classified by the scopes 1 to 3. This classification aims to delineate direct and indirect emission sources in order to improve transparency, avoid double counting, and provide applicability of the instrument for different organization types [30]. At present, there is no consensus in the scientific community on delineating emission types and system boundaries [4]. Often, calculations focus on scope 1 emissions since the effort for including emissions of scope 2 and 3 is considerably higher [31]. Due to the lack of regulation, the "GHG protocol" has become the unofficial corporate standard and is currently the most widely used instrument [32].

Scope 1 includes all direct GHG emissions. The WBCSD and WRI (2007) specify them as all "emissions from sources that are owned or controlled by the company" such as generation of electricity, heat or steam; physical or chemical processing or transportation of materials, products, waste and employees [10]. Typical scope 1 emissions in the air transport industry are GHG emissions that result from fuel burned in the aircraft engines. The most important flue gases are CO_2 and nitrous oxide (N_2O). Further, methane (CH_4) and other by-product gases are emitted. The fuel use and emissions depend on aircraft type and utilization, as well as flight distance, altitude and the typical flight cycle [33]. The length of a flight cycle depends on the flight distance. Shorter routes are operated in lower cruise altitudes [34].

An aircraft flight is divided into various phases: Taxi (roll on the airfield), take-off and climb-out, cruise flight, and decent flight inclusive landing [34], [35]. These phases can be further separated into two main parts: *Landing/Take-off (LTO) cycle* (all activities near the airport below the altitude of 1000 m (taxi-in and -out, take-off, climb-out, and approach landing)) [33], [36] as well as *Cruise* (all activities that take place at altitudes above 1000 m (climb to cruise altitude, cruise, and descent from cruise altitudes)) [33], [37].

The fuel consumption of the LTO phase can be calculated in two different ways: first, the specific fuel consumption of an aircraft type per LTO-cycle [38] or second, the standard fuel consumption of an average aircraft, separated into LTO cycle and cruise [38]. For the first one the IPCC [38] provides a table of aircraft types and their frequent uses for domestic and international aviation equally. The second approach supplies data for national and international aviations separately. Furthermore the fuel consumption for the LTO cycle is differentiated in old (kerosene consumption per LTO: 1000 kg national, 2400 kg international) and average fleet (kerosene consumption per LTO: 850 kg national, 2500 international). For the average calculations of international air transport IPCC uses the average fuel consumption of 1675 kg kerosene/LTO [39], [40].

The fuel consumption of the cruise phase depends on the length of the flight, that is calculated by the total fuel use minus fuel use in the LTO phase for domestic and international aviation separately.

The emissions of air traffic can be calculated based on average fuel consumption and corresponding emission factors. The fuel jet (kerosene) used in aviation is a mixture of different hydrocarbons, which emits in its (complete) combustion mainly CO_2 and water (H2O). These emissions as well as sulphur oxide (SO_2) depend on the properties of the specific kerosene burned. Emissions of non methane volatile organic compounds (NMVOC), CH_4, carbon monoxide (CO), hydrocarbon (HC), nitrogen oxide (NO_x) and N_2O also depend on engine performance, flight altitude and flight phase. However, CO_2, CH_4 and N_2O are the only aircraft emissions that are part of CF.

The emission factors, especially of CH_4 and N_2O, differ in the two phases of flight, LTO cycle and cruise. Thus, the calculation of the relevant material and energy flows has to be accounted separately for each phase and in dependency of domestic or international flights [40], [41]. For the cruise phases the flight emission factors per amount of consumed fuel are used.

Additionally, scope 1 emissions can also result from fuel combustion in car engines. Here, the fuel usage and emissions depend on the car type with its vehicle mass, size of engine, car utilization, the driving distance and the driving behaviour [34], [42]. GHG emissions from fuel combustion in cars can be calculated by the multiplication of the driven kilometres and the vehicle specific emission in g CO_2/km. The emissions by burning the fuels petrol (Otto-Motor) or diesel (Diesel-Motor) are CO_2, NO_X, SO_2, NMHC (non-methane hydrocarbons) and particulate matter. Of the vehicle emissions, only CO_2 is part of the CF. The specific data for every vehicle type is provided by the manufacturer or available in databases [43]; [42].

The **second scope** covers indirect GHG emissions associated with generation of electricity, heat, or steam purchased for consumption in owned or controlled equipment or operations [10], [30]. Electricity, heat, and steam can be produced by burning fossil fuels in stationary combustion units, which immediately results in greenhouse gas and other emissions. CO_2 emissions depend on the energy intensity of a given mode, the fuel carbon content, and the degree of combustion [44]. Alternatively, energy can also be generated by nuclear or renewable sources (e.g. wind, solar). Therefore, each energy supplier provides a different energy mix with different emission factors. Even tough the emissions are physically emitted at the combustion facilities, the emissions are actually a consequence of the activities of the end consumer [45]. The “GHG protocol” bases its GHG estimation method on an emission factor-based methodology. This method calculates GHG emissions by multiplying a level of activity data (e.g. electricity consumption in MWh) by an emission factor (e.g., grams of CO_2 per MWh) [45].

The GHG guide only includes the calculation of CO_2 as it usually accounts for about 99 percent of the GHG emissions from the stationary combustion of fossil fuels. The estimation of other GHG emissions requires much greater efforts [45].

The GHG protocol defines **scope 3** emissions as “other indirect emissions, such as those associated with the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting company, electricity-related activities (e.g., transmission and distribution losses) that are not covered in Scope 2, outsourced activities, or waste disposal” [30]. In addition to this classification a further distinction of scope 3 emissions was made by WRI and WBCSD in 2009. A supplement of the GHG Protocol divides scope 3 emissions into three categories: Upstream scope 3 emissions from purchased products, downstream scope 3 emissions from sold products and

other scope 3 emissions. The first category encompasses those emissions "that occur in the life cycle of inputs (i.e., purchased or acquired goods, services, materials, and fuels), up to the point of receipt by the reporting company". Downstream emissions are "the emissions that occur in the life cycle of outputs (i.e., sold goods and services) subsequent to sale by the reporting company". Any emissions that do not fit into either of these two categories are subject to "other scope 3 emissions" that are "limited to employee activities such as commuting, which are neither purchased nor sold" [46].

This paper examines the application of the CF approach in the passenger air transport industry. The focus is put on European low cost carriers with short and medium distance flights. Using different developed questionnaires that consider industry-specific characteristics the case study research method is applied. The case is a European low cost carrier, called Aircarbon. The CF will be calculated for every scope and the results will be compared to other airlines.

II. METHODOLOGY

Case studies are a common research method in social science. They are used in many situations to undertake an in-depth investigation of individual, group, organizational, social, political, and related phenomena [47]. Like an explanatory case study according to Yin (2003), this article provides information how an airline could measure its GWP. Throughout the paper a standardized approach for the calculation of a CF in the air transport industry will be developed. The basis for this development builds a questionnaire for the collection of GHG emissions data for a low cost carrier. The real-life context of this investigation is provided through the application of this questionnaire for the collection and calculation of the CF of Aircarbon. Aircarbon is a low cost carrier located in Germany. The destinations are in Europe so that from 2012 every flight is subject to the EU ETS.

The approach of this work shall be based on the guidelines of the GHG protocol. The operational system boundary includes the scopes 1 to 3. Organizationally, the empirical assessment of Aircarbon comprises its European operations. The collection of life cycle inventory data shall be enabled through an industry-specific questionnaire. Subsequently, the emissions data queried by the developed questionnaires from Aircarbon are converted into CO_2-equivalents by considering the emission intensity of each source and weighting of the GWP of non-carbon dioxide greenhouse gases. If specific emission factors are not available, standardized values can be used instead. The aggregated final CO_2-equivalents amount states the airline's CF.

The **scope 1 questionnaire** collects data on air traffic and vehicle fleet of an airline. The required aircraft fleet data is based on fuel use and of the number of flights that is distinguished in domestic and international air traffic. In both cases, travel volume is determined according to fuel consumption of aircraft types given by IPCC [38] or by standard fuel consumption of an average aircraft fleet for LTO cycle and Cruise. On this basis, the questionnaire asks for the national and international fuel consumption and number of flights if available per aircraft type and, if not, the average consumption over the fleet. The number of national and international flights gives the respective LTO number. For the vehicle fleet the questionnaire intends to retrieve the data for the driven distance per vehicle type and the specific CO_2-emission factor of the vehicle type.

The scope 2 questionnaire intends to retrieve the data for each of the energy types, electricity, heat, and steam, separately. This procedure allows for a detailed analysis. Each

section aims to query activity data as well as data for the calculation of the emission factor. Electricity is usually consumed in the office and maintenance facilities, as well as by aircrafts for its supply on ground. For the determination of scope 2 it is necessary to query the ownership and operating status of the office building as only operationally controlled electricity consumption belongs to scope 2. In the case that specific data on electricity supplies are not available, the information on facility space area should be provided. Electricity for consumption can either be purchased or might be generated by the airline itself. For scope 2 analysis only the purchased quantity is relevant. Resold electricity is neither part of this analysis. For the determination of the accurate emission factor, the energy mix of the local energy supplier has to be known. As renewable energy sources can be regarded as carbon-neutral, this share has to be subtracted. For the later derivation of reduction potentials, information about the company's electricity sinks, such as illumination or maintenance, are helpful. The same data is required for the analysis of heat consumption. Steam is usually used for the production of electricity or as process heat. Neither use is likely for an airline. Thus, only steam consumption in maintenance might be expected. The energy consumption data is most likely to be received from the energy supplier. For scope 2 emission factors, the default values of the database "ProBas" will be used.

For the evaluation of **scope 3 emissions** of Aircarbon following categories or sources are relevant: purchased goods and services such as the aircraft itself, food and beverages as well as cleaning agent, the transportation and distribution of the mentioned purchased goods and the purchased fuel for the aircrafts, employee business travel, disposal/ treatment of waste generated in operations, disposal of sold products like the aircraft at the end of their life as well as the employee commuting. Focusing on employee commuting a online survey was established in order to receive information of their commuting behaviour. To calculate the amount of fuel that an employee consumes on her/his way to work, four parameters have to be collected by the survey: Commute mode (transportation mode/fuel type), days commuted using this mode, distance commuted using this mode and passenger miles per litre [48]. For testing the functionality of the survey and to reach its final status, pre-tests were conducted and the GESIS – the Leibniz institute for social sciences – has examined the survey.

III. RESULTS AND DISCUSSION

Based on the questionnaires, Aircarbon provided information on scope 1, 2, and 3 life cycle inventory data for 2009. For neither scope, the data is exhaustive. Thus, it only allows for an approximation in the calculation of the GWP.

Aircarbon only operates a fleet of the rather small aircraft A 319 within Europe. Moreover, information on the number of international flights (larger than 600 km) is not available. Thus, an average kerosene consumption of 850 kg/LTO can be assumed in the calculation. Table 1 summarizes the input data.

TABLE 1: SCOPE 1 INPUT DATA OF AIRCARBON

	Emissions factors 2009			Kerosene/ Emission [t]
	National	International	Average	
LTO	LTO		Kerosene [t]:	53,329
CO_2	3.15	3.15	3.15	167,986.35
CH_4	0.00035	0.00013	0.00024	12.79896
N_2O	0.00012	0.00009	0.000105	5.599545
Cruise	Cruise		Kerosene [t]:	165,380
CO_2	3.15	3.15	3.15	520,947
N_2O	0.0001	0.0001	0.0001	16.538

The environmental impact of the common six GHG emissions in the impact category GWP differ. Thus, each GHG has to be weighted by its GWP to finally obtain the total GWP in CO_2-equivalents. In the combustion of kerosene in aircrafts only CO_2, CH_4 and N_2O are emitted and thus, considered in the CF calculation. The standardized conversion factors used in this work are provided by the IPCC [49]. Table 2 summarizes the results. The Scope 1 emission from the vehicle fleet could not be calculated because the fuel consumption of the cars are not listed.

For the calculation of scope 2, a large part of input data remained unavailable. The energy consumption data provided can be found in table 3. Using the official scientific values of the energy mix for electricity production in Germany „El-KW-Park-DE-2010“ as well as the energy mix for a district heating network “Wärme-Fern-mix-DE-2005/el-mix” of the database ProBas leads to a total global warming potential of 827,6 tons.

TABLE 2: SCOPE 1 GWP OF AIRCARBON

Environmental impac / Environmental aspect	**GWP**	**2009**	
	Impact factor	Emissions [t/year]	t CO_2e
CO_2	1	688,933	688,933
CH_4	21	13	269
N_2O	310	22	6,863
Total			**696,065**

TABLE 3: APPROXIMATION OF SCOPE 2 GWP OF AIRCARBON

Electricity		**Heat**		**Total scope 2 [tCO_2e]**
Annual consumption [MWh]	**Emissions [tCO_2e]**	**Annual consumption [MWh]**	**Emissions [tCO_2e]**	
1,297	798.7	154.5	28.9	**827.6**

The Aircarbon’s scope 3 emissions only encompasses emissions from the employee commuting. Data regarding other categories could not collect during the investigation period. For the evaluation of the emissions of employee commuting three different emission factors for each transport mode were used. In the end, the results are averaged to

incorporate the different emission factors into one figure. Based on the emissions factors from the EPA-guidelines [50] the average CO_2 emissions per employee per working day are 8.1 kilograms. This corresponds to an output of 1,678 kilograms of CO_2 for 207 possible working days. This includes an average of 30 vacation days and approximately 8 days of absence due to illness. For a total of 1,015 employees the amount of 1,703 tones for the year 2010 were estimated. Using other emission factors the average emissions of CO_2 account between a little less than 7 kilograms per person DEFRA (2008) and 7.5 kilograms [51]. This corresponds to the amount of 1,439 kilograms of CO_2 for the year 2010 or 1,549 kilograms. For the entire staff the amount is equivalent to a quantity of 1,460 tones of CO_2 or 1,549 kilograms. Based on these the results the average value GWP of 1,578 tones CO_2 are calculated from Aircarbon's employee commuting emissions for the work year 2010.

Comparing the GWP of the three scopes, it is obvious that scope 1 accounts by far for the largest amount. Finally, the total global warming potential of Aircarbon's (reported) GHG emissions is about 700 kilotons CO_2-equivalents.

A closer consideration of the data provided by the selected benchmark airlines, exhibited in table 4, shows that these are also biased. For instance, Finnair only included aviation in its scope 1 consideration, while Iberia also refers to emissions from boilers and generator sets (natural gas or diesel) and vehicles that are owned or rented by Iberia [52]. Lufthansa only included electricity data in scope 2 and together with Iberia only calculated carbon dioxide emissions (not equivalents). Only three out of seven benchmarks consider scope 3 at all. Excluding scope 3, the climate impact of an airline can easily be improved through outsourcing of activities. Moreover, the data originates from different years (2008 and 2009).

Apparently, GHG emissions in the air transport industry highly depend on an airline's service volumes (e.g. distance travelled). As shown before, the volumes differ significantly within the industry. For benchmarking, these differences have to be eliminated, so that only the emission intensity of the operations themselves (e.g. caused by the aircraft model and operation) are compared. The application of the relative indicator - revenue passenger kilometre (RPK) - leads to an altered competitive picture. Aircarbon reached 6,241 million passenger kilometres in 2009. With the calculated GWP of about 700 kilotons CO_2-equivalents, the company's emission of CO_2e per RPK is 111.9 grams of CO_2e per RPK. The comparison of the relative indicator of CO_2e emission per RPK shows that TUI achieves the best industry ranks. Aircarbon only achieves an average relative position.

Once again, the significant variances in the results in table 4 show that the data is biased. An obvious factor is differences in the business scope. For instance, Lufthansa is also active in the cargo transport business, while British Airways provides taxi services, both augmenting scope 1 emissions [53], [54]. At the same time, in the functional unit here only considers passenger-kilometres, which finally increases the CO_2 emissions per passenger kilometre. Moreover, the selected airlines used quite different methodologies for their calculation, which shall be discussed in the following.

The calculation of the CF of Aircarbon is based on the GHG protocol. However, at the time being a variety of calculation and reporting procedures are used within the airline industry. For instance, Lufthansa calculates its direct emissions (scope 1) and the indirect

emissions (scope 2) of CO_2 according to the requirements of the GHG protocol [53]. Finnair uses the guidelines of the Global Reporting Initiative (GRI) [55], [56]. Other airlines do not specify their approaches at all so that company-own guidelines might be assumed. These different approaches, paired with the variation of included emissions, lead to entirely different results that can hardly be compared. The disparate results received emphasize the necessity of the establishment of a standardized CF procedure within the industry. The examination of such a standard shows that the guidelines of the GHG protocol provide a supporting tool for the identification, determination, and reporting of GHG emissions of airlines. The approach enables a relatively accurate differentiation of scope 1, 2 and 3. However, the boundaries have to be defined clearly in practice.

For scope 1, the protocol offers comprehensive examples of possible direct GHG emissions from combustion of fuels by company owned or controlled mobile combustion sources. The kerosene or other fuel data should be available by controlling entities or technical support. However, for better comparability and precision of an aircraft's emissions, a uniform inventory of consumption and emissions (especially for LTO phase) for each aircraft type should be provided. There is not only an emission difference between LTO and cruise cycle or national and international flights in general, but also between aircraft types and plane ages [38]. A standardized database could bring detailed results of the airline's emissions instead of average calculations. The activity data of the vehicle fleet (km per vehicle type) can be found in the driver's logbook. The specific guidance for the analysis of the consumption of purchased electricity, heat, and steam covers the potential scope 2 emissions of an airline. Energy consumption data should usually be available through the invoices of the energy supplier, the airport operator or the owner of other facilities. However, current, detailed information might be difficult to provide at short notice (delays in invoicing etc.). The facility-specific method is often not available for leased, office-based facilities that are not owned by the reporting company. The determination of scope 3 emissions by employee commuting should apply actual and region specific emission factors. Additionally, CO_2 emission factors are based on aggregated values. Situations such as driving in the inner city and the corresponding higher consumption are not taken into account. The examination of other scope 3 relevant processes, such as outsourced activities, that are required for a comprehensive scope 3 assessment remains subject to further research. To limit the quantification effort for the rather marginal scope 2 and 3 emissions, an airline's footprint will be rather based on default values and estimations than on actual values of the supplying parties.

TABLE 4: COMPARISON OF SCOPE 1 TO 3 EMISSIONS, TOTAL GWP AND GRAMS CO_2E PER RPK OF SELECTED BENCHMARKS

Airline (Year)	Scope 1	Scope 2	Scope 3	Total GHG emissions	RPK	GWP per pkm
Aircarbon (2009)	696,065 tCO_2e	827,8 tCO_2e	1,578 tCO_2	698,471 tCO_2e	6,241 mio. pkm	111.9 gCO_2e/pkm
British Airways (2008) [57]	16,840,627 tCO_2e	105,781 tCO_2e	639,113 tCO_2e	17,585,521 tCO_2e	114,346 mio. pkm [54]	153.8 gCO_2e/pkm

Airline (Year)	Scope 1	Scope 2	Scope 3	Total GHG emissions	RPK	GWP per pkm
easyJet (2009) [58]	4,307,000 tCO_2e	2,000 tCO_2e	n/a	4,309,000 tCO_2e	50,566 mio. pkm [59]	85.2 gCO_2e/pkm
Finnair (2009) [55]	2,246,271 tCO_2e	34,900 tCO_2e[14] (electricity only)	n/a	2,281,171 tCO_2e	19,935 mio. pkm	114.4 gCO_2e/pkm
Iberia (2009) [52]	5,688,709 tCO_2e	26,391 tCO2	28,324 tCO_2	5,743,424 tCO_2	62,158 mio. pkm [60]	92.4 gCO_2/pkm
Lufthansa (2009) [61]	24,228,134 tCO_2	305,947 tCO_2 (electricity only)	n/a	24,534,081 tCO_2	166,371 mio. pkm	147.5 gCO_2/pkm
SAS (2009)	3,203,956 tCO_2 [62]	127,429 tCO_2e[15] (electricity only)	n/a	3,331,385 tCO_2e	25,228 mio. pkm [63]	132.1 gCO_2e/pkm
TUI (2009) [64]	6,297,794 tCO_2e	104,408 tCO_2e	45,167 tCO_2e	6,447,369 tCO_2e	82,553 mio. pkm	78.1 gCO_2e/pkm

The scope specific questionnaires developed rephrase the requirements of the "GHG protocol" under consideration of the specific circumstances in the airline industry. The questionnaires can therefore ease the implementation of a standardized process to enable a broad application. As a comprehensive CF includes all processes and sub processes of an airline, the assessment will affect various stakeholders, such as suppliers and service providers, so that a close communication is necessary. The passenger kilometre can be regarded as a comprehensive functional unit as it includes the two main factors influencing service volume. However, it cannot be the only influencing factor (driver) for GHG emissions. The various corresponding processes are also influenced by e.g. the number of take-offs (and landings), the load factor, or the efficiency of ground handlings. In order to identify reduction potentials, it is necessary to identify all operation's processes that affect GHG emissions such as the handling of passengers and cargo, engineering, as well as administration.

IV. SUMMARY

By means of the LCA method CF, the climate change impact of an European low cost carrier, named Aircarbon, was assessed. Therefore a standardized procedure that considers the industry-specific characteristics and follows the guidelines of the "GHG protocol" was developed. For the European aviation sector such a standard procedure becomes increasingly important, since the industry is not only obligated to participate in the EU ETS starting in year 2012, but also exhibits significant growth. The developed procedure, which incorporates an industry-specific questionnaire, was applied to Aircarbon, which revealed a GWP of about 700 kilotons CO_2-equivalents. The data provided by Aircarbon was not sufficient for a systematic determination of the company's CF. Therefore the analysis faces a large lack of precision. Besides missing emissions data for all three scopes,

[14] CO_2e derived from electricity consumption of 56,693MWh [55].
[15] CO_2e derived from electricity consumption of 207,000 MWh [62].

the calculation also comprised several simplifications. Moreover, the comparison of the results with the published GHG emissions information of European competitors showed that the assessment procedures vary significantly. These obstacles faced throughout the examination of this article emphasize the necessity for the establishment of a standardized procedure within the airline industry that eventually might also include a standard tool, such as a software application. A harmonized instrument facilitates the quantification process and incorporation of emissions of the whole airline's supply chain including both upstream and downstream emissions. Thus, it can enable CF assessments on a regular and global basis with less operating effort. Such facilitation is especially important for scope 2 and 3 since these emissions only represent a relatively small share of an airline's emissions so that their quantification should only cause an appropriate effort. The development of such an instrument remains subject to further research.

It has also been demonstrated that absolute values only provide little information on an airline's environmental performance in comparison to its competitors since passenger and flight volume vary significantly. Instead, the utilization of the relation grams of CO_2e per RPK was suggested. Another research focus could analyse appropriate indicators for cargo air transport.

Besides the finalization of the CF analysis of the airline Aircarbon considering all emissions caused, a consecutive examination could concern company-specific GHG emissions reduction potentials, such as technological efficiency improvements of the aircraft (scope 1), utilization of passive energy (scope 2) or utilization of commuter rail systems by employees (scope 3). The opportunities in the implementation of a corporate CF analysis, especially for scope 2, include a strong focus on efficiency improvements and alternative energy supply, which eventually also provides a positive profitability effect. Moreover, the improvement of reputation among investors and other stakeholders might facilitate access to financial assets and entrance into new markets, such as sustainable tourism. An industry-wide initiative might prevent further legal regulations. However, from a sustainability perspective, the CF as environmental aspect has to be balanced by the social and economic view [2].

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ENVIRONMENTAL MANAGEMENT AND CORPORATE SOCIAL RESPONSIBILITY – TOOLS AND TRENDS TOWARDS SUSTAINABILITY

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I. INTRODUCTION

Topics such as industrial ecology, environmental management, corporate social responsibility, global value chains and systems understanding are becoming more interconnected as business are going global. The international conventions - the Global Compact (UN, 1999), the UN Millennium Development Goals, and the Global Reporting Initiative (GRI, 2002) – provide important guiding principles for business that want to meet the sustainability challenges. As a result of globalization the focus of corporate social responsibility (CSR) needs to be widened. For companies that want to improve their environmental performance, environmental management tools and techniques are crucial. They can be applied to different levels of systems; for a corporate site, for a product's life cycle, and to the global value chain. This requires multidisciplinary understanding and systems thinking.

II. INDUSTRIAL ECOLOGY (IE) AND CORPORATE SOCIAL RESPONSIBILITY (CSR)

Industrial Ecology is the broad umbrella or the framework for thinking about and organizing production and consumption systems in ways that resemble natural ecosystems. This idea considers human societies to be part of and operating within natural ecosystems (Ehrenfeld, 1994). The aim of IE is to interpret and adapt an understanding of the natural systems and apply it to the design of the man-made systems, in order to achieve a pattern of industrialization that is not only more efficient, but also is adjusted to the tolerances and characteristics of the natural system. The emphasis is on forms of technology that work with natural systems, not against them. The concept of industrial ecology was first introduced in 1989, with the publication of an article in *Scientific American* entitled "Strategies for Manufacturing" by Robert Frosch and Nicholas Gallopoulos (in Ehrenfeld, 2004). Simply stated, an industrial ecosystem optimizes the consumption of energy and raw material while minimizing the creation of waste and pollution by creating a use for everything produced in a manufacturing process – both desired and waste products.

There are several definitions of IE (O'Rourke et al, 1995), and they all take into account objectives such as closed material cycles, evolutionary principles, resiliency of systems thinking (the ability to recover), dynamic feedback, and cooperation and competition in ecosystems. The definition by Graedel et al. (1995) is based on a system view:

Industrial Ecology is the means by which humanity can deliberately and rationally approach and maintain a desirable carrying capacity, given continued economic, cultural, and technological evolution. The concept requires that an industrial system be viewed not in isolation from its surrounding systems, but in concert with them. It is a system view in which one seeks to optimize the total material cycle from virgin material, to finished material, to component, to product, to obsolete product, and to ultimate disposal. Factors to be optimized include resources, energy, and capital.

Industrial ecology operates at 3 levels, at the firm level, across firms and at a regional or global level. At each of these levels, industrial ecology aims to provide tools and knowledge for analysis and design towards more sustainable solutions. At the firm level we find green accounting and environmental management; across firms, industrial symbiosis, product-life cycle management, and supply chain management; and, at a global level, material flow analyses and other tools.

Corporate Social Responsibility (CSR) is about business and industry taking responsibilities beyond that of creating economic value for shareholders. For companies to make an honest contribution to CSR, it is important that they have a clear understanding of what it really means for them. There is not yet a universal definition of the concept of CSR, and the concept is still vaguely defined (Michael, 2003). According to Marrewijk (2003) CSR is too often seen as *"the panacea that will solve the global poverty gap, social exclusion and environmental degradation"*, and he believes that it is necessary to develop a clear definition before working further with the concept of CSR.

Dahlsrud (2006) has evaluated the existing CSR definitions to determine the definition that incorporates the most important concepts of CSR. The study showed that the definition of the European Commission (2001) was most used in the discourse, and as a result it was seen as the most comprehensive definition. Their definition is cited here (European Commission, 2001):

"…a *concept whereby companies integrate social and environmental concerns in their business operations and in their stakeholders on a voluntary basis* "

The definition of the European Commission (2001) includes both social and environmental dimensions, and the phrase "business operations" is an expression of the economic dimension. Other important dimensions are stakeholders and voluntariness. Dahlsrud's analysis (Dahlsrud, 2006) found that these five dimensions are widely used within the definitions, and that they are regarded as important components of CSR.

III. SUSTAINABLE DEVELOPMENT AND ENVIRONMENTAL MANAGEMENT

The three dimensions – social, economic and environment – are referred to as the triple bottom line, and also as the three pillars upon which the concept sustainable development rests. For many, CSR is mainly concerned with the social aspects. In the larger picture, CSR is also about how companies handle the economic aspects, which includes how they create value for their shareholders, and last, but not least, the environmental aspects. This last is the focus of this paper.

Figure 1 illustrates the progress towards sustainability mainly addressing the environmental challenges. The horizontal axis shows the temporal concerns; the vertical axis illustrates the scope of environmental concern. The different numbered blocks represent different approaches to environmental consciousness. Block 1 represents environmental engineering with a focus on the manufacturing process of a product's life cycle. Block 2, pollution prevention, also considers the planning phase, while 3, environmentally conscious design and manufacturing, emphasizes the entire life cycle of a product. As we see, block 4, Industrial Ecology, encompasses several products and manufacturers over a long term perspective, and finally 5, sustainable development, has a broad perspective concerning the whole society in a long term perspective that is also multi-generational. The challenge is to move from the lower left corner towards the upper right corner.

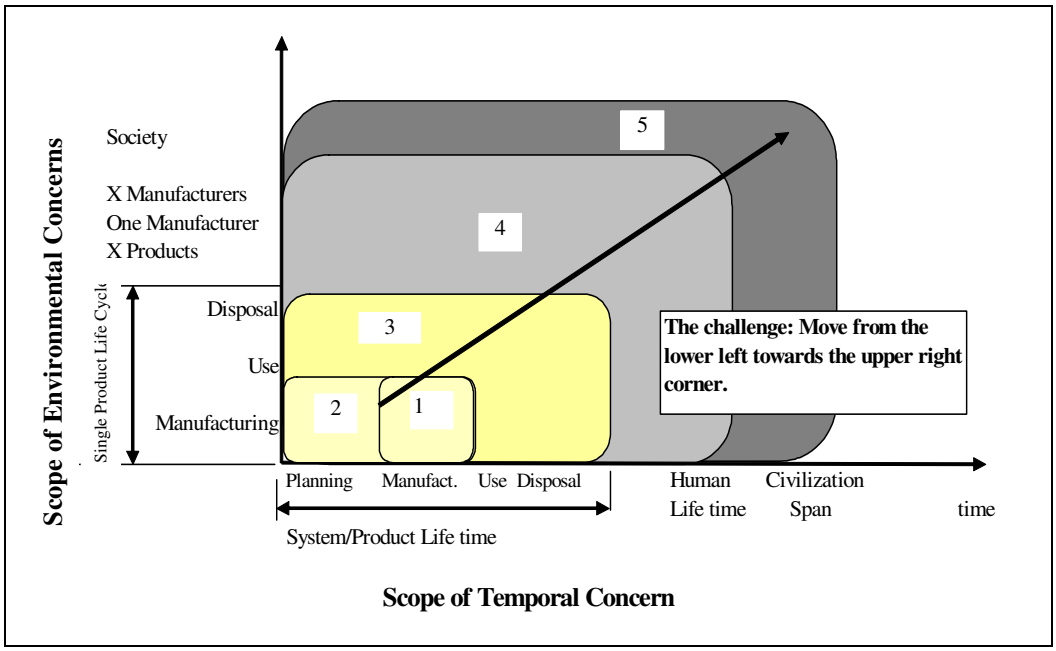

FIGURE 1: PROGRESS TOWARDS SUSTAINABILITY (FET, 1997, MODIFIED AFTER BRAS, 1996).

To help companies in meeting these challenges, several standards are already available. The most recognized for environmental management are the ISO 14000-standards. Some of these concern the organization; others are for environmental product assessment. It can be very chaotic for companies when they start looking at possibilities and tools for improving their environmental performance. The chaotic picture can be made more systematic for companies by sorting the tools into process-related, product-related and management related approaches, as seen for some of the environmental related assessment tools, see Figure 2.

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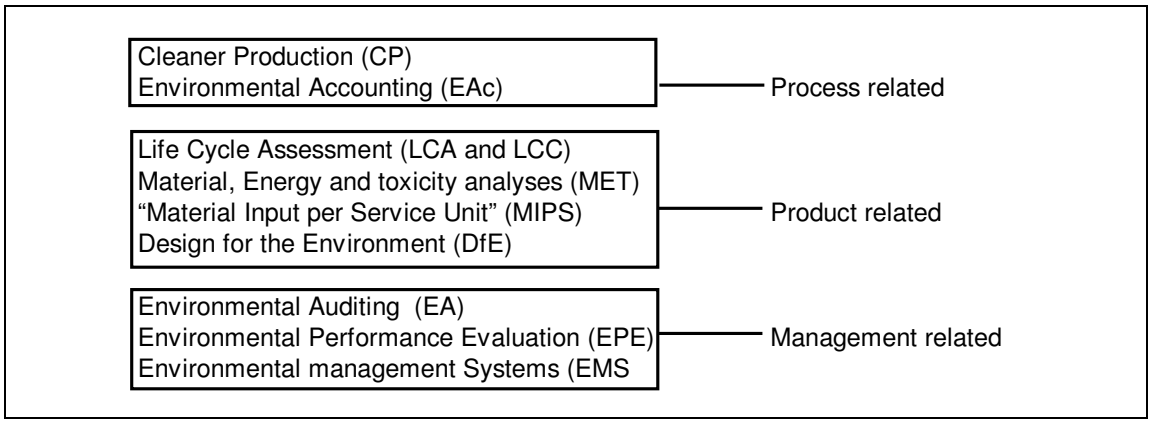

FIGURE 2: METHODS AND TOOLS CATEGORIZED

Another way of systematizing the tools is by using the framework presented in Figure 2. Figure 3 uses the same horizontal and vertical axis to illustrate how process related, product related and management related tools can be applied systematically to meet the challenge of sustainable development.

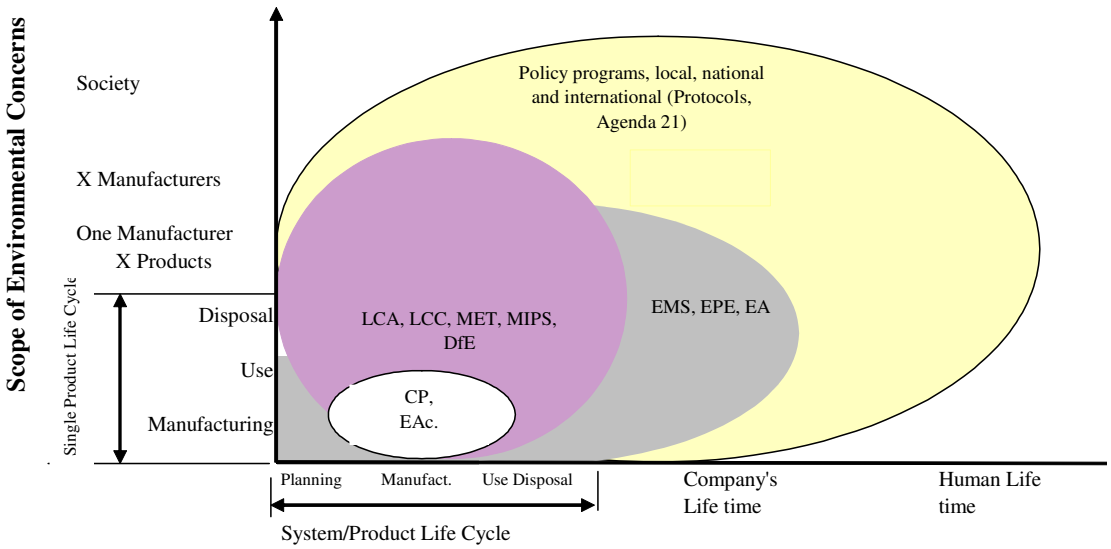

FIGURE 3: APPLICATION OF PROCESS, PRODUCT AND MANAGEMENT RELATED TOOLS TO MEET THE CHALLENGE OF SUSTAINABLE DEVELOPMENT (FET, 1997).

In cleaner production and in environmental accounting, site-specific input-output analyses have been the traditional approach. Input-output analyses looks at material and energy flows into a production system, and emissions or pollution to air, water and ground as outputs. Changing the viewpoint to a global scale, the same analysis is still important, but now with a wider focus considering the opportunities for improvement along the entire value chain also including sub-suppliers and the consumers. The product related tools, see

Figure 2, concern more than one manufacturer, they represent a shift from the site focus to a focus on a larger system - the entire value chain of the product consisting of the production phase, the use phase and the end of life phase. Input-output analyses from each of these phases are needed for a complete life cycle assessment (LCA) of a product.

The results from an LCA are often presented by means of performance indicators showing the contribution to different environmental impact categories. The relative contributions to the different impact categories show the hot-spots and potentials for environmental performance improvements of a product, illustrated by the diagrams at the right in the figure. Information about the product can be presented in environmental product declarations (EPD) (ISO 14025, 2006, Fet and Skaar, 2006).

IV. PERFORMANCE INDICATORS AND THE GRI FRAMEWORK

One of the initiatives of the United Nation Environmental Program (UNEP), supported by Worlds Business Council for Sustainable Development (WBCSD), is the Global Reporting Initiative (GRI). GRI was established in 1997 with the mission of developing globally applicable guidelines for reporting on economic, environmental, and social performance. The GRI's Sustainable Reporting Guidelines represents the first global framework for comprehensive sustainability reporting. The latest version (G3) was published in November 2006, which gives guidance to reporters on selecting generally applicable and organization-specific indicators, as well as integrated sustainability indicators. The G3 replace the 2002 Guidelines. The GRI Indicator Framework organizes the performance indicators in accordance with the following hierarchy:

- Category: Under economic issues we find the ones that have a direct economic impact, under social issues we find four categories Labor practice and decent work, Human rights, Society and Product responsibility.
- Aspects are the general subsets that are related to a specific category.

Performance Indicators are the specific measurements of an individual aspect that can be used to track and demonstrate performance. These are often, but not always, quantitative. A given aspect (water) may have several indicators (e.g., total water use, rate of water recycling, discharges to water bodies). A pillar of the GRI framework is that aspects and indicators derive from an extensive, multi-stakeholder consultative process.

Under the category Environment in GRI we find the aspects *Materials, Energy, Water, Emissions, Effluents, and Waste.* These are dealt with within site specific analyses (e.g. input-output analyses). When we shift to a product focus and look at the value chain, or network of actors along the life cycle of the product, aspects such as *Suppliers, Products and Services, Compliance and Transport* become important in addition to the aspects already mentioned. For each aspect the GRI-framework suggests a set of performance indicators. For these aspects under the category environment, the recommended indicators are listed in Table 1.

TABLE 1: ASPECTS AND PERFORMANCE INDICATORS FOR THE CATEGORY ENVIRONMENT (GRI, 2002).

Aspect	Performance Indicators
Suppliers	Performance of suppliers relative to environmental components of programs and procedures described in response to Governance Structure and Management Systems section
Products and Services	• Significant environmental impacts of principal products and services. • Percentage of the weight of products sold that is reclaimable (recyclable or reusable) at the end of the products' useful life and percentage that is actually reclaimed.
Compliance	Incidents of and fines for non-compliance with all applicable international declarations / conventions/treaties, and national, sub-national, regional, and local regulations associated with environmental issues. Explained in terms of countries of operation.

The international guidelines for social responsibility (SR), the ISO 26000 standards, is building upon the same model as the ISO 14000-standards, following the plan-do-check-act improvement cycle. The ISO 26000 will be published in 2008 and its usage will be voluntary. It will not include requirements and will thus not be a certification standard. However, it will provide practical guidance related to operationalizing social responsibility, identifying and engaging with stakeholders, and enhancing credibility of reports and claims made about social responsibility within an organisation. This means it will have an influence on improvements in the value chain. Nevertheless, it will not be a standard for assessing CSR-aspects related to the product life cycle. Similar models, such as those used for environmental assessment, could be used to address the CSR-issues at the site and in the product value chain. The challenge is to do this in a coherent way, e.g. by standardized methods. The life cycle impact assessment methodology could be further developed to include indicators for a set of actual CSR-impact categories. In the GRI-framework, the social issue has 4 categories. Similar as for environmental issues there are defined a set of aspects and related performance indicators. This is demonstrated for the aspect Product responsibility in Table 2.

TABLE 2: EXAMPLES OF PERFORMANCE INDICATORS FOR THE CATEGORY "PRODUCT RESPONSIBILITY" UNDER THE SOCIAL ISSUES (GRI, 2002).

Aspect	Performance Indicators
Customer Health and Safety	• *Description of policy for preserving customer health and safety during use of products and services, and extent to which this policy is visibly stated and applied, as well as description of procedures/programs to address this issue, including monitoring systems and results of monitoring.* • *Number of complaints upheld by regulatory bodies to regulate the health and safety of products and services.* • *Voluntary code compliance, product labels or awards with respect to social and/or environmental responsibility.*
Products and Services	• *Description of policy, procedures/management systems, and compliance mechanisms related to product information and labeling* • *Number and type of instances of non-compliance with regulations concerning product information and labeling.* • *Description of policy, procedures/management systems, and compliance mechanisms related to customer satisfaction.* • *Number and types of breaches of advertising and marketing regulations.*

Aspect	Performance Indicators
Advertising/ Respect for Privacy	• *Description of policy, procedures/management systems, and compliance mechanisms for consumer privacy.* • *Number of substantiated complaints regarding breaches of consumer privacy.*

By comparing the indicators in Table 1 and Table 2, we see the following:
For environmental issues the listed performance indicators address upstream requirements:

- Requirements on the performance of suppliers:
  - On the practicing of environmental management
  - On compliance with external regulations
- Requirements on the supplier regarding product information:
  - On the environmental impacts from products
  - About the recyclability of products (end-of life treatment)

For the products responsibility category under the social issue, the listed performance indicators address obligations downstream (to customers):

- Obligations concerning open information about
  - Self-imposed procedures and codes of conduct
  - Internal systems to monitor the procedures
  - Openness about complaints and breaches of good practices
- Obligations concerning openness about product information on
  - Potential health aspects from products
  - Eco-labeling and implemented systems for providing such on own products

These requirements are summarized and illustrated by Figure 4.

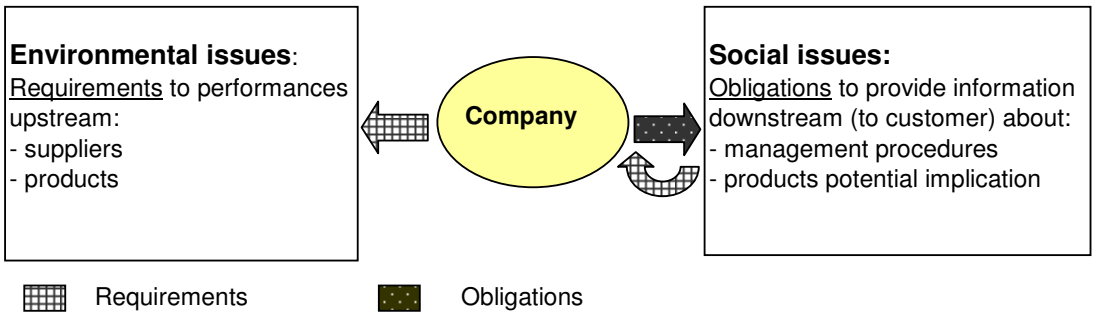

FIGURE 4: ILLUSTRATION OF REQUIREMENTS REGARDING ENVIRONMENTAL ISSUES, OBLIGATIONS REGARDING SOCIAL ISSUES, ACCORDING TO THE GRI-SYSTEM.

Companies that have implemented an environmental management system are committed to require information about the environmental performance of each supplier, and also to use this information as criteria when they choose their suppliers. This is also one of the requirements in ISO 14001. In the last version of ISO 14001 (ISO 14001, 2004) the requirement to identify environmental aspects concerning their products, processes *or*

activities is now changed to products, processes *and* activities This means that the focus on the environmental aspects of the products has been strengthened.

V. SYSTEMS ENGINEERING, CSR-MANAGEMENT AND THE PROGRESS TOWARDS SUSTAINABILITY

Systems Engineering (SE) offers an approach for companies trying to use different standards for similar purposes. Figure 6 illustrates the SE approach in 6 steps (Fet, 1997).

In the context that is described in this paper, especially on the obligations the companies have vis-à-vis the customers, answers to each step in Figure 6 can be formulated in the following way:

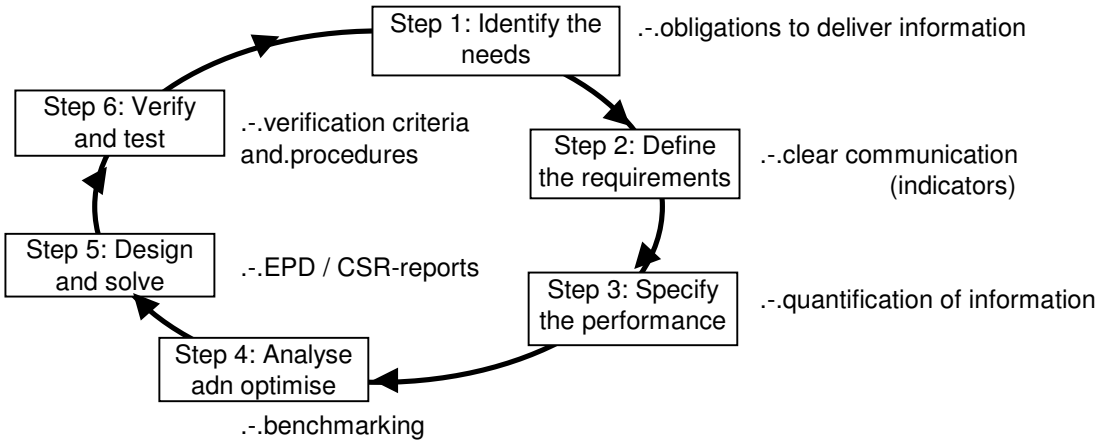

FIGURE 6: SE AS CSR-MANAGEMENT MODEL.

STEP 1,
The needs identification delivers product information / declaration, and company presentation / information in a coherent and consistence way.

STEP 2:
Definition of the requirements should produce clear communication and verifiable information that answers the questions

- Which performance indicators shall be included?
- Which set of impact categories should be included?

STEP 3:
It is important to be able to follow up on the performance and to benchmark/compare the information between different alternatives. This step answers the question, ”How can the information be presented in qualitative and quantitative forms?”

STEP 4:
The information / indicators/ categories should be analyzed for different systems and purposes. System modeling of global value chains and use of analytical tools will be important here.

STEP 5:
As part of designing and implementing a solution, generate an optimized set of performance indicators and information declarations (e.g. EPDs with added information on health impact, social aspects) and their relevance to other reporting systems.

STEP 6:
The final step concentrates on processes that verify and validate the needs defined in step 1 (verification procedures, criteria etc.), and related testing procedures in accordance with international expectations and future standards.

The SE-methodology builds upon the principles of feedback, and this is the same in most of the management standards; the principles of continual improvement are fundamental. Another way of seeing CSR-management as a tool towards sustainable development is shown in Figure 7. Using the same axes as Figure 1 and Figure 3, this diagram shows the progress towards sustainability in the context of the application of the methods and tools. As illustrated in Figure 7, CSR and SE can be placed within the same framework.

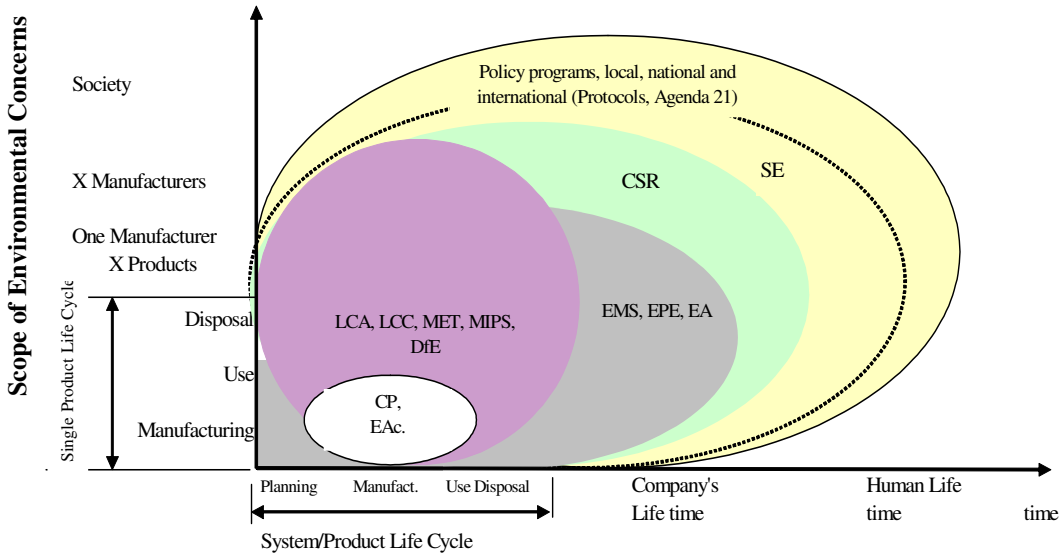

Figure 7: CSR-management and SE

VI. DISCUSSION AND CONCLUSION

This paper has pointed out some of the sustainability challenges business are facing in the context of globalization. With the focus changing from the traditional site-based concerns to a concern for the entire value chain of products and services there is a need to apply new methodologies and standards. Input-output analyses and environmental management standards have been in use for some years and businesses are becoming familiar with these

tools. Waste management systems and energy saving programs are examples of these. However, when the business responsibilities widen to larger systems involving different actors along the product value chain, businesses are meeting new challenges regarding the way they are able to communicate their performance, both on the managerial level and about their products and services. A further challenge is how to communicate this downstream and at the same time require the same information from upstream sources. Tools for LCA and guidelines on sustainability reporting and EPDs are already available and in use in larger companies. Smaller companies are still struggling with how to find the best ways for communicating their performances relative to the triple bottom line.

This paper has suggested using Systems Engineering as an approach to gather the needed information for this communication. However, this will be further dealt with in coming research programs, such as reported in Haskins (2007). To sum up, the challenge towards sustainable development has been met by both the governmental agenda and the business agenda. However, throughout the last 30 years we have seen a shift from governmental command and control through co-regulatory principles, to economic instruments and partnership. On the other hand, business has moved from compliance and cleaner production to improvement of eco-efficiency and now putting CSR on their agenda and taking a larger systemic responsibility on the way to sustainable solutions.

VII. ACKNOWLEDGMENT

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CARBON EMISSIONS LOCKED - IN TRADE

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Abstract: ***In recent years there has been a growing concern about the emission trade balance of countries. It is due to the fact that countries with an open economy are active players in the international trade, though trade is not only a major factor in forging a country's economic structure anymore, but it does contribute to the movement of embodied emissions beyond the country borders. This issue is especially relevant from the carbon accounting policy's point of view, as it is known that the production-based principle is in effect now in the Kyoto agreement.***

The study aims at revealing the interdependence of countries on international trade and its environmental impacts, and how the carbon accounting method plays a crucial role in evaluating a country's environmental performance and its role in the climate mitigation processes. The input-output models are used in the methodology, as they provide an appropriate framework for this kind of environmental accounting; the analysis shows an international comparison of four European countries (Germany, the United Kingdom, the Netherlands, and Hungary) with extended trading activities and carbon emissions.

Moving from the production-based approach in the climate policy, to the consumption-perspective principle and allocation [15], it would also help increasing the efficiency of emission reduction targets and the evaluation of the sustainability dimension and its impacts of international trade. The results of the study have shown that there is an importance of distinction between the two emission allocation approaches, both from global and local level point of view.

The research is part of the "Sustainable Consumption, Production and Communication" Project financed by the Norwegian Fund.

Keywords: International Trade, Carbon Footprint, Input-Output tables, Consumption-based Accounting, Carbon - dioxide embodied in trade

I. INTRODUCTION

The UNFCCC and the Kyoto Protocol call for a stabilization of the greenhouse gases concentrations in the atmosphere at 1990 levels in order to curb the harmful effects of climate change. The so called Annex I Parties are required to reduce their emissions of greenhouse gases to the percentages set by the Kyoto Protocol. Not only ambitious targets should be set for the global climate agreement, but there are further challenges which need to be addressed concerning the climate accounting methods and climate agreements. The relation of the international trade and carbon leakage can be a central issue, as it is commonly known that approximately 20% of the world's emissions are embodied in international trade. The national emission inventories are based on the production-based emission allocation approach. Regarding the transparency and fairness of the emission accounting processes, a country should be responsible for the emissions of consumption, as the final demand is dependant on emissions generated elsewhere.

On a global scale many of the imported emissions come from other (developing) countries while it represents only a minor share of the import value. Responding to the climate change there can be two main strategies: mitigation and offsetting. The reduction of emissions can be distorted as the basis of the allocation is not fair, while offsetting can lead to rebound effects and could create externalities. That is why, the question of the

emission trade balance and the consumption-based emission accounting, has become lately quite relevant recently.

This study aims at revealing the interdependence of countries on international trade and their environmental impacts, and how the carbon accounting method plays a crucial role in evaluating a country's environmental performance.

II. THEORETICAL BACKGROUND: THE THEORY OF THE ECOLOGICAL UNEQUAL EXCHANGE AND THE CARBON FOOTPRINT

The theoretical background of the study can be related to the theory of ecological unequal exchange (EUE). It has to be noted that for long, the ecological aspect of trade flows were not in the limelight of research. Originally the unequal flows of purchasing power (Prebisch, Singer), and labour time (Emmanuel) between one part of the world at the expense of the peripheries, were examined. Concerning the climate change negotiations, the ecological content needs to be captured as well, as according to the Kyoto agreement only domestically produced carbon emissions and greenhouse gases (GHGs) are accounted for, while the imported GHGs because of final demand, are not included in the national emission quotas and targets. Examining the allocation responsibility and the fairness of allocation, it is evident that the net GHG exporters can be overtaxed while net GHG importers can be undertaxed according to the present accounting system. Considering ecological unequal exchange, it is vital to examine the justice of climate accounting methods. At a macro level, it is true that if we look at the North-South trade flows, the North benefits from the ecological unequal exchange, as the embodied emissions and ecological resources are greater than its exports, so the environmental load generated because of the final demand in the Northern countries should be allocated to them [1]. The study of Peters [15] gives a detailed analysis and comparison on the theory of production and consumption-based responsibility.

Kenneth [9] argues that the indicators of carbon footprint and the embedded CO_2 can be used convincingly to measure the EUE and the environmental loads of trade.

First, it has to be defined what is meant by carbon footprint, as this indicator is used in the study. In the relevant literature there has been a dispute recently on the definition of the carbon footprint, as the term has been used widely, with a wide interpretation.

The methodological root of the carbon footprint goes back to the concept of "the energy cost of living" developed in the 1970s, and to the net energy analysis [7]. The term itself as a footprint is rooted in the language of the ecological footprinting [18] and when used in Ecological Footprint studies, this term is synonymous with demand on carbon uptake land [5].

According to [20] it is not clear what should be included in the calculation of the carbon footprint, only CO_2 or other greenhouse gases (like methane) as well. Finkbeiner [6] examines the central questions concerning the clarity of the definition, and argues that carbon footprinting needs to be changed, the definition should be clarified.

Concerning the carbon footprint, an important question is whether it should reflect and include only the direct emissions or the indirect as well, the life-cycle impacts of goods and services used. A major question is the measurement unit of this indicator. There can be two options: it can either be measured in CO_2 equivalents, in this case measuring only the amount of carbon emissions in tonnes, or it can be measured in area units - in global

hectares as well, thus showing its impact of global warming potential and the area based unit of land appropriation.

According to Global Footprint Network, during the calculation of the carbon footprint, the CO_2 emission data are translated into the area, measured in global hectares, which account for absorbing the carbon emissions. So, it is actually the fossil fuel footprint or CO_2 land. The carbon footprint is the area of annual forestry required to sequester the CO_2 emissions [13]. The CO_2 land is defined by the Global Footprint Network as "The demand on biocapacity required to sequester (through photosynthesis) the carbon dioxide emissions from fossil fuel combustion, it includes the biocapacity, typically that of unharvested forests, needed to absorb the fraction of fossil CO_2 that is not absorbed by the ocean" [5].

Wiedmann [20] proposes the following definition: "The carbon footprint is a measure of the exclusive total amount of carbon - dioxide emissions that is directly and indirectly caused by an activity or it is accumulated over the life stages of a product". So the direct (on-site, internal) and indirect (off-site, external, embodied, upstream, downstream) emissions are both taken into account. It is important for the concept of carbon footprint to be all-encompassing and to include all possible causes that give rise to carbon emissions, and it is equally essential to make clear what this includes. CO_2 is measured in mass units (kg, t, etc.) as the conversion to area units could increase the uncertainties. In this study the carbon footprint is applied after the definition of Wiedmann.

III. METHODOLOGY: CARBON FOOTPRINTING COMBINED BY INPUT-OUTPUT TABLES

In the analysis the carbon footprinting combined by the input-output analysis has been applied in order to quantify and evaluate the carbon emissions embodied in international trade from the consumption-based accounting approach. Wackernagel et al. [19] propose the application of input-output analysis to allocate footprint into detailed consumption categories, as the input-output approach is able to track the transformation of goods through an economy.

The input–output analysis was developed by Leontief [10] in the form of an industry-by-industry matrix. It has been extended by Cumberland [2] later, where the economic and environmental interactions were incorporated into the input-output tables [12]. An additional sector was integrated in it by Leontief [11], in order to simulate the removal of pollutants in the input-output structure. A few years later, Victor [17] came up with a combined ecological–economic input-output model, and introduced economic components in monetary terms while ecological ones were expressed in physical terms. The input-output tables were in the form of a commodity-by-industry table combined with economic and environmental commodities.

In the study, the symmetric, industry by industry input-output tables from the OECD's STAN Database for Structural Analysis [14] were used for the year 2005, as it was as the most recent data which was available for the analysed countries. The carbon-dioxide emission values were from the database of the Global Footprint Network [4], which were used in the environmentally extended input-output matrix, also for year 2005. In the database of the Global Footprint Network emission data were given on product level, so the first step of the calculation was aggregating the product level emissions to sectoral level. The emissions for domestic production and the emission embodied in imported products and services were available in the database.

The carbon footprint values of the analysed counties were calculated using the consumption-based accounting approach, where the emissions of both from domestic

production for domestic demand and emissions because of imported products were used in the calculation. The aim was to decompose and quantify the carbon footprint of domestic final demand due to domestic production (CF_d), and imported products (CF_m).

The carbon footprint describes the carbon-dioxide emissions by sectors owing to the final demand of a sector (1):

$$CF = F(I - A)^{-1} y^{com} \quad (1)$$

In the equation $\boldsymbol{F}$ stands for a row vector, each element representing the carbon footprint value (domestic and imported environmental load together) per unit of industry output. $\boldsymbol{(I-A)^{-1}}$ represents the direct and indirect requirement matrix calculated from the symmetric input-output (industry by industry) tables. This is the so-called Leontief inverse matrix, showing the input requirements in case of one additional unit of output. Finally, $\boldsymbol{y^{com}}$ is the vector of the domestic consumption's final demand. The vector of the domestic final demand needs to be diagonalised in order to obtain the consumer's environmental load. The result is a matrix which shows the individual carbon footprint values of the industrial sectors in the analysed category.

The carbon footprint has been quantified and decomposed into the two parts.

I. The Carbon Footprint of domestically produced products and services (CF_d), which has been emitted because of the domestic consumer demand. Emissions due to exported products are not included.

$$CF_d = F(I - A_d)^{-1} y_d \quad (2)$$

Where $\boldsymbol{A_d}$ is the matrix of domestic industry requirements of domestically produced products, calculated from the IO table, and $\boldsymbol{y_d}$ is the vector of final demand of domestic consumption.

II. The Carbon Footprint of imported goods and services, which can be further divided according to the origin of the footprint.

$$CF_m = F\left[\left((I - A)^{-1} - (I - A_d)^{-1}\right) y_d + (I - A)^{-1} y_m\right] \quad (3)$$

The carbon footprint of direct imports show the environmental load of imported products immediately and directly used for final domestic demand.

In the calculation of the imported footprint, the Leontief inverse is used and it is assumed that each commodity imported is produced by using proportionally the same kind of inputs (materials, intermediates, labour and energy) as used in the domestic production sector.

As a result of the calculations, the carbon emissions were gained on sectoral level in the four analysed countries, and further indicators were calculated in order to illustrate the emissions embodied in imports.

IV. RESULTS AND DISCUSSION

In this study four European countries were compared concerning their CO_2 emissions embodied in international trade. The countries were chosen based on their high carbon-dioxide emissions and on their international trading volumes. The carbon footprint of Germany, United Kingdom, the Netherlands have been analysed primarily, but Hungary was also included in the analysis.

The aim of the study is quantify to what extent the analysed countries' final demand can be responsible for the emission generated outside of their country borders. Furthermore a sectoral analysis was carried out in order to define which sectors can boast with the highest carbon footprints and carbon intensities concerning the imported products.

Figure 1. shows the result of the decomposition of the carbon footprint. It can be seen that the emissions embodied in import play a significant role in each country. It is the Netherlands where the embodied emissions are relatively the highest, the emissions embodied in direct imports are 69,3% of the total emissions. This is followed by Hungary and Germany, where though the carbon-dioxide emissions are far lower in Hungary than in the other three countries, it has to be noted, that because of the consumption-based emission accounting method, the national emissions are significantly different compared to the present accounting system. It is the United Kingdom, where the emissions embodied in direct and indirect imports are the lowest in this comparison, still they give 54,3% of the total emissions. As the internationally traded goods are mainly finished goods, that is why the direct carbon footprint is greater in all countries and in each country in almost all the industry sectors.

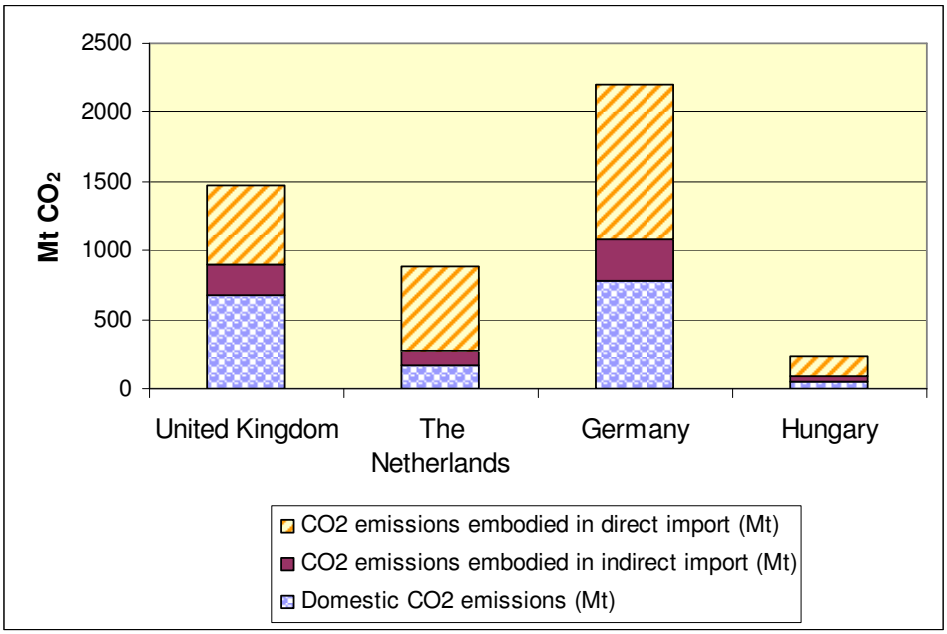

FIGURE 1: CO_2 EMISSIONS OF PRODUCTION AND EMBODIED IMPORTS

The consumption-based accounting approach should be compared to the present, production-based accounting method in order to illustrate the differences in the results and to underpin the theory of ecological unequal change. Figure 2. shows the CO_2 emissions generated because of domestic production and exports. It can be seen clearly, the emissions of production-based approach are smaller than the emissions which are allocated according to the consumption-based responsibility. It can be concluded, that the adoption of the approach based on a country' final demand would lead to the adoption of carbon efficiency measures at all levels, as a country would need not only to have its production chains at the least carbon intensive as possible, but would also have to look for the most efficient carbon trading partners. There would be a fairer result and more compliance with policies.

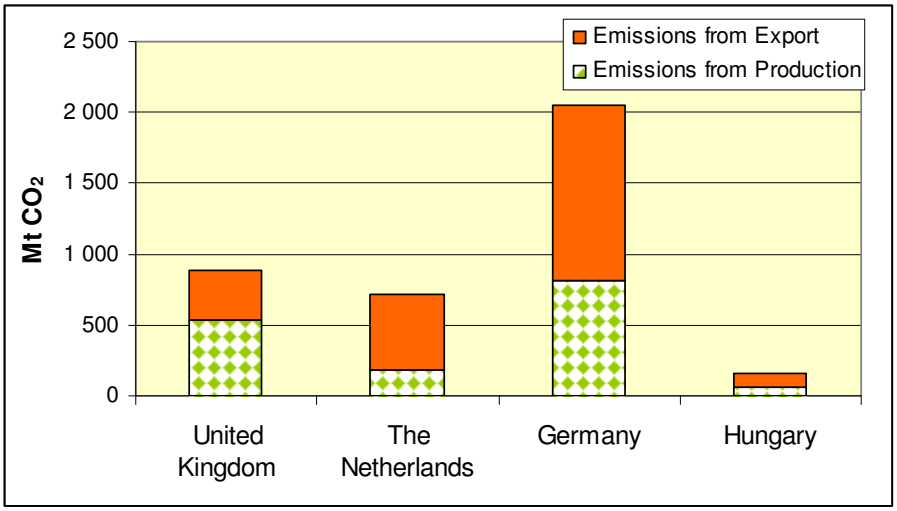

FIGURE 2: CO_2 EMISSIONS OF DOMESTIC PRODUCTION EXPORTS

From the climate accounting point of view, not only the emissions embodied in international trade are important, but the sectoral level needs to be examined as well. According to the ecological unequal exchange theory, those sectors are especially harmful to the environment where, the relative share of carbon-dioxide emissions embodied in imports are greater than the imported values share to the total import value of the country, so where the intensity (the tonne of CO_2 embodied in imports per currency spent on imports) of embodied emissions is high.

The industries in each country were ranked according to their carbon intensity and total emissions, so in the following section the industry sectors having the highest import intensity can be found for the analysed countries.

In the Netherlands the sectors which are quite carbon intensive concerning the imports can be seen in Table 1. The sectors of Chemicals; Basic Metals and Mining and quarrying have also one of the highest total carbon emission values.

TABLE 1: CO_2 EMISSIONS AND INTENSITY OF IMPORTS IN THE NETHERLANDS

Rank	Industry sector	Total carbon-dioxide emissions (Mt CO_2)	Import/Total Import value	Imported Carbon Footprint/ Total Imported CF
1	C24 Chemicals and chemical products	160,90	10,8%	21,2%
2	C27 Basic metals	69,87	3,4%	9,8%
3	C10T14 Mining and quarrying	49,65	8,3%	7,0%
4	C15T16 Food products, beverages and tobacco	65,86	5,5%	6,4%
5	C23 Coke, refined petroleum products and nuclear fuel	38,59	3,7%	5,1%

Interestingly, in Germany, the first three carbon intensive sectors, which also have high carbon emission values in absolute terms as well, are the same as in the Netherlands. Furthermore, it is the textile industry which requires a high amount of raw materials, after the industries providing metals and minerals, which generate emissions in the exporting countries.

TABLE 2: CO_2 EMISSIONS AND INTENSITY OF IMPORTS IN GERMANY

Rank	Industry sector	Total carbon-dioxide emissions (Mt CO_2)	Import/Total Import value	Imported Carbon Footprint/ Total Imported CF
1	C24 Chemicals and chemical products	236,87	10,0%	13,0%
2	C27 Basic metals	174,82	6,1%	12,1%
3	C10T14 Mining and quarrying	145,45	7,8%	9,4%
4	C23 Coke, refined petroleum products and nuclear fuel	120,29	3,6%	7,4%
5	C17T19 Textiles, textile products, leather and footwear	128,50	5,0%	6,4%

As for the United Kingdom (Table 3.), which on an aggregate basis, had the lowest share of embodied emission, the sectors are more varied concerning the emissions embodied in imports.

The Chemicals and chemical product, the Motor vehicles industry and the Food processing industry can be given responsibility for the high amounts of imported emissions and they contribute to the total carbon-dioxide emissions in a great extent as well.

TABLE 3: CO_2 EMISSIONS AND INTENSITY OF IMPORTS IN THE UK

Rank	Industry sector	Total carbon-dioxide emissions (Mt CO_2)	Import/Total Import value	Imported Carbon Footprint/ Total Imported CF
1	C24 Chemicals and chemical products	139,08	7,9%	13,2%
2	C27 Basic metals	48,48	2,7%	5,9%
3	C17T19 Textiles, textile products, leather and footwear	73,44	5,8%	5,9%
4	C29 Machinery and equipment n.e.c	55,90	5,4%	5,8%
5	C60T63 Transport and storage	94,85	4,5%	4,6%

The Chemicals and chemical products seem to have a high share of carbon-dioxide emissions in Hungary as well, and this sector is also responsible for a high amount of emission embodied in imports. Basic metals and machinery are those products which contribute to the carbon-dioxide emissions significantly through the import activities of the country.

TABLE 4: CO_2 EMISSIONS AND INTENSITY OF IMPORTS IN HUNGARY

Rank	Industry sector	Total carbon-dioxide emissions (Mt CO_2)	Import/Total Import value	Imported Carbon Footprint/ Total Imported CF
1	C24 Chemicals and chemical products	26,59	7,5%	12,1%
2	C27 Basic metals	16,09	4,0%	8,8%
3	C29 Machinery and equipment n.e.c	12,29	6,1%	6,6%
4	C28 Fabricated metal products except machinery and equipment	7,48	3,5%	4,1%
5	C15T16 Food products, beverages and tobacco	11,67	3,1%	3,9%

The carbon emissions per industry unit of output, the so-called physical coefficients have also been analysed, showing that the industries of electricity, gas and water supply; basic metals, mining and quarrying and chemicals can boast with the highest coefficients, but the rank of the industries varies in the analysed countries.

V. CONCLUSION

Results have shown that the analysed countries generate a high amount of carbon emissions abroad because of the final demand. It is the Netherlands which generates the highest amount of CO_2 emissions abroad. A sectoral analysis has been carried out as well for each country, concerning the carbon emissions of production, indirect and direct import activities.

In this study we could see that the production - based approach can be viewed as an asymmetry concerning the internalization of external costs in climate accounting. By quantifying the CO_2 embodied in overall consumption, and consumptions of the specific industry sectors, it can highlight for policy makers the extent to which the country is dependant on other countries ecological resources, where their footprint directly falls and their responsibility for consumption. What is more, the trade management of a country might contribute to the reduction of its emissions and footprint. Facing climate change and the future scarcity of resources all nations will have to look for alternatives to reduce their emissions, and the allocation method can also help motivating the countries to do so.

VI. ACKNOWLEDGMENT

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PROFILING AS TOOL FOR INCREASING THE EFFICIENCY OF GHG RELATED POLICY

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Abstract: ***Consumer policy approaches regarding green products and solutions can be differentiated by their main focus. "Green positioning" is basically targeted at environmentally aware consumers while "efficiency-focused positioning" concentrates on the efficiency gain of the product or solution, targeting the whole society, regardless of consumers' environmental awareness. The paper argues that the scope and total environmental benefit can be increased if green products or solutions are promoted in different ways, not only as "green", but also based on other arguments (like cost-efficiency, return on investment etc.). The paper suggests a model for improving the efficiency of GHG-related consumer policy. Based on the marginal social cost curve and the marginal private cost curve, different (green, yellow and red) zones of action are identified. GHG mitigation options chosen from those zones are then evaluated with the help of profiling method, addressing the barriers to implementation. Profiling may help design implementation strategy for the selected options and make consumer policy more effective and acceptable for mass market. Case study results show three different ways of positioning of GHG-related consumer policy in Hungary from 2000 and gives practical examples of profiling, based on the latest marginal social cost curve and the contemporary energy saving policy of the state regarding the residential sector.***

I. INTRODUCTION

The McKinsey report [1] found that in the United States, almost 40 percent of abatement could be achieved at negative social cost which means that investing in these options would generate positive economic returns over their lifecycle. These options are often labeled as "no-regret". The report estimates the biggest abatement potential for improving energy efficiency in buildings and appliances. Wesselink and Deng [2] analyzed cost scenarios for the EU27 and found half of the options falling into the negative social cost zone.

If there are so many "no regret" options, then why are these opportunities not often realized? How can we overcome implementation problems? The paper studies the implementation barriers behind GHG related investments and suggests a method called "profiling" for analysing and finding solutions for these barriers.

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II. THE THREE ZONES OF THE MARGINAL SOCIAL COST CURVE

The answer for "not acting reasonably" is partly buried in the difference between marginal private costs and marginal social costs of abatement. Both the curves for social costs as well as that for private costs are gained by summing up the marginal private abatement cost curves horizontally. The difference is how costs were calculated (e.g .taking into account taxes, transfers, private and social discount rate etc.) The sign SIGMA at Figure 3 indicates that private and social costs of selected product groups are calculated at national level rather than for a single producer.

Negative marginal social costs do not necessarily assume negative private costs. National MAC calculations are carried out on the basis of social costs, by correcting market prices for market inefficiency, externalities, market distorting regulations, subsidies

and taxes. Logic dictates that public policy should concentrate on projects with high abatement potentials and low, preferably, negative social cost. Figure 1 illustrates that for certain abatement options marginal social costs might be negative, while marginal private costs are still positive. They are worth being implemented for the society, but not for the individuals. Using a traffic light analogy:

- Green zone options pay back both for the society and for the economy. They penetrate the market without intervention, although this penetration may take time depending on the technological lifecycle.
- Yellow zone options pay back for the society, but not for the individual. This is the major arena for consumer policy design. The options definitely need public policy intervention and investment, but those efforts will pay back for the society.
- Red zone options neither pay back for the society nor for the individual. They can only be promoted under very special circumstances (e.g. in case of spin-off technologies).

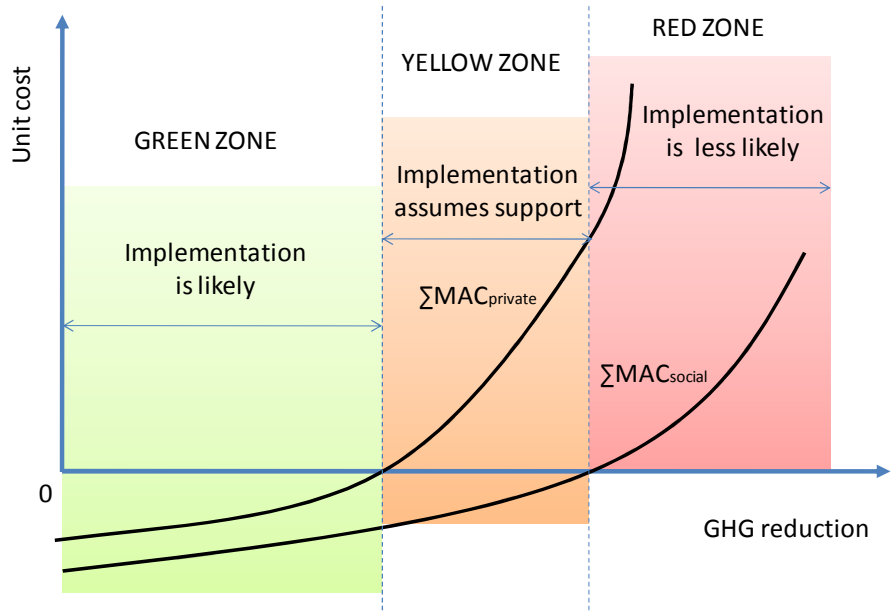

FIGURE 1: IMPLEMENTATION CHANCES OF GHG REDUCTION OPTIONS, BASED ON MARGINAL SOCIAL AND MARGINAL PRIVATE COSTS

The above cited studies [1] and [2] suggest that there is a huge potential in household energy saving and the options with the most environmental potential fall into the green zone. However, there are still a lot of backlogs in implementing those options which makes a further assessment of the selected green and yellow zone options necessary, from the point of view of consumer policy design. Profiling helps identify barriers and cope with them, especially in case of yellow zone options.

III. IDENTIFYING IMPLEMENTATION BARRIERS – USE OF THE PROFILING CONCEPT

In spite of their negative marginal social costs, green and yellow zone options involve a series of widely known and frequently mentioned barriers a consumer policy designer must cope with.

- Up-front investment problems are seen as major barriers for the private sector [3]. Up-front costs may be prohibitive for lower income families even if those investments would pay back in reasonable time; (e.g. additional insulation). These families often don't have proper access to capital [4].
- Lack of information on options, potentials and cost effectiveness, or lack of awareness [4] even when the information is available; (e.g. LED bulbs).
- Long lifetime of certain technologies may hinder implementation. Less efficient boilers or not airtight windows are kept until they get into bad physical condition.;
- Habits, fashion, insisting to the well-known (e.g. unusual form of CFL or LED bulbs);
- Risks involved in new solutions (e.g. alternative energy use at home);
- Lack of marketing budget at producers to disseminate information about new solutions (e.g. window film reflecting sunrays);
- Massive marketing by certain companies which works against these options (e.g. massive marketing of air conditioning equipment works against energy saving shading solutions). Certain solutions, e.g. insulation or shading, are sold by small or medium size companies that cannot compete with the marketing power of air conditioning equipment producers.
- Low energy prices do not motivate for energy-efficiency [4].
- Split incentives or insufficient incentives to make pertinent decision is also mentioned by a UNEP RISO Centre working paper, meaning "inadequate or inefficient policies often create more barriers rather than ease them" [5].
- Indirect costs and benefits of the options [6] are not recognized.
- Financial and technological risks, etc. also cause difficulties [4].

Beyond social costs, the above listed barriers as well as benefit potential also have to be considered in assessment. In the following, the concept of profiling, borrowed from risk management, will be presented as a useful tool for evaluating public perception of GHG mitigation options. Hazard profiles have been used for a long time in the environmental decision making for prospecting public perception of new, unknown or high scale risks [7] [8]. The same profiling methodology can be used in consumer policy as profiling seems to be especially useful for anticipating public perception of proposed consumer policy actions and designing implementation strategy for a new, innovative solution. When an innovative and a conventional option share the same profile, similar public reaction can be expected and similar strategy can be used which was successful for the conventional option, in order to tackle barriers of the innovative solution.

Table 1 summarizes the most important factors for the assessment of the selected GHG mitigation options. Every option can be characterized with specific scores given to the option in the case of each and every evaluation factor.

TABLE 1: EVALUATION FACTORS AND THEIR SCORES FOR THE PROFILING OF GHG MITIGATION OPTIONS

	PROHIBITIVE for mass market	**CONTINGENT, requires external support**	**ACCEPTABLE**
	score:1-3	score: 4-6	score: 7-9
COST factor			
Initial investment cost (private)	High	Medium	Low
Private cost based payback period	More than 10 years	6-10 years	Less than 6 years
Marginal social cost of implementation	High	slightly positive	Negative
BENEFIT factor			
Environmental benefits	Low	Medium	High
Co-benefits	Low, non-quantifiable	Some benefits	Medium to high, at least same range as energy savings
Compromise required from customers	Perceived as high Acceptable only to less than 10% of people	Perceived as medium (acceptable to 10-30% of people)	Perceived as low (acceptable to more than 30% of people)
COOPERATION factor			
Chance to build strategic alliances	No or low interest (1-3)	Some interests from certain partners (4-6)	High interest in several partners (7-10)
Integration with other policies	Other policies work against	Neutral	Good integration
Counter interested market agents	May threaten the success of the policy	Can be neutralized	Low lobbying power
Information and marketing requirements	Stakeholders are difficult to get involved	Stakeholders can be informed at low costs	Well informed stakeholders
RISK FACTOR			
New or common technology	New	Medium	Common
Trust in policy	Low	Medium	High

Based on the scores for each factor, the consumer policy profile of the selected GHG mitigation options can be drawn. Figure 2 shows three examples, which are significantly different in their profiles, without numbers to illustrate the logic of profiling.

Designing policy implementation involves pushing the curve into the acceptable zone. Costs of consumer policy can be significantly reduced if there are economic agents who find co-benefits in the proposed solution and are willing to invest into promoting it.

The profile should be seen as a flexible string rather than a curved rigid pole. Pushing a certain point of the string impacts and changes other points as well. Thus, working on the feature falling into the prohibitive zone is not the only approach the policy may take when addressing the barriers of implementation. The policy may rely on and take advantages of features where the option was given high scores.

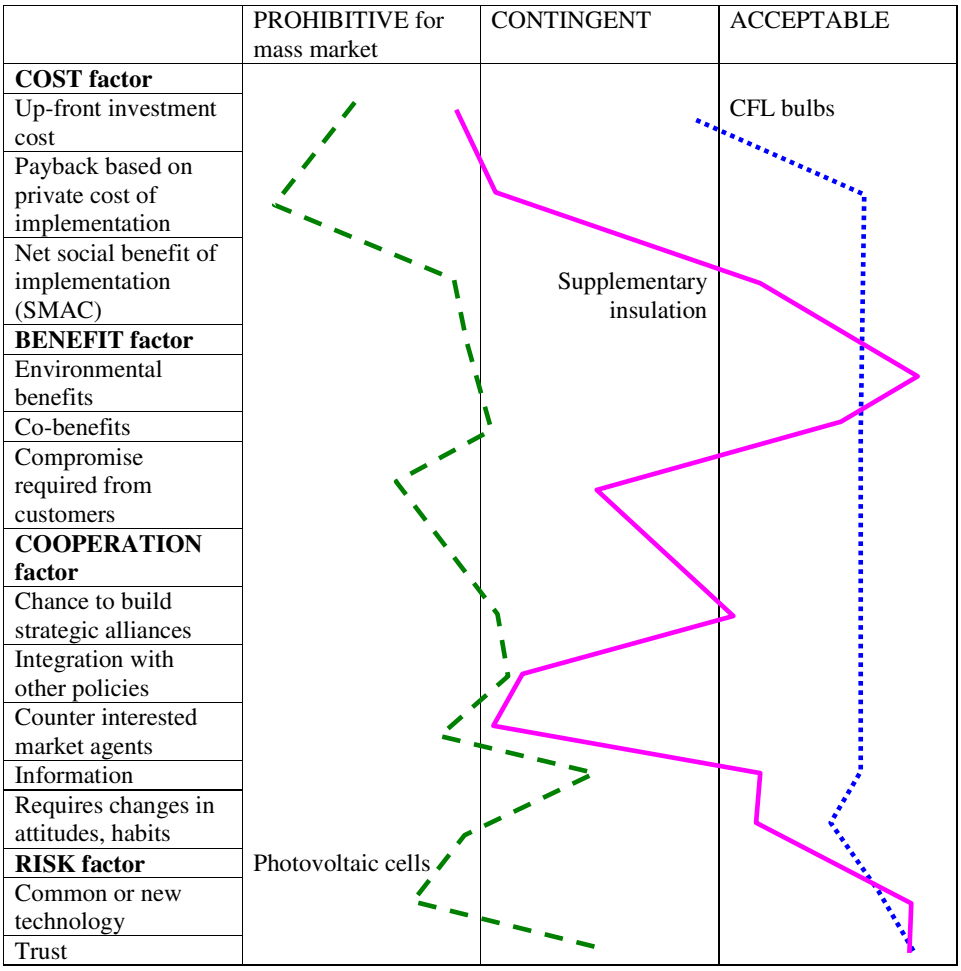

FIGURE 2: USING PROFILES FOR DESIGNING AN IMPLEMENTATION STRATEGY

For example, the profile of the „insulation" option reveals prohibitive investment costs, but good co-benefits and high chance to build strategic alliances. Co-benefits include energy saving and increase value of the property. Potential strategic partners can be found among local entrepreneurs of the building industry and among financial institutions dealing with loans. Consumer policy, then, may focus on:

- Reducing investment costs by subsidizing investment and building strategic alliances with the building industry. Subsidies increase demand for the building industry, so the industry might want to take over the marketing tasks; OR
- Quantifying co-benefits like increased value or marketability of the rebuilt home. Investment costs seem to be relatively lower when they serve several purposes; OR
- Building strategic alliances with banks. The financial institution provides loans for the insulation investment and the payback comes from energy savings; OR
- Lobbying for not to subsidize the (non-renewable) energy prices or the fossil fuel industry.

Thus, the prohibitive nature of high insulation costs might be solved by better cooperation with other actors.

IV. CONCLUSIONS

The paper presented the use of three interrelating tools –construction of the marginal social cost curve, identification of three zones of action, as well as profiling the implementation barriers of selected options – which can help design GHG-related consumer policy to increase its efficiency. In our opinion, options with high environmental potential and negative, zero, or slightly positive social costs have to be put into the spotlight. These are the typical yellow and green zone options, the implementation of which is likely but some barriers may impact discouraging and slow down the process. Consumer policy should use the profile of these options and work towards overcoming implementation barriers.

V. ACKNOWLEDGMENT

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ENVIRONMENTAL ACCOUNTING IN HISTORIC PERSPECTIVE

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Abstract: ***The importance of sustainable development is unarguable. The concept of environmental accounting extends more and more. The roots of both of them originate from the 60s- 70s, so they are quite young research areas. Currently, we can see that the theoretical framework is worked out well. My aim is to deal with the historical perspective of the sustainable development and environmental accounting. I examine the two main discussion fields in parallel. The main statement is that the sustainable development has got a very huge effect on the development of environmental accounting.***

I. INTRODUCTION

In this paper I focus on the evolution of sustainable development and environmental accounting. First of all, I determine the base concepts of each field which have various definitions.

The acceptable description of sustainable development in my work is the following well-known definition. Sustainable development is a "development that meets the needs of the present, without compromising the ability of future generations to meet their own needs" [1].

Environmental accounting definition originates from social accounting. “Social accounting is about some combination of: (a) accounting for different things; (b) accounting in different media; or (c) accounting to different individuals or groups and (d) accounting for different purposes” [2]. We may see that social accounting is a very complex research area. At the beginning, common terminology and framework did not exist. Today, it has attained a full growth resulting in the system of environmental accounting, which can be used for organising, managing and supplying data and information on the environment in physical and monetary units [3]. Environmental accounting is a subsystem of social accounting.

I want to disclose the main tendency in social accounting and within this, environmental accounting. I do not want to analyse the philosophical background, the development of the terminology and findings. I want to point out the main events, occasions, publications to deviate from the main stream development.

This article is descriptive. I use the relevant literature, the occasions, and publications of United Nations and European Union, to analyze the progress of sustainable development and environmental accounting.

II. THE EXTENSION OF THE CONCEPT OF SUSTAINABLE DEVELOPMENT

In this chapter I describe the main events which gave inspiration to focus on sustainable development. To present that, I use publications, books, environmental organisations occasions from 1960s (Figure 1).

First of all, “sustainable development has been in existence for much of humankind’s history, but became to wider prominence with the Brundtland Report” [4]. I begin the analysis from the year of 1960 based on findings in the Brundtland report.

In the 60s, 70s, the potential of major environmental disasters inspired people to deal

with the environmental effect of human's activities [5]. Increasing number of negative effects of the human activities on the environment is identified [6] [7]. In this period lots of publications were reporting about the connection between environment and business. One of the books is Bowen's The Social Responsibility of the Businessman (1953), in which the concept of corporate social responsibility is used for the first time. In addition, Carson published The Silent Spring in 1962, in which she dealt with the damaging effects of the pesticides DDT on the environment. The author blamed the chemical industry because of misdirection [8].

In the next phase, the United Nations and European Union supported a number of conferences and publications, which made a significant impact. The idea of sustainability comes into view in a series of meetings and reports during the 1970s and 1980s. First of all, in 1972, The Limits to Growth report [9] was published, commissioned by the Club of Rome. The book emphasises the consequences of a rapidly growing world population, which takes place with restricted resource supplies. Another important occasion in 1972 was the first United Nations Conference on the Human Environment in Stockholm. The topic of the conference was about how human activities were destroying the environment and putting humans at risk.

The next step was the World Conservation Strategy (WCS) in 1980. The Strategy emphasises, that the conservation of nature can not be achieved without development. It gives intellectual frameworks and practical direction for the conservation action obligatory [10].

The next important event to mention is, the World Commission on Environment and Development (WCED), which was created in 1983. The purpose of the organisation was to examine world's critical environmental and development problems with the objective of devising solutions.

The main milestone of the sustainability development was in 1987, when the WCED published the report of Our Common Future, which considered social, economic, cultural and environmental issues together to recommend global solutions. In this report, the concept of sustainable development is created.

In 1992, the first United Nations Conference on Environment and Development was organised in Rio de Janeiro. Over 178 governments adopted the Agenda 21 and the Rio Declaration on Environment and Development.

A period of numerous conferences, meetings and summits followed on this topic, out of which I highlight the most important once.

In 2002, World Summit on Sustainable Development was held in Johannesburg. It reassured global focus on sustainable development.

The 2009 United Nations Climate Change Conference (Copenhagen Summit) recognised that climate change was one of today's greatest challenges.

The development of the concept is not finished, but we can see, that the meetings and agreements are inadequate.

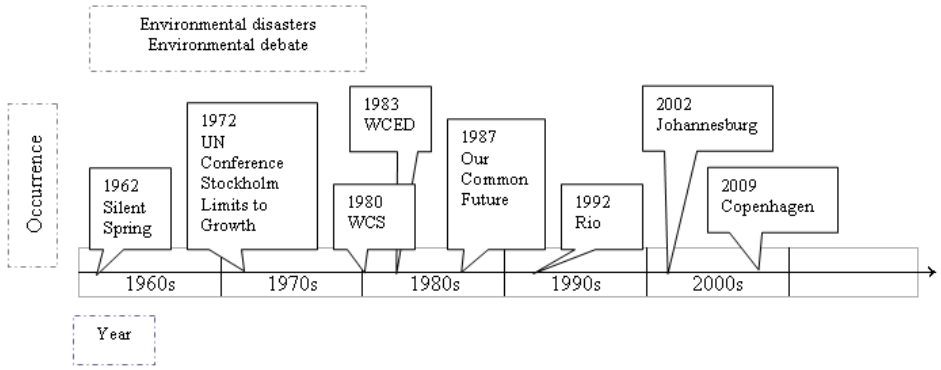

FIGURE 1: THE CRONOLOGY OF SUSTAINABLE DEVELOPMENT.

III. THE DEVELOPMENT OF ENVIRONMENTAL ACCOUNTING

In this chapter I review the main development point of environmental accounting using academic publications.

The environmental accounting concept roots in the idea of social accounting (Figure 2). The social accounting debate origins from the business and social responsibility discussions of the 1960s and 1970s. Because of the lack of standardized background, social accounting received various labels, for example social responsible accounting, social audit, corporate social reporting and environmental accounting. It was followed by a number of inhomogeneous projects of social accounts. Various objectives, methods and approaches were used [11]. The main dimension of the research is the imperfection of conventional accounting, the social and environmental accounting education and the elaboration on the theoretical background.

1960s, the recognition of social accounting grew [11]. The interest rose on corporate ethics [5], social responsibility, ecological degradation.

1970s, the number of publications increased in measurement of social performance, in connection between business and society. This is the time when the managerial and corporate social responsibility began to develop.

Additionally, accounting journals and accounting organisations are supporting the development of social accounting, (inspire, support and issue publications of this topic). For example, UK Accounting Standards Steering Committee has published about the significance of social accounting information in financial statement (1973). In addition American Accounting Association has published reports about the environmental effects of organisations behaviour (1973) [12]. Journals, Accounting Review, Accounting, Organisations and Society took up social accounting and laid down mostly empirical studies [11]. The publications are unsophisticated, included a large portfolio of interests. The theoretical base had not developed yet by then.

1980 professor Gray raised a question for the public about the corporate responsibility of the activity. Furthermore, the companies have to give information for the shareholders

about the effects of the operation [13]. This event encouraged the publications with different purposes: the cost savings, increased revenues of green marketing strategy [14]. In this period a lot of journals were established in this new research area, for example Accounting, Auditing and Accountability Journal and Journal of Accounting and Public Policy.

As a next step, the Coalition for Environmentally Responsible Economies (CERES) was established in 1989 and published the 10 principles of environmental management (Ceres Principles). This organization launched the Global Reporting Initiative in 1997, which was one of the most important milestones of environmental accounting development. GRI is a voluntary, globally applicable sustainability reporting guideline.

In the 90s, sustainability and accounting received continuing attention in academic and professional accounting literature [15]. The publications focusing on sustainable development and accounting can be grouped to three categories. The first group analyzes the effect of sustainable development on accounting. "Sustainability is a good thing and thus accountants should be involved in its pursuit" [16]. The second type explores the reflection of accounting to the sustainable development issues. The third type of the accounting and sustainability literature emphasises the need for new accounting focusing on the requirements of sustainable development. Gray (1992) [17] deals with the sustainable cost first [4]. In this period, lots of empirical surveys were completed on sustainable cost for example the Green ledgers [16].

In the 90s, specialization gained ground within social accounting. The interest grew in environmental accounting with numerous publications. The topics of environmental accounting publications are diverse, and first emerge from social aspect [14].

One special field is the national environmental accounting. The environmental accounting has got two levels, which are the national and organisational one. The national environmental accounting deals with the problems of System of National Accounts (SNA). The main unsustainable theoretical assumption is that natural resources are inexhaustible assets. This problem was examined in 1970s. The first attempt was to use the Measure of Economic Welfare indicator (MEW, Norhaus and Tobin, 1972). After that, increasing number of researcher and organisations have been trying to work out indicators and indicator systems reflecting sustainability and sustainable development [3]. Agenda 21 introduces the concept of environmental accounting as a tool to push for putting sustainable development into practice. This is the beginning of the sophisticated national environmental accounting. My aim is to deal with environmental accounting at organisation level, not on the national aspect.

Another main stream is the emission trading and the intangible assets in the balance sheet. The roots of emission trading are in the United Nations Framework Convention on Climate Change treaty. It is an international environmental treaty produced at Rio de Janeiro Earth Summit (1992). The main aim of the treaty was to stabilize greenhouse gas concentrations in the atmosphere.

Furthermore, in 1997 Elkington created the concept of triple bottom line. The fair values to measure organisational performance are economic, ecological and social criteria [18]. This approach integrates financial, social and environmental reporting.

The next main publication field is the new form of accounting for the environment promoted by Schaltegger. Ecological accounting is involved into traditional accounting, both financial and managerial level [19].

One of the important elements of environmental accounting is input-output analysis. It gives an account of the physical in- and out-flows of a process (analysis of environmental effect, too) [18] [20].

The last concept within environmental accounting which I mention is financial environmental accounting. I emphasise two main events, which plays important role in financial environmental accounting.

In 1999 AccountAbility 1000 standard was created, which aim is to improve the accountability of organisations. Among others it was the first standard for building corporate accountability [21]. It provides a framework that organizations can use to understand and improve their ethical performance [22].

In 2002, Johannesburg World Summit on Sustainable Development, Sustainability Accounting Guidelines (SAG) plays an important role in the development of financial environmental accounting [18].

It can be seen, that the development of sustainability has got a big influence to the development of environmental accounting.

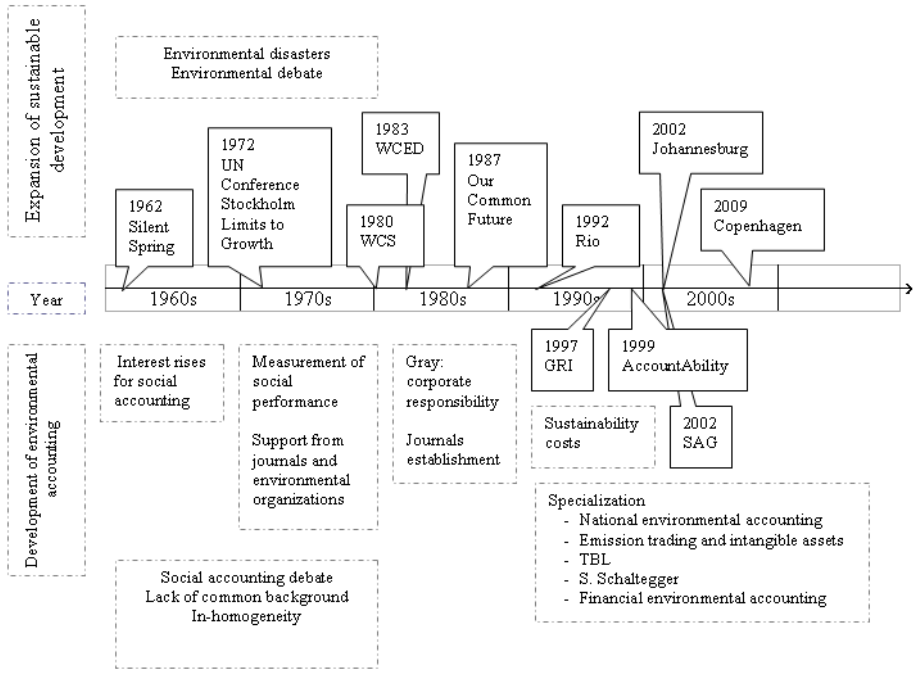

FIGURE 2: THE CRONOLOGY OF ENVIRONMENTAL ACCOUNTING.

IV. CONCLUSION

This small work shoes that the root of the historical perspective of sustainable development and environmental accounting derive from 60s. The main trend is appointed by the main milestone of the expansion of sustainable development. The international conferences and meetings are the moving power of this process. The development of sustainability influenced the progress of environmental accounting. In 60s there was confusion, what features the development of environmental accounting. The specialization

and the common framework were worked out only in 90s.

I think these two fields are very hard combined with each other. Despite that, this two research areas stand alone too. The topics of environmental accounting are very different nowadays, but we can find separate trends. Together with, the empirical studies are very common in our days.

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SHORT AND LONG TERM SOCIAL DISCOUNT RATES ON THE BASIS OF STATED PREFERENCES

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Abstract: ***This study presents the results of an investigation into stated time preferences through pair-choice decision situations for various topics and time horizons. It is assumed that stated time preferences differ from the observed time preferences, as they decrease hyperbolically over the long term due to a lot of anomalies in temporal decisions.***

The social time preference rate (STPR) tries to capture in brief how the wellbeing of future generations is discounted by the present generation The research question is how the gap between the calculation and the results of surveys can be resolved at all, and how the real time preferences of individuals can be interpreted using a social time preference rate.

In order to reveal the discounting patterns of Hungarian people we conducted a survey using different types of questions, including personal and community profits, saving lives and the future costs of climate change. Time discounting behaviour seems to be significantly affected by religion, qualification, happiness and environmental attitude.

I. INTRODUCTION

Samuelson's discounted utility (DU) model was introduced in 1937 and applied for policies (e.g. Cost-Benefit Analysis) until recent times and generally accepted as a model which can describe actual intertemporal behavior representing it in one parameter (Social discount rate). The social time preference rate consists of two main components; the first one shows the pure time preferences of people and the second one makes the wellbeing of different generations equal. These two components added together give the calculated social time preference rate.

Over the last decades a lot of empirical research (Loewenstein and Prelec [1992], Chapman [2001], Lazaro et al. [2002]) have documented anomalies in intertemporal choices. The most important discovery is that the discount rates are not constant over time, but are decreasing and seem to follow a hyperbolic curve on the basis of several observed anomalies in responses [Loewenstein and Prelec, 1992], namely: (1) sign effect (gains are discounted more than losses); (2) magnitude effect (small amounts are discounted more than large amounts); (3) delay/speedup asymmetry (greater discounting is shown to avoid delay of a good than to expedite its receipt); (4) improving sequences (in choices over sequences of outcomes, improving sequences are often preferred to declining sequences though positive time preference dictates the opposite); (5) violations of independence and preference for spread (in choices over sequences, violations of independence are pervasive, and people seem to prefer spreading consumption over time). Beyond those anomalies, time effect (inverse relationship between time horizon and discount rates) and domain effects (different discount rates are used for different goods, e.g. money, health) can be observed in case of long-term stated time preferences [Chapman, 1996].

Chapman [2001], Lazaro et al. [2002], Hendrickx and Nicolaij [2004], Berndsen and Pligt [2001] conducted their studies on students and revealed their time preferences on various topics. Lazaro et al. [2002] found that stated preferences do not correspond with

the behavior predicted by the axioms of Samuelson's discounted utility model and their results also underpin the assumptions of time effect, magnitude effect and delay/speed-up asymmetry in social intertemporal decisions.

Chapman [2001] has undertaken 3 experiments among a sample of students and studied the difference between intergenerational and intragenerational discounting behavior. Despite the assumption that the intergenerational discount rates should be lower, empirical research shows similar parameters for both time intervals [Chapman, 2001].

Svenson and Karlsson [1989] as well as Hendrickx and Nicolaij [2004] investigate the connection of temporal discounting and environmental risks. Hendrickx and Nicolaij [2004] focus on the ethical and loss-relating concerns related to risk evaluation. Svenson and Karlsson [1989] analyze the significance of time horizons and the discounting of negative consequences using a decision theoretic framework. Both empirical studies found that the majority of people did not discount environmental risks.

This study is based on a representative sample of 1000 elements, in contrast to other authors, who have undertaken their studies on samples of students. We consider that students would not represent the actual attitudes of all social clusters, although they would give us proper and accurate answers. Our survey is representative for the Hungarian population regarding gender, age and income.

II. METHODS

The questions in the survey aim to measure personal preferences through getting rewards in the future and also try to capture the personal preferences which concern common decisions mainly through allocation of common costs over time. We also attempt to reveal the long term intergenerational time preferences through saving lives and the last type of question investigates the willingness to pay (WTP) of people about the future costs of climate change.

Each questionnaire consists of 4 types of questions regarding "Winning money", "Saving lives", "Flood" and "Climate costs" over different time horizons.

As described above, each questionnaire consists of 4 types of questions and each question type contains 11 pairs of 2 alternatives which arranged on an ordinal scale. Thus, it is possible to investigate respondents' "switching point" where they switch from alternative "A" to alternative "B". For example, the first type of question assumes a hypothetical situation, where the respondent wins a certain amount of money, and has to decide when he/she wants to receive it. Alternative "A" involves receiving 100 000 HUF immediately while alternative "B" involves receiving a bigger amount 1 year later:

TABLE 1: SAMPLE OF QUESTIONS (WINNING MONEY 1 YEAR DELAY)

	A I get NOW	B I get in 1 YEAR	Choice	Do not know	X
a.	100 000 HUF	100 000 HUF	A B	9	X
b.	100 000 HUF	101 000 HUF	A B	9	X
c.	100 000 HUF	102 000 HUF	A B	9	X
d.	100 000 HUF	103 000 HUF	A B	9	X
e.	100 000 HUF	104 000 HUF	A B	9	X
f.	100 000 HUF	105 000 HUF	A B	9	X
g.	100 000 HUF	106 000 HUF	A B	9	X
h.	100 000 HUF	110 000 HUF	A B	9	X
i.	100 000 HUF	115 000 HUF	A B	9	X
j.	100 000 HUF	120 000 HUF	A B	9	X
k.	100 000 HUF	125 000 HUF	A B	9	X

The second type of question refers to social decisions related to flood protection. The hypothetical situation is the following: “Imagine that the state offers a certain amount of money to villages along the river Tisza, which has to be spent on flood protection. If the subsidy is asked for immediately, the state can offer a lower amount, if you wait 1 or 10 years, villages will get a larger sum, which makes more efficient protection possible (e.g. stronger dams). What is your decision?”. The purpose of this question is to reveal people’s attitude to urgent and pressing situations, where it is important to act as soon as possible. Our assumption is that in such a decision situation, where intervention is urgent, using time preference rates is meaningless or using stated preferences will lead to a paradox exchange: the quicker the intervention should be, the higher the time preference rate, which induces decisions for postponing actions.

The third question type deals with saving lives, using the following hypothetical situation: “Imagine that you have to decide between two programs, which financially support medicine and therapy researches. In case of Program “A” an already existing treatment is supported, which can save 100 lives immediately. Program “B” supports medicine researches, which could help more than 100 people in 1, 30 or 100 years to stay alive. What is your decision?”.

The last group of questions, regarded as the most abstract or hypothetical, deals with the financial consequences of climate change: “Imagine that you have to choose from two options regarding climate costs. Option “A” is that, from now on, you pay a certain amount annually (to cover the costs of climate change), and option “B” involves postponing the costs and paying 1 million HUF (in 10 years) or 10 million Ft (in 30 years), when the catastrophic consequences of climate change occur. What is your decision?”

In all cases, inflation is ignored, 1 HUF now is equal to 1 HUF in the future.

In Table 2 the four types of questions are summarized by temporality, involvement, type of outcome and time horizons.

TABLE 2: TYPES OF QUESTIONS

Questions	Domain	Type of discounting	Involvement	Type of outcome	Time intervals
Winning money	money	short term, intragenerational	personal	postponing reward	1, 3, 10 years
Flood	risk	short term intragenerational	social	avoiding costs	1, 10 years
Saving lives	health	long term, intergenerational	social	saving lives (postponing reward)	1, 30, 100 years
Climate costs	money/risk	long term, intergenerational	personal	postponing costs	10, 30 years

Discount rates have been calculated according to the following equation:

$$Discount\ rate = \left(\frac{indifference\ point}{immidiate\ benefit}\right)^{\frac{1}{n}} - 1$$

where n is the number of years implied in the choice. The indifference point is the point where the respondent switches from one alternative to another [Chapman, 2001]. The indifference number stands with the last preferred immediate benefit (alternative "A"), before alternative "B" is chosen, e.g. if winning 115 000 HUF in 1 year is preferred to getting 100 000 HUF now, but 100 000 HUF now is preferred to getting 110 000 HUF in 1 year, then the indifference point is 110 000 HUF.

In the questionnaire besides time discounting questions, respondents were asked about happiness, life satisfaction, general attitude to the environment (5 questions) and personal data (gender, age, number of children, qualification, net income) as well. The general attitude questions tried to reveal how people evaluate our environment and what they think should be done to preserve our natural resources for the next generations. Respondents were asked to decide on a 5 grade scale (1- totally disagree, 5 – totally agree) whether they agree or disagree with the following statements:

1. The state is responsible for preserving our natural resources. ("state")
2. It is everybody's right to use natural resources for private purposes. ("private")
3. I believe that technological development and innovations will solve the environmental problems. ("innov")
4. We should radically change our consumption behavior in order to preserve our environment. ("change")
5. People must ensure that natural resources will be available for the next generations. ("nextgen")

The questions about happiness and life satisfaction were measured on a scale from 1 to 10 where 1 means "unhappy/dissatisfied" and 10 means "very happy/very satisfied".

III. RESULTS

Although 1012 individuals completed the questionnaire, there were missing values and in many cases the results were not appropriate for analysis for different reasons. It often occurred that respondents chose two or more switching points, which are not consistent in an ordinal scale, or they did not switch from one alternative to another. The latter event could happen for several reasons: (1) respondents do not want to discount at all (2) the scale is not wide enough, thus they could not find their indifference point (3) respondents do not understand the situation or (4) they do not want to make a decision. Thus, the inconsistent and unusable replies were coded as "do not know" and excluded from the analysis.

Table 3 shows the number of respondents, the minimum and maximum value of discount rates, and their means by question types. Various time delays were used for different topics, in order to examine people's decision-making over different time horizons.

A repeated measures ANOVA was conducted between time delays within each question group. The results of RM ANOVA suggest that the time delays within all question groups significantly differ from each other (Greenhouse-Geisser and Huynh-Feldt tests show p=0,000 significance level), but according to the pairwise comparisons of means by Bonferroni correction in "winning money" the means of time delays 1 and 3 years do not differ statistically (p = 0,546).

In case of 'Saving lives' and 'Climate costs' scenario, we have long term (intergenerational) discount rates, and we can observe that the rates fall as the delay increases (time effect), and there is a significant difference between the discounting of money and health (domain effect). The high rate for flood in a 1 year delay implies a preference for early intervention and the very low number of responses in favour of a 10 year delay also correspond with findings of other research by Svenson and Karlsson [1989] as well as Hendrickx and Nicolaij [2004], illustrating that the majority of people do not discount environmental risks, where they could be involved personally.

TABLE 3: DESCRIPTIVE STATISTICS

	N	Minimum	Maximum	Mean
winning1	335	0%	25%	14,40%
winning3	423	0%	26%	14,06%
winning10	541	0%	26%	16,74%
flood1	361	0%	67%	29,34%
flood10	47	0%	13%	4,74%
savinglives1	584	-1%	25%	8,06%
savinglives30	385	0%	9%	5,03%
savinglives100	355	0%	5%	2,93%
climate10	302	1%	35%	16,81%
climate30	300	3%	15%	9,15%

A one-way ANOVA method was conducted in each question group using discount rates as dependent variables. Independent variables were gender, age, net income, qualification,

happiness, life satisfaction, number of children and attitude questions about environmental problems (Table 4 contains only those variables which have statistically significant results).

No connection can be observed between time discounting and gender: women and men use the same discount rates. There was absolutely no statistical connection between age, number of children and time discounting behavior.

TABLE 4: ONE-WAY ANOVA FOR VARIABLES (SIG. LEVELS, P<0,1)

	Net income	Qualification	life satisfaction	religion	happiness	"State"	"Private"	"Innov"	"Change"	"Nextgen"
winning1	,288	**,016**	**,028**	**,006**	,167	**,002**	,806	**,000**	**,000**	**,000**
winning3	,139	**,001**	**.020**	**,031**	,223	**,040**	,384	,585	**,013**	**,000**
winning10	**,030**	,217	,194	**,018**	**,017**	**,021**	**,001**	**,052**	**,003**	**,000**
flood1	,144	,903	,455	**,009**	**,097**	,878	,684	**,000**	**,022**	,187
flood10	,420	**,042**	,468	**,007**	**,069**	,384	,397	,186	,282	,225
savinglives1	,236	**,095**	,110	,493	**,055**	**,003**	**,011**	**,001**	**,007**	**,000**
savinglives30	**,031**	**,005**	**,036**	**,034**	**,038**	,269	,175	,087	**,000**	**,000**
savinglives100	**,046**	,503	,191	**,034**	,209	,175	,158	,256	**,039**	**,000**
climate10	**,030**	,268	,883	,989	,123	,908	,414	,351	**,015**	,287
climate30	,167	**,049**	,870	,138	**,056**	,930	,713	,483	**,007**	**,045**

In cases of net income, life satisfaction and happiness we can observe a very weak connection with time preference rates, but the strongest relationships are apparent when we look at religion, happiness and the attitude questions, especially „change" and „nextgen".

According to the results above, a two-step cluster analysis was carried out on the 1012-element- representative sample, based on 4 factors: religion, qualification, happiness and "change". Three clusters were identified.

Table 5 shows the one-way ANOVA results which tested the connection between the identified clusters and discount rates. Thus, we have identified social clusters, where significantly different time discounting behavior is noticeable in two domains: saving lives and climate costs.

The main difference between clusters is along the "change" factor, that says we should radically change our consumption behavior in order to preserve our environment. In the analysis religion factor also turned out to be an influential element on time discounting decisions. People were asked, whether they are religious, and they could choose one of the following three options: 0- not at all, 1- do not know, 2- yes, moderately, 3- yes, positively. The happiness factor has the lowest influence and the qualification factor had a moderate effect on clustering.

TABLE 5: ONE-WAY ANOVA FOR CLUSTERS

	1	2	3	Total	Sig.
winning1	13,85%	16,14%	12,37%	14,42%	**,003**
winning3	14,19%	14,44%	13,39%	14,13%	,600
winning10	16,04%	18,00%	15,72%	16,77%	**,007**
flood1	30,07%	29,50%	29,02%	29,59%	,923
flood10	7,27%	3,55%	3,75%	4,85%	**,027**
savinglives1	6,73%	9,03%	8,06%	8,04%	**,068**
savinglives30	4,79%	5,75%	4,24%	5,06%	**,000**
savinglives100	2,87%	3,25%	2,56%	2,95%	**,011**
climate10	18,07%	15,18%	16,88%	16,64%	**,095**
climate30	9,80%	8,38%	9,34%	9,06%	**,009**
Qualification	3,57	4,08	4,57	4,00	**,000**
Net income (HUF)	129 123	141 427	173 819	143 529	**.001**
Happiness	6,06	6,44	6,19	6,24	**,030**
Religion	2,10	1,66	0,33	1,54	**,000**
„Private"	2,57	2,24	2,47	2,41	**,000**
„Change"	3,61	4,94	3,51	4,13	**,000**
„Nextgen"	4,25	4,85	4,19	4,48	**,000**

The mean values of variables for the three clusters, where statistically significant differences were found.

Cluster 3 disposes of the lowest rates in all time categories in winning money and mostly in saving lives domain as well. This cluster consists of those respondents, who are the most qualified and typically in the highest income category, and their main feature is to have been largely undecided on the attitude questions, usually choosing the value of 3, which is the medium value between agree and disagree. Only in case of one attitude question they have positively agreed with the statement that, people must ensure that natural resources will be available for the next generations ("nextgen").

Cluster 1 is regarded as the least well-paid category with the lowest qualification (skilled workers without high school graduation) and the lowest happiness rate. Although this cluster contains the poorest people, not this group used the highest discount rates by winning money, but they wanted to postpone the most the future costs of climate change. The majority of this group of people esteem themselves religious. Regarding environmental attitude questions they gave similar answers as Cluster 3.

In cluster 2 the most remarkable observation is that these people on the basis of their answers unambiguously stand up for environmental protection, which is underpinned by having the lowest rates in climate costs. Though, this group of people belongs to the middle income category, and has the highest happiness rates, it also contains the least religious people.

IV. CONCLUSIONS

The paper contrasts temporal discounting in individual and social exchanges. The primary aim of the study was to reveal the time discounting behavior of people and cluster them, based on their attributes and attitudes to environmental problems.

Using one-way ANOVA and cluster analysis 3 social clusters were identified, where significantly different time discounting behavior is noticeable in two domains: saving lives and climate costs. The main difference between clusters is along religion, qualification and people's attitude to environmental problems.

It is clear that we cannot use the same rates over time or across different domains. The observed methodology of calculating social discount rates consists of two main parts. The first part is called pure time preference rate (p), which describes the attitude of people to next generations' welfare. The second part makes next generations' welfare equal with current generation's welfare. This part is calculated from the product of 2 parameters; elasticity of marginal utility of consumption (e) and the growth rate of per capita real consumption (g) [Evans and Sezer, 2005]. There are several methods for the calculation of each parameter, but most prevalent is the tax-based (mostly income tax) method for the elasticity of marginal utility of consumption [Evans, 2005] and the use of GDP as a growth rate. Our study revealed that time discounting behavior has no connection with gender, age and is also very weakly connected with qualification, happiness and life satisfaction.

Regarding time discounting patterns, the strongest relationship after clustering was discovered between religion and the five attitude questions towards the environment. Accordingly, it seems acceptable to reckon observed preferences on the basis of income levels (income taxes) and people's attitude to next generations, which literally corresponds with the meaning of pure time preference rate (p). This rate is calculated based on the number of deaths relative to the population (this rate is called "Changing Life Chance" by Pearce and Ulph, [1995]) and is used in many countries to compute SDR for Cost-Benefit Analysis. The argument for using the death rate as the expression of people's attitude is absolutely refuted by our results. The ageing has no connection with discounting behavior, elderly people discount the same way as young people do. So, it can be concluded that the income level influences our discounting patterns which has to be considered in an SDR model and can be calculated top-down, but the calculation of pure time preference rates should be based on the interpretation of real stated preferences.

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ASSURANCE ON SUSTAINABILITY REPORTING: JAPANESE PERSPECTIVE.

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Abstract: ***The objective of this paper is to understand the sustainability reporting assurance practices in Japan principally motivated by the prior studies such as O'Dwyer and Owen (2005, 2007) and Deegan et al.,. In total 58 assurance statements attached to sustainability reports published in 2008 and 2009 by leading Japanese companies is evaluated using content analysis methodology. Power's (1999) analysis on the relationship between accountability and auditing is used to analyze the findings. While we confirm the findings of the prior studies regarding the variability and ambiguities of the assurance practices, however, at the same time we observe a number of improvements. Finally we argue that in analyzing the accountability and related assurance practices emphasis should also be given on the socio-cultural environment of the country.***

Key Words: Sustainability Reports, Assurance, Auditing, Accountability, Japan.

I. INTRODUCTION

Sustainability Reporting (also known as Social and Environmental Reporting or CSR Reporting or Triple Bottom Line Reporting) has become a common phenomenon among the world's leading corporations. However, the credibility and completeness of these reporting are frequently questioned as the reporting is mainly voluntary and unregulated. It is argued that management is motivated by their own benefits such as building favorable image rather than ensuring transparency and accountability to stakeholders [11]. In this context assurance on sustainability reporting emerges the objective of which is supposed to ensure the reliability and accountability and thereby enhance confidence among users/stakeholders in the information disclosed [5]. However, the first wave of research in assurance on sustainability reporting was critical in nature questioning the value addition of the contemporary assurance practices. Research observes a wide variations and ambiguities in the assurance practices and major concern related primarily to the independence of the assuror, lack of application of guidelines/standards, variation in assurance procedures, management control over the assurance process, lack of performance based 'first order' audit, ambiguity with respect to opinion expressed, absence of stakeholder engagement [3]; [9]; [1]; [11-12]; [6]; [2].

The objective of this exploratory study is to evaluate the assurance statement attached to SR in Japan where almost all N100 companies voluntarily disclose information concerning their social responsibility in an advanced manner exceeding international standards. The study is influenced by prior studies such as O'Dwyer and Owen, (2005, 2007) and Deegan *et al*., (2006). O'Dwyer and Owen (2005, 2007) is motivated primarily by normative accountability framework and stakeholder centric assurance model, we embrace Power's (1999) thesis on the relationship between accountability and auditing where he also emphasis on the socio-cultural dimension of accountability relationship.

II. AUDIT, ASSURANCE AND ACCOUNTABILITY

Accountability and account giving are become part of our daily life [15]. In fact, the demand for accountability becomes so great is the society that it becomes ethically problematic for the person or organization that is giving an account which Judith Butler labels as "ethical violence" [10]; [17]. So, it is difficult to precisely define accountability which is subjectively constructed and changes with

the context [18]. Power (1999: 5) makes the concept further difficult when he asks "who are the relevant principals: shareholders, local residents, taxpayer, and future generations?" From the organization-society point of view identification of relevant agent and principal are difficult as different communities and societies institutionalize different forms of accountability and principal-agent relationship.

However, mere giving an account is not enough is situations of doubt, conflict, mistrust and danger [15]. That is agents can't be entirely trusted with economic resources because of 'moral hazards' and 'information asymmetries' and they must discharge the responsibilities through sufficient and appropriate information that should be verified or checked by competent third party such as auditor [15:122].

Power (1999) argues that although some kind of audit or assurance is necessary, however, the concrete audit practices are difficult to predict as auditing is not simply a matter of technical expediency but also a cultural and political issue. Different societies have developed and institutionalized different forms of accountability and auditing practices.

Like any practice, auditing is characterized by both programmatic (normative) and technological (operational) elements [15]). While programs are the aims or ideals which auditing is intending to achieve, technologies are the specific operations, procedures and practices that are employed to fulfill these aims [14]. In this context, Power (1999) points out the difficulty of identifying a precise meaning around the programmatic dimension of auditing while the ever changing audit environment can create new programmatic demand.

III. GUIDELINES/STANDARDS FOR ASSURANCE

Although a number of guidelines/standards are avaiable there is no universal or authoritative framework to govern the assurance practices. At present worldwide the two dominant standards are: the International Federation of Accountants' (IFAC's) International Auditing and Assurance Standards Board (IAASB) International Standard on Assurance Engagements (ISAE) 3000 Assurance Engagements Other Than Audits or Reviews of Historical Financial Information (ISAE 3000) (2003); and the Institute of Social and Ethical Accountability's (AccountAbility) AA1000 Assurance Standard (AA1000AS) (2003, 2008). In Japan a high profile initiative was undertaken by Japanese Association of Assurance Organizations for Sustainability that issued Practical Guidelines for the Assurance of Sustainability Information in 2007. The content of the assurance statement recommended by all these standards are summarized in table 1 below. The evaluative framework for this study is based on these three standards/guidelines which is similar to the earlier studies.

TABLE 1. EVALUATIVE FRAMEWORK.

Content of report	**J-SUS Guideline**	**ISAE 3000**	**AA 1000**
Title of the report	✓	✓	
Addressee	✓	✓	✓
Scope and purpose/objective of the engagement	✓	✓	✓
Respective responsibility of reporter and assuror	✓	✓	✓
Criteria used to assess evidence and conclusion	✓	✓	✓
Assurance standards used	✓	✓	✓
Parties and purpose for which the report is restricted, (if any)		✓	✓
Significant inherent limitation in evaluation (if any) of subject matter		✓	✓

Content of report	J-SUS Guideline	ISAE 3000	AA 1000
Summary of work performed	✓	✓	✓
Conclusion	✓	✓	✓
Competencies of assuror			✓
Impartiality of assuror towards stakeholders/conflict of interests/Independence	✓		✓
Additional comments/recommendations			✓
The report date	✓	✓	✓
Name and location of assuror	✓	✓	✓

Adapt from O'Dwyer and Owen, 2005.

IV. RESEARCH METHOD

A total of 58 assurance statements attached to SR (believe sufficient based on prior studies) of the two most recent years 2008 and 2009 was analyzed. With the objective of collecting as many as possible we searched N100, Nikkei 225, and GRI reporting list as prior literature notes the relationship between purchase of assurance and size of the firm. Objective was to collect as many as possible. Only English version of the report is considered. Collected statements were analyzed using content analysis based on evaluative framework shown in table 1.

V. FINDINGS

5.1. Information relating to the assurance providers: Different parties are involved in providing the assurance services that are included in the following table.

TABLE 2: TYPES OF ASSURORS.

Assurors	No. of statements assured
Accounting Firms (Big Four only)	36
Certification firms	10
NGO/NPO/Voluntary Org.	12

Similar to prior literature our sample also notes reluctance to disclose assurors competencies in the statement with none of the assurors except one from certification firms who have assured two statements clearly mention their experiences and other competencies in the relevant field.

5.2. Title of the statement

TABLE 3

Title	Acc. firm	Certification firm	NGO/NPO	Total
Independent review report	21		4	25
Independent assurance report	15	3		18
Third party verification report		3		3
Third party verification and opinion			5	5
Independent verification report/opinions		1	2	3
Third party review		2		2

Title	Acc. firm	Certification firm	NGO/NPO	Total
Verification report		1		1
The third party statement			1	1
	36	10	12	58

5.3. Addressee of the statement

TABLE 4

	Acc. firm	Certification Firms	NGO/NPO.	Total
Board of Directors	17			17
Director, Chairman, president, CEO	19	4	11	34
Senior management and stakeholders			1	1
The company		2		2
All the readers		1		1
None		3		3
	36	10	12	58

5.4. Statement on responsibility of the management and assuror

TABLE 5

	Acc firm	Certification Firms	NGO/NPO	Total
Clearly stated	36	9	11	56
Only auditors responsibility stated		1	1	2
	36	10	12	58

5.5. Objectives of assurance engagements

TABLE 6

	Acc. firm	Certification Firms	NGO/NPO	Total
To Independently report the result	15			15
To express an independent opinion	7			7
To express conclusion/independent conclusion	8			8
To provide independent assurance		2		2
To provide limited assurance	6			6
To validate the descriptions		1		1
To report the result and opinion/conclusion		1	11	12
To verify the reliability/consistency of selected data		4		4
To evaluate/review selected data		2		2
To express the views			1	1
	36	10	12	58

Levels of Assurance

TABLE 7

	Acc Firm	Certification Firms	NGO/NPO	Total
Reasonable	0	0	0	0
Limited/moderate	24	3	1	28
Not clearly mention	12	7	11	30
	36	10	12	58

5.6. Scope of the assurance engagement

TABLE 8

	Acc. Firm	Certification Firms	NGO/NPO	Total
Clearly stated	36	10	12	58
Not clear				
Subjects Assured:				
Key environmental performance Indicators/data	15	7		22
Environmental accounting Indicators	14	2		16
Material quantitative environmental information	4			4
Key Sustainability performance indicators	3			3
Economic, social and environmental performance data and relevant qualitative information	3			3
Environmental and social indicators	11			11
ESH and social performances and accounting indicators	2			2
GRI Compliance check	4			4
Environmental policies, Principles		1		1
Social and environmental issues		1		1
Selected data		1		1
Text and data contained in the report		2		2
Environmental and social section of the report			1	1
Performance indicators			11	11
Responsible care Initiatives			11	11
Non numerical data contained in CSR report			11	11
Sustainability report		1		1

5.7. Reporting criteria against which the reports were assessed.

TABLE 9

	Acc. firm	Certification Firms	NGO/NPO	Total
Environmental reporting guidelines-2007 (MOE, Japan)	14			14
GRI sustainability reporting guidelines-2006.	17			17
2009 Environmental reporting assurance and registration criteria of the J-SUS	11			11
Environmental accounting guidelines-2005 (MOE, Japan)	4			4
Company's own policies and standards	22			22
Bureau Veritas standard procedures and guidelines based on current best practice		2		2
Japan Audit and Certification Organization's verification criteria		2		2
SGS own protocols based on best practices		2		2
The Natural Step's Sustainability Analysis			1	1
Not mentioned		4	11	15

5.8. Standards used in assurance process

TABLE 10

	Acc. Firm	Certification Firm	NGO/ NPO	Total
Assurance standard for environmental reporting (pilot version) (MOE, Japan-2004)	16			16
Practical guidelines of sustainability information assurance- 2008 (J-SUS)	24			24
International standards on assurance engagements (ISAE)-3000 (IFAC 2003)	25	2		27
Proposed Environmental report review standard-2004 (MOE Japan)	6			6
Accountability, AA 1000 Assurance Standard		3	1	4
Firm's own standard		2		2
Not mention any standard		3	11	14

5.10. Assurance procedures employed by the assuror.

TABLE 11.

	Acc. firm	Certification Firms	NGO/NPO	Total
Control tests	12	1	3	16
Substantive tests:				
Review/Inspection of documents/standards/systems/process	34	3	11	47
Site Inspection	28	3	5	36
Recalculation/reconciliation	28	1	3	32
Analytical procedure	12			12
Inquiry/Interview of management	35	3	11	49
Attending stakeholder dialogue		2		2
Validation with external stakeholders		2		2
Pre-assurance research		2		2
Not mention specifically/mutually agreed upon procedure		6		6

5.11. Wording in conclusions/opinion

TABLE 12

Words or phrases used	Acc. firm	Certification Firms	NGO/NPO	Total
Nothing has come to our attention/we were not aware of any /No negative evidence found	36	3		39
Accurately	10	4	10	24
Fairly presented/stated/generated	3			3
Rationally	14		5	14
In accordance with /comply with	28	2		30
Included	5			5
Conform	3			3
Consistent	2		3	5
Applied	1			1
Appropriately		1	1	2

Words or phrases used	Acc. firm	Certification Firms	NGO/NPO	Total
Reliable		6		6
Adequate		1		1
True representation		1		1
Free from serious errors		2		2
Fair and balanced representation		2		2
Satisfied/Confirmed			3	3
Adequately/sufficiently responded			1	1
Well balanced perspective			1	1
Reasonable			3	3
Impressed /appreciable			3	3
Evaluate highly/excellent/proactive/commends/noteworthy		1	8	9
Conclusion based on Materiality, Completeness and Responsiveness		1		1
Valid and effective			1	1
Value			1	1

5.12. Comments/Improvements identified by assurance provider

TABLE 13

	Acc. Firm	Mgt. system and certification consultant	Soc. and Env. NPO	Total
Yes		1	9	10
No	36	9	3	48
	36	10	12	58

5.13. Expressly mention about the independence of assurance providers

TABLE 14

	Acc firm	Certification Firms	NGO/NPO	Total
Yes	31	3	1	35
No	5	7	11	23
	36	10	12	58

VI. DISCUSSION AND CONCLUSION

Earlier studies analyzing sustainability report assurance such as Ball *et al.,* (2000), Owen and O'Dwyer (2005; 2007), Deegan *et al.,* (2006) are critical in nature that shows the great variability and ambiguity in assurance practices. Among others lack of independence of the assurors and management control over the assurance process raised the question of value added by the assurance to the SR. Although comparing with those studies will be very general because of time difference, however, it can give important perspectives that will be used to assess the assurance quality from Japanese perspective. In most of the areas of out analyzing protocol which are similar to earlier studies we observe some improvements. Specially with respect to the title of the statement, responsibility of the management/assuror, standard/guidelines use for evaluation of report as well for assurance,

procedure of the assurance work performed and declaration of assuror interest and independence. Similar to financial audit independence is the most debatable issue. In our case while more than 95% of the sample clearly separated management and assurors responsibility, over 60% of the sample gives the explanation of their interest with company and impendence. Arguably these enhance the independence at least the independence in appearance of the assurors.

Considering the accountability to the broader stakeholders we are also concern with addressee, purpose, and scope of the assurance statement. Most of the cases are the example of limited assurance for some selected data/information especially environmental indicators and environmental accounting data for their accuracy. None of the assurance is for whole SR or for reasonable assurance. It can be easily assumed that the management has the control over this scope determination process. Giving the emergent nature of this assurance practice it is not uncommon as Free et al. (2009) evidence of the negotiated nature of the audit process in new assurance domains because the entities involved attempt to balance external credibility with the practicalities of cost, time and available information [7:122]. Another concern is that given the diversity of the SR it may be a concern whether all information is at all "auditable". However, over 70% of the statement clearly state that they are giving limited assurance which may help the users to minimize the 'expectation gap'.

When we compared the approaches of different assurors, accounting firms are trying to standardize their practices based on guidelines/standards. However, examples show they only provide limited assurance or review level engagement with emphasis on data accuracy or compliance with guidelines/standard rather than strategic or value added approach. In contrast, the statements of certification firms lack quality in certain respects such as without addressee (30%), non explanation of assurance procedures (60%), without mentioning the level of assurance (70%) or reporting and assurance standards (40%) and without any declaration of independence (70%). However, similar to accounting assurors they also emphasis on the reliability and accuracy of the reported information. NGO/NPO's assurance statements on the other hand, also lack quality in certain respects such as declaration on independence, level of assurance, guideline/standard used for report as well as assurance. Compare to others this group, however, have wide scope of assurance. They also provide recommendations for future improvement thereby can be treated as strategic and value added for the management as well as for the stakeholders.

In general most of the assurance statements disclose information about the technical aspects of the assurance practice such as standard/guideline used, scope/objective of audit, sample selection, methodologies applied and evidence gathering procedures. Though corroborative evidence is necessary this gives some clue that the assurance practices are at least operational at the technical level [2]. Based on Power (1999) we can argue that the practices are codified and formalized over time.

Although programmatic ideals of audit are difficult to understand [15], these are embodied in reports, proposals, plans and legislation, and are taken for granted knowledge. Arguably we can say that the programmatic ideal of ISAE 3000 and J-SUS guideline (developed based on ISAE 3000) that mainly guide our samples is to give comfort to stakeholders and management regarding the accuracy of reported data rather than ensuring true accountability.

The cultural, socio-political environment of the country also has strong influence on the accountability relationship and audit. Historically audit or assurance was not demanded in the Japanese society [17]; [8]. Yoshimi [2002] opines that although the situation is

changing steadily but 'Japanese people have no expectation of auditing and auditors'. One of the reasons may be as argued by Power (2003) due to the values of solidarity, cooperation, and trusts exist in Japanese society. Humphrey and Owen [8] also note that audit in Japan is something imposed by Americans after the Second World War. From this discussion arguably we can deduce that the demand for SRA is not high from the external stakeholders groups within Japan thereby companies are voluntarily engage in assurance practices for other reasons than to ensure accountability and transparency.

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THE CLIMATE JUSTICE APPROACH FOR POLICY INDICATORS IN ISRAEL

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Abstract: ***For the last decade the environmental justice has been becoming a central theme on the agenda of the environmental movement in Israel. The Environmental Justice Association in Israel (AEJI), research oriented center, recently published a methodical review that evidently pointed out that many of the environmental problems and public health concerns share a clear social context, stemming from policies that are inconsiderate of vulnerable populations, preference of the welfare of the business sector mostly, while neglect exercised by authorities entrusted with law enforcement and the care for public health. The two economic aspects of the analysis outcomes are: A) In theory, the government in Israel uses 'stick and carrots' when addressing industries: negative and positive incentives. Neither is being activated appropriately. Economic incentives to motivate existing companies to improve production procedures or environmental efficiency are insignificant at present. B) Israel has reached extreme distributional injustice, not only of a spatial nature, but also in terms of poverty dimensions and income disparities (The National Insurance Institute's yearly review, 2010) government policies continuously amplify economic disparities.***

Those finding are on the basis of the new research AEJI has been conducted, following Copenhagen climate summit last year and the consequent declaration of the Israeli government about targeted CO_2 emissions. The research is focused on the socio-economic profile of the climate policy aims to develop indicators for governmental policy in two main areas:

One is the differentiated CO_2 contribution of different socio-economic and ethnic groups (disadvantage groups in terms of environmental justice according to research data) in Israel. Pilot calculations related to the use of transportation and electricity indicate that Israeli belonging to the upper 10% of the socio-economic ladder produce up to 26 times more CO_2 than those belonging to the lowest 10% of the population. These data are even higher than difference of the income inequalities between the socio-economy ranks.

The research has been elaborating the indicators to allow on-going comparisons of this nature in four fields of consumption: electricity use, transportation, good and food consumption, water and solid waste production and treatment.

The article will discuss the whole spectrum of the work which aimed to be accomplished towards the mid of 2011, and perform the list of climate justice policy indicators to be presented to the government.

ENVIRONMENTAL RESPONSIBILITY IN THE FOOD CHAIN: WHAT TO MEASURE?

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Abstract: ***Many food companies have identified corporate responsibility's (CR) value for their business and corporate strategy. Business pundits and academics, however, still struggle defining the concept of CR, as it is multidimensional and contextual. This also makes CR difficult to measure and communicate to the stakeholders. Traditionally, CR is divided into environmental, social and economical aspects, yet a more specific content for each aspect is still under debate, and lack consensus. The purpose of this paper is to focus on the environmental aspect of CR in the food chain and construct a holistic framework for defining and measuring environmental responsibility from an extended supply chain point of view. The study was based on participatory research approach. Data were collected from participatory workshops, which have similarities with focus group methods. The first workshop targeted environmental specialists from research and governmental institutes, whereas the second consisted of business representatives from four food companies. The data were analysed qualitatively with content analysis.***
Keywords: Environmental responsibility, corporate responsibility, food chain, measuring, criteria, indicators.

I. INTRODUCTION

Most of the companies still have not defined what coporate responsibility (CR) means in their business environment. Also among academic scholars, there is still huge confusion on how CR should be defined [cf. 1]-[2]-[3]. The most common definition for CR is derived from the Triple Bottom Line (TBL) [4]. CR consists of environmental, economical, and social responsibility [5]-[6] or sociocultural responsibility [7]. Importantly, this frame sets the scene for businesses to consider the needs of planet, profit and other people beyond their direct and short-term fiscal interests. The generic TBL type of rhetoric without more explicit definitions, however, can be badly misleading and may provide a smokescreen behind which firms can avoid truly effective social and environmental performance and reporting [8]. In addition, these generic and universal models fail to consider industry-specific CR issues [9]-[10] and are increasingly concerned on macro-level challenges, instead of addressing local needs. On the other hand, the local frameworks cannot either deal with the global concerns that according to Brundtland Commission Report should be prioritised [cf. 11]. By focusing on meeting the needs of the future generations – who ever they are and where ever they are – leads us addressing the environmental concerns both on the global and local levels.

In addition to the terminology puzzle, business pundits and academic authors are striving for measures for corporate responsibility (CR). This task has proved to be very challenging. The complexity [12] and contextual nature of the concept [3] [13] has lead to a discussion whether CR should be measured in the first place [14]. However, incresing external stakeholder pressure for CR reporting, is pushing companies to find means for measuring their CR [15]. Consequently, many firms have come up with different sorts of indicators and measures, leading to a plethora of diverse criteria for measuring CR. However, before the question 'how to measure CR' can be answered the question 'what to

measure' must be addressed. This paper attemps to fulfil the latter research gap for envionrmental responsibility.

The purpose of this paper is to focus on the environmental aspect of CR in the food chain and construct a holistic framework for defining and measuring environmental responsibility from an extended supply chain point of view. The research problem is phrased as follows: *what are the environmental issues within corporate responsibility that need to be addressed and measured in order to develop and evaluate environmentally responsible business praxis?* As a recent and detailed case study reported the contradiction between market efficiency and environmental effectiveness [16], the principle aim of this paper is to increase the environmental effectiveness and environmental consideration in the food chain, instead of market efficiency.

II. THEORETICAL FRAMEWORK

In this part, the standpoint on corporate responsibility (CR) and environmental responsibility are discussed, as well as the drivers and challenges behind measuring CR and its relationship with reporting. The contextual life-cycle approach to the phenomenon is presented before moving on to the empirical section.

A. Corporate responsibility and environmental responsibility

Kenneth Goodpaster [12] who coined the term CR, called for detailed case-by-case analysis. It has also been concluded later that "one size does not fit all" [6] and more context-specific examinations are needed [13]. As the concept of CR can not be defined in general terms, the attempts to measure should also be contextual. The TBL typology is however a solid platform for this study to departure.

Corporate environmental responsibility (CER), that is, the ecological dimension of CR, is also broad and case-specific [17]. According to Confederation of Finnish Industries [18], environmental responsibility contains sustainable and effective use of natural resources, protection of water, air and soil, decrease of greenhouse gases, decrease the amount of waste and control over health and environmental risks of chemicals. Hence, a responsible company becomes aware of its environmental impacts and develops its functions constantly. DesJardins [19] emphasizes holistic and eco-centric perspective of environmental responsibility and highlights sustainable development model, which seeks to combine the natural constraints established by ecological laws with minimal moral constraints placed upon business activity. Businesses then have a moral responsibility to insure that its activities are ecologically sustainable [19]. This conceptual standpoint is adopted for further theoretical discussion.

Kovács [20] adduces extending CER in the supply chain since it increases supply chain collaboration, though mainly within the product chain. The environmental demands from the product chain can also spill over to process supply chains, from primary to supporting supply chain members [20]. The importance of supply chains should not be ignored, since poor environmental performance at any stage of the supply chain process, may damage the company's reputation [21 in 22] and the natural environment. In fact, organisations have started to expand their CER beyond the firm level and include managing CR in the supply

chain [21 in 23]. In addition to reputational motivations, [24] identified increasingly stringent end-market environmental regulation and operating legitimacy, as key drivers of the adoption of firm-based environmental standards. Their analysis also suggested, that "firms are responding to these external drivers in part because of the characteristics of global production networks – a production form that depends on the ability to produce from any manufacturing plant to any end market" [24]. However, measuring the success of CER management is a task very challenging, as (inter alia) Harland [25] has reported increasing vertical disintegration and complexity in the supply chains.

B. Life cycle assessment

CR and CER are often dissected on firm level but increasing affected by the life-cycle thinking and level of analysis. From the dawn of the new century, the supply chain management (SCM) has increased its presense in the CER debate [i.a. 26]-[27]. Measuring CR is worthwhile in the supply chain level, as a chain can be perceived as responsible as its least responsible member. However, it is a great challenge to generate knowledge about the chains of organisations and networks since the complexity increases with the number of organisations involved [28].

Life-cycle assessment (LCA) is a tool to deal with the complexity of a production chain. The environmental impacts e.g. can be mapped through the entire supply chain with LCA methods. In the LCA model, all environmental impacts are measured per functional unit [29]. This type of models has mainly been used by downstream businesses and policy makers but increasingly manufactures are publishing LCA-based data on their products to enable environmentally conscious consumers to make more responsible consumption decisions [30]. In the background of LCA is Integrated Product Policy (IPP), which aims at decreasing environmental impacts of products by looking all phases of products' life cycles and taking action where it is most effective [31]. Assessing environmental impacts of food (life cycles) is challenging from a methodological point of view (such as allocation rules and quality of and level of primary data sources data which affects reproducibility of results and comparability between studies) [32]-[33]. However, research in this area is increasing.

In line with the idea of LCA, this study views the responsibility issues from cradle to grave. However, the traditional LCA that concerns the product related impacts is altered to cover the organisational level, the (supply) chain of companies.

C. Drivers behind measuring and interplay with reporting

"In the last few decades […] the scale, speed, and depth or Earth's environmental decline have been unprecedented" [34]. The need for evaluating the role of corporations' responsibility in contribution to the decline is worth assessing. The corporate interest in measuring CR performance is originated from the increased external stakeholder pressure for CR reporting [15], instead of developing environmental effectiveness and CER performance due to their intrinsic value. "In modernity, nature has come to be considered as a 'resource' to be used instrumentally to fulfil human desires. The most extreme manifestation of this 'anthropocentric' paradigm is reflected in the dominant values and beliefs of consumerism" [33]. This rather instrumental approach to CER is rooted in the

utilitarian ethics of Jeremy Bentham and John Stuart Mill [7] [35] and is characterised by economic discourse and weak sustainability discourse [16].

In the 70s, pioneering firms started to report their CR and CER, and around the change of the Millennium CR reporting became rather mainstream. Studies that have measured the CR performance have focused on content analysis methodologies that are based on firms reporting [see 36]. The data has been collected from annual reports [see 37]-[38]; reputation indexes [see 39]-[41] and firm web pages [see 42]. The scientific validity and reliability of these sources has been impugned. How objective are the sources and how selected is the information provided for measuring, even if the documents are official and assurance practices are rendered [see 43]? Not only researchers, but also the firms' stakeholders are becoming increasingly cynical and confused about the interpretation of the data [15]. Cultural differences can also distort the data, as firms rooted e.g. in the humble India may not brag about their CER performance as loud as their Anglo-American counterparts might. In addition, the perception of what is responsible differs between contexts. In the food chain, a vivid example can be derived by comparing the living conditions of cows in India and United States or Finland.

Firms are still increasingly establishing and communicating their CR agendas [44] and the interplay between reporting and measuring is heating up. The traditional measuring of CER performance is based on the reporting practises. A need for more valid and reliable information and reporting has arisen. This study departs from this craving and the argument that reporting CR should be based directly on measuring, and the measuring is ought to give impulses for reporting CR, not vice versa. Hence, the assumption is that reporting based on measuring is more useful and meaningful for all purposes, than measuring based on reporting.

Yet, measuring CR has proved to be a task very challenging. The complexity [12] and contextual nature of the concept [3] [13] has lead to a discussion whether CR should be measured in the first place [14]. However, incresing external stakeholder pressure for CR reporting, is pushing companies to find means for measuring CR [15]. Consequently, many firms have come up with different sorts of indicators and measures, leading to a plethora of diverse criteria for measuring CR. While many throughout measure are time-consuming to collect, costly to 'operationalise' and are not widely available [15], more middle-brow measures are adopted.

Measuring CR is greatly important. It is argued that only by measuring CR a firm or supply chain can develop, manage, and improve its CR performance [45]. CR measures also assist users of the information to make more informed consumption, employment and investment decisions [15]. Lately, the CR measurements have been developed through traditional management tools, e.g. Kaplan and Norton's Balanced Score Card [46]-[47 in 35]. Out of the three CR dimensions, the environmental dimension has arguably enjoyed the most extensive attention [15] [48]. This study attempts to shred light on the measuring debate through three lenses: life-cycle assessment, organisational level analysis, and food chain.

III. METHODOLOGY

The research took a qualitative approach to the phenomenon and was based on participatory research [49] with features from focus group methods [50].

In Cornwall and Jewkes' [49] *participatory research,* participants have an active role as research participants. Participatory research approach regards people as agents rather that objects by affirming valuable of people's own knowledge. These participatory methodologies are often characterized as reflexive, flexible and iterative compared to linear characteristic of most conventional science. They include multiplicity of approaches and applications. A typical characteristic is also to adapt methods of conventional research and use them innovatively in new contexts in new ways. Similarly, *focus groups* are to collect data through group interaction on a topic selected by researcher(s) [50].

Data collection

The data were collected in terms of two participatory workshops. The participants in the first workshop consisted of researchers and governmental representatives, whereas the second workshop was compounded of corporate representatives. The following research questions were posed: a) what are the elements that environmental responsibility in the food chain consists of, and b) what are the factors within the elements?

For the first participatory workshop (WS1), environmental experts from academia and governmental institutes were invited to assess the content of environmental responsibility. It was held in August 2010 with four environmental experts partaking. Initially seven experts were signed up for the WS1 but three experts cancelled their participation at the last moment. However, the WS1 was arranged as planned. The experts were from leading research institutes of Finland and represent following expertise: biodiversity, environmental and climate impacts of food production), ecology of food systems, agro ecology, eco-design, sustainable consumption, sustainable product policy and the environmental labelling of products. The WS1 was started by giving an overview of the research project and objectives of the session. Although no specific case products were chosen, the life-cycle phases of four products were depicted and brought up during the workshop session for brainstorming. The session took three hours in total.

In the first phase of WS1, the participants worked individually 10-15 minutes writing their ideas, thoughts and key words on post-it notes. The notes were gathered and arranged on a blackboard according to affinity by two moderators (authors of this paper). In the second phase, the participants worked together discussing and evaluating the grouped notes on the blackboard and their detailed contents. The roles of the moderators were to lead the discussion yet not to influence the content or the direction of the discussion.

The second WS2 was held in the end of October with five corporate representatives partaking. These environmental managers and directors were from four case firms involved in the research project. At first, the moderator presented the results of the WS1. After this, the corporate representatives discussed the produced content by the environmental experts from WS1. The moderator inquired the same research questions as in the previous workshop. In addition, the participants debated the measurement of selected environmental responsibility elements.

Data analysis

The aim was to find key elements and criteria for environmental responsibility and evaluate them. The data analysis was based on detailed notes that were taken in the WSs. As the outputs of the WS1 differed from the WS2, a detailed analysis of the reasons and rationales were conducted. To detect and arrive to the key elements and criteria that are depicted in findings, analysis was based on five guidelines:

1) To merge the factors those are equal or similar;
2) To remove the factors those are based on legislation or national requirements;
3) To relocate the factors those are more suitable under other responsibility dimension, principle, and criterion;
4) To discuss the factors that corporate representatives and researchers and governmental representatives disagree upon; and
5) To discuss whether the issues belong to element, criteria or indicator level.

The WS sessions results were documented on post-it cards that were photographed from a blackboard. In addition, two research assistants wrote detailed notes from the sessions.

IV. FINDINGS

Based on an iterative research process and participatory workshops with researchers, corporate and governmental representatives, three elements for environmental responsibility in the food chain were identified: a) efficient and sparing use of natural resources; b) decreasing of environmental impacts; and c) efforts for creating a sustainable market. These elements, for one, consist of different amounts of criteria which are either specific to a one chain actor or common to all. The experts produced altogether 64 ideas. Company representatives saw the content analysis of experts comprehensive but they summarized and simplified the content of environmental responsibility into 53 ideas. As a final stage, the research group (the authors of the paper) analysed the ideas into 50 units as depicted in Figure 1.

A. Efficient and sparing use of natural resources

The first element, efficient and sparing use of natural resources was approached from following criteria and sub criteria; 1) production inputs and 2) infrastructure, 1a) raw materials, 1b) other materials, 1c) energy, 1d) chemicals, 1e) water and 2a) land property, 2b) machines and 2c) equipments and buildings.

The experts highlighted the efficient and sparing use of natural resources as one of the main principle of environmental responsibility. Economical optimization was seen also as part of this principle and natural resources were divided to fixed and variable inputs. The experts regarded that natural resources are not observed nowadays enough compared to emissions (outputs). Thus, it is important to emphasize this principle as separate element. The efficient use of inputs was seeing as part of companies´ internal operations whereas externalities (external costs) are under the social steering.

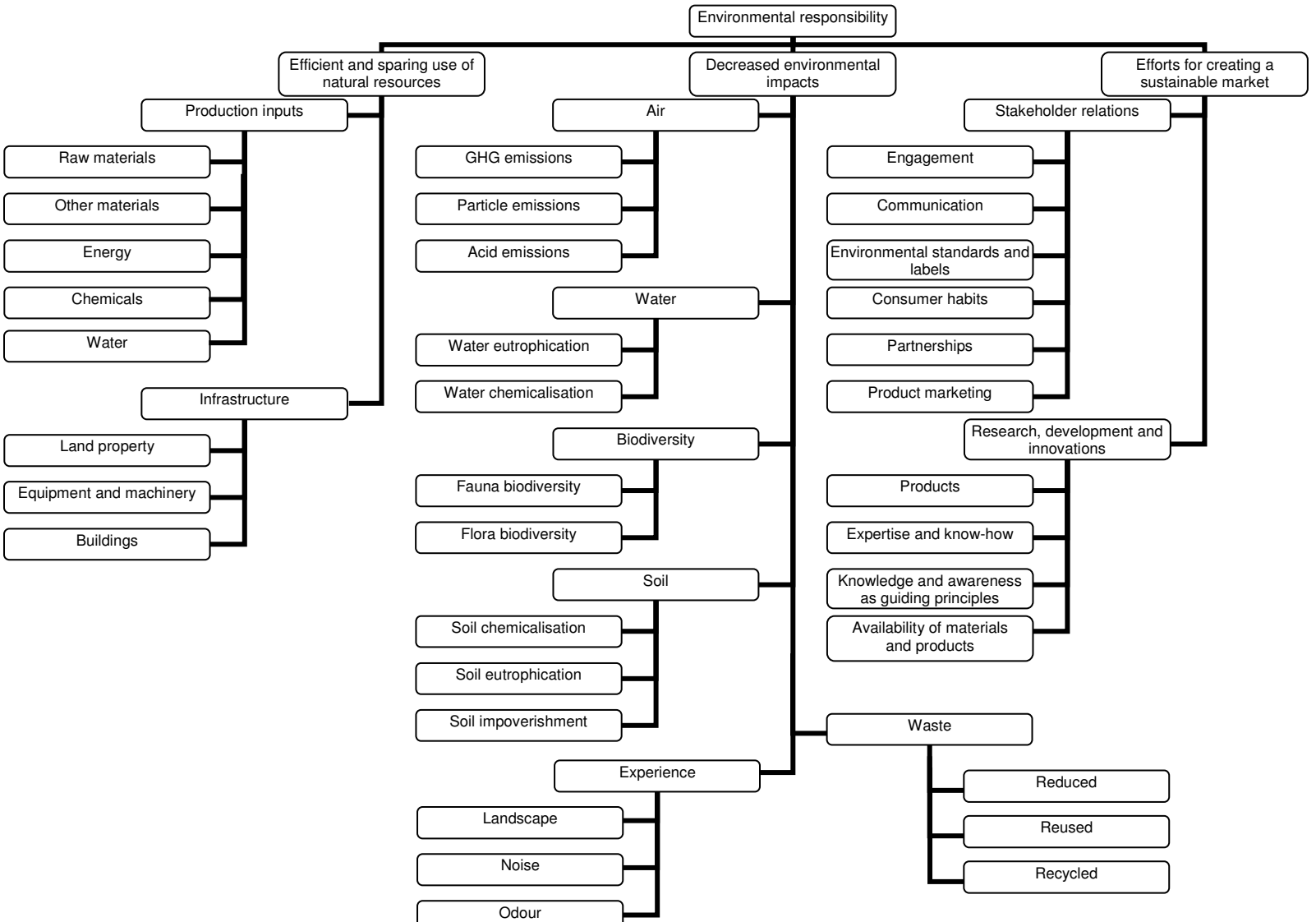
The company representatives summarized and modified the content analysis of experts. For example the term `fixed and variable inputs` was seeing not easy understandable and

thus, it has been changed to ´inputs and infrastructure`. Some sub factors has been summarized under the one concept. For example phosphorous, carbon and palm oil were considered all as materials and thus were relocated under the new concept. Some sub factors were considered as measures (as fertilizer) and thus were removed.

B. Decreased environmental impacts

Based on the workshops and analysis of data, the second element, decreased of environmental impacts was divided the following criteria: impacts on 1) air, 2) impacts on water, 3) impacts on biodiversity, 4) impacts on soil, 5) impacts on experience and 6) waste. The sub factors are the following: 1a) GHG emissions, 1b) particle emissions and 1c) acidificative emissions, 2a) water eutrophication, 2b) water chemicalisation, 3a) fauna biodiversity, 3b) flora biodiversity, 4a) soil chemicalisation, 4b) soil impoverishment 4c) soil eutrophication, 5a) landscape, 5b) noise, 5c) odour, 6a) reducing waste, 6b) reused waste, 6c) recycled waste.

FIGURE 1: THE ELEMENTS AND CRITERIA OF ENVIRONMENTAL RESPONSIBILITY IN THE FOOD CHAIN.



The experts defined the second element 'externalities', which has been modified later by research group as decreased environmental impacts. The experts discussed about the internalize of external impacts of companies, which means that by developing management and practices, the companies can diminish their own external impacts and thus, act more responsible way. However, the companies are not permitted to compensate negative external impacts for positive. The experts also considered a concept of land use. It was seen as a too wide and global of an issue which companies cannot manage.

The company representatives summarized the output of the WS1 but also added new criteria and sub criteria. For example, land use was considered as a part of soil impoverishment and biodiversity. Waste was perceived as a significant factor in food industry and thus it (and also group of sub criteria) was added as a new criterion under decreased environmental impacts.

C. Efforts for creating a sustainable market

'Efforts for creating a sustainable market' was identified as the third element of environmental responsibility. It consists of the following criteria: 1) stakeholder relations and 2) research, development and innovations. The sub criterions are: 1a) engagement, 1b) communication, 1c) environmental standards and labels, 1d) consumer habits, 1e) consumer habits, 1f) partnerships, 1g) product marketing and 2a) products, 2b) expertise and know-how, 2c) knowledge and awareness as guiding principles and 2d) availability of materials and products.

According to the experts in WS1, this element was to indicate that companies can themselves develop responsible markets and demand for sustainable business. Every part of the food chain has they own 'markets' but at the same time they are part of one market. The experts saw environmental responsibility as a system that has basis on the first two elements (efficient and sparing use of natural resources and decreased environmental impacts) and above them are the efforts for creating a sustainable market.

In WS1, the experts formed a fourth element 'impacts of global food market'. The company representatives opined that food markets are increasingly global everywhere and hence should not be separated. The criteria under the element were relocated under the other elements.

Another example of the analysis process can be derived. In WS2, the company representatives suggested modifications for the criteria. For example, 'season and locality' sub criteria were perceived as parts of product criterion and were thus linked to product criterion.

The research group analysed the content of environmental responsibility created by experts and company representatives in accordance with the five guidelines presented in data analysis. For example, elements and criteria were modified in order to describe better the content at issue. Also criteria were removed and relocated under other responsibility dimensions.

V. DISCUSSION AND FURTHER STUDIES

The purpose of this paper was to focus on the environmental aspect of CR in the food chain and construct a holistic framework for defining and measuring environmental responsibility from an extended supply chain point of view. To arrive at the results and conclusions, a qualitative research approach was deployed. Two stakeholder workshops were organized for data collection. As a result the framework (Figure 1) depicts the environmental issues within corporate responsibility that need to be addressed and measure in order to develop and evaluate environmentally responsible business praxis.

In this framework, environmental responsibility consists of three elements with different amount of criteria. It can be concluded that the identified criteria under the elements are common to all of the companies in the food chain. Yet, specific criteria and elements are more vital in the up-, mid- and downstream of the supply chain. For example, in the downstream, retailers should take actions to create a sustainable market as it is arguable the most effective position for such actions. Or, reducing the GHG emissions such as carbon dioxide should be emphasised in the upstream – i.e. where it is the most effective. However, the purpose of the framework is not to divide responsibilities to chain member specific criteria. Every chain member needs to minimize their impacts on air, water, soil, biodiversity and experience, and waste impacts themselves.

Open and transparent communication between chain members has a central role in managing environmental responsibility in the supply chain. Firms also need help from research and society at large to get enough information and tools to reduce their environmental impacts and thus increase their CR.

Also several criteria under the element ‘efforts for creating a sustainable market’ require efforts from also other actors, like NGOs’ and media, to evolve. For example the criterion ‘affecting consumer habits’ is an issue that companies by themselves feel incapable of changing. Therefore, help from other actors is needed.

Even though the study was consensus-oriented between two different kinds of stakeholder groups and the results can be considered as one step closer to a common definition for CR, a context-generic (time and place) and system level consistent (product and firm) measures for CER still seem like an objective too far away. According to current studies, it is very challenging to measure CER, for example companies’ impacts on biodiversity [51]. However, this constructed framework offers a solid foundation for creating CR management tools for integrating environmental responsibility into corporate strategy. Further research will focus on this task [52] and also developing indicators for each criteria presented.

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DEVELOPMENT AND APPLICATION OF ENVIRONMENTAL ACCOUNTING FOR TAIWAN POWER COMPANY

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Abstract:

Taiwan Power Company has been setting up the Environmental Accounting since 2005. As an establish unit, started as a thermal power plant case, and continue expended to all thermal power, nuclear energy, hydroelectric plants, and distribution system. As to the establish content, from environment cost to material input/ output and measuring and exposure of environmental efficiency. The entire process not only presents how Taiwan Power Company makes effort to environmental account, but also an epitome of the development of Taiwan's environmental accounting in recent decade. In this research, it is comprehensive arranged how Taiwan Power Company set up the environmental accounting from background, procedure to difficulties of operation and application of management. Through the case of Taiwan Power Company environmental accounting, it can be known the experience during establishing, and the important environmental accounting developing progress in Taiwan for the recent 10 years.

EMPIRICAL ANALYSIS OF ENVIRONMENTALLY INNOVATIVE APPROACHES IN THE HUNGARIAN CHEMICAL SECTOR

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Abstract: ***Novel environmental innovations are only slightly dependent from the size of the company. It means that all companies, even the small ones (with probably lack of significant financial resources) should be able also to innovate and not just to adopt existing technologies. Novel innovations are also only slightly dependent from the efficiency of the companies, so even the ones with older or less flexible technologies should be able to find the way to innovate. To be able to capitalise on their own strengths, companies should strive to move even more towards achieving cleaner production type innovations, instead of using end-of-pipe technologies. The empirical study is based on 70 structured interviews with representatives of Hungarian chemical companies, carried out by the Budapest Corvinus University in April-May 2010.***

Keywords: Environment, innovation, chemistry

I. INTRODUCTION

The effect of mankind on the environment can be described by the following formula [1]: I=P*A*T, where P means population, A means affluence (calculated with the income per capita), T means technology, which is emission generated in connection with producing goods, services and the consumption of these.

In order to be sustainable, we have to decrease our environmental load, to which one way is to decrease the T factor. In this paper I study the possibilities of reducing T factor by producing one unit of goods/services with less environmental pollution.

II. THEORETICAL BACKGROUND

Reducing T factor is possible with environmental innovation, under which I understand the following in this paper:

Environmental innovation is a technical innovation, through which the environmental load by unit of good/service can be reduced. Environmental advance can actually be the specific aim of the innovation, or just a side-effect.

Innovation activity can hardly be measured, as there is no functional relationship between the input and output of an innovation. Environmental innovation is even harder to be measured, as one innovation usually targets more fields, and environment can be only one of these, or just an unintentional side-effect. One way to gather information about this topic is empirical study.

III. METHODS

The empirical study is based on structured interviews with representatives of Hungarian chemical companies, carried out by the Budapest Corvinus University in April-May 2010. This research was part of an international research, within the EU Act Clean project, which focuses on environmental innovation. Chemical professionals were involved in planning the interviews, in order to ensure the relevancy of the interview questions. The objects of the study were the Hungarian chemical companies, with the exception of the pharmaceutical sector. (We didn't deal with the pharmaceutical sector due to the large discrepancy between them and the rest of the sector.) There are about 700 companies registered in the chemical sector, and by taking out that are active mainly in the pharmaceutical sector, having only commercial or no activity, we came to a list of about 350 companies. We had the opportunity to interview 70 of them personally. Interviews were carried out by students of the Budapest Corvinus University, who were preliminary trained.

In our sample, the variables are mostly qualitative, quasi-rank and rank level. I applied the $\chi 2$ test of independency using contingency tables. The drawback of this method is that the number and the limit of categories influence the results, so in most of the cases I've done the analysis with multiple versions. As a general rule, with the sample size of about 100, 6-12 categories can be created.

IV. EMPIRICAL RESULTS

The sample can be called representative, as it contains companies of different size, activity and location. The distribution of companies regarding revenues and number of employees can be seen on Figure 1. and Figure 2.

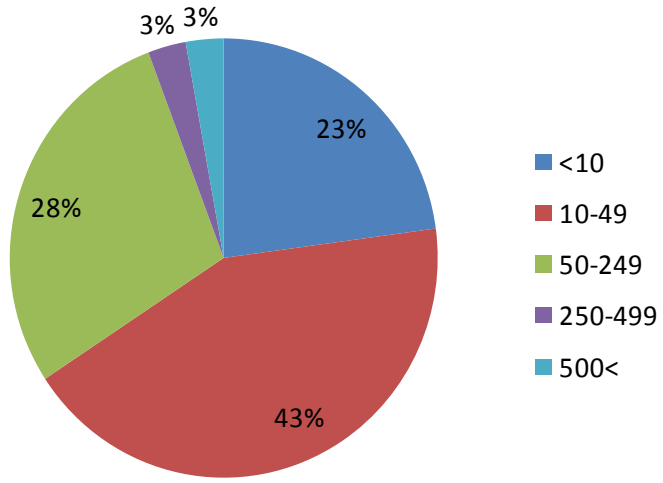

FIGURE 1: COMPANIES SORTED BY NUMBER OF EMPLOYEES

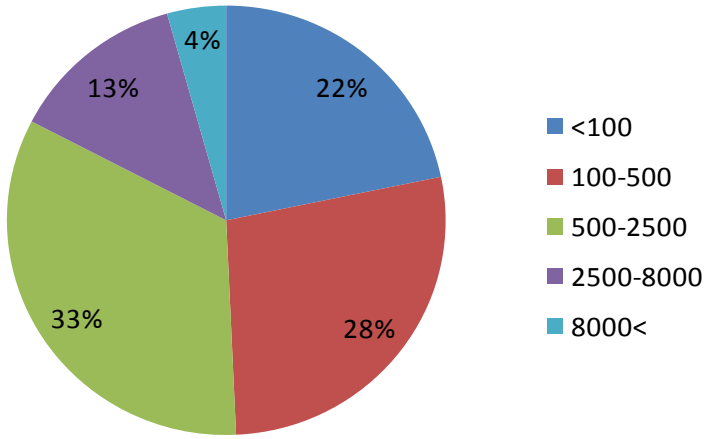

FIGURE 2: COMPANIES SORTED BY 2009 REVENUES MEASURED IN MILLION HUF

Most of the interviewees possessed relevant knowledge about innovations in the company. Most of them were from the management and from the production department, which can be seen on Figure 3.

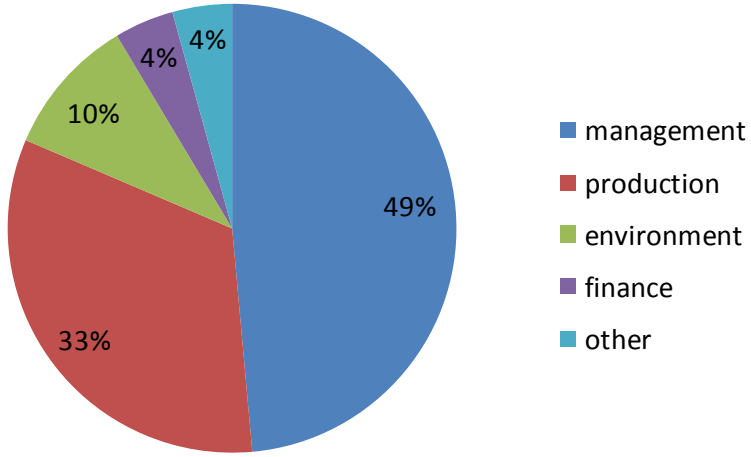

FIGURE 3: POSITION OF INTERVIEWEES WITHIN THE COMPANY

69 companies answered the question, what proportion of the company's products and processes were affected by innovations, and by environmental innovations. Taking out that 17 %, who answered illogically (claiming to have made more environmental innovations, than innovations), the result is, that in the case of more than half of the companies almost all significant innovations were environmental innovations. As the interview's topic was mainly environment, in my opinion a lot of companies tried to show a better picture about themselves. (This is understated by the 17 % illogical answers.) Apart from this, we can come to the conclusion, that in the majority case of chemical companies, most of the innovations are also environmental innovations.

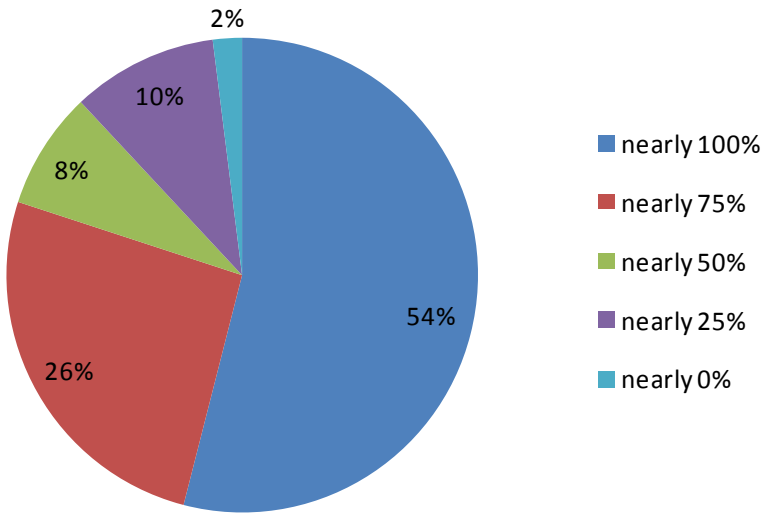

FIGURE 4: PROPORTION OF ENVIRONMENTAL INNOVATIONS TO ALL INNOVATIONS

The 70 companies reported 104 environmental innovations in the last three years (one company could report only the most significant 3 ones; 17 reported 3).

Examples of environmental innovations are:

- Cleaning and reusing the water in the production-cycle
- Cleaning the pipes with a cheaper and more environmentally friendly material, instead of dissolvent
- Change in production technology, resulting in lower organic-dissolvent output
- Using energy-saving light bulbs
- Monitoring the contamination of ground water
- Use of new, advanced technology
- Sewage treatment facility
- Using gas-heating instead of oil-heating

From this list it is clear (and is underlined by lot of interviewees) that the main driver of innovation is not always the environment, but the reducing of costs and upgrading technology.

In our sample most of the reported environmental innovations are cleaner production technologies. This means that in most cases, the change in technology causes the environmental improvement, rather than a filter added to the process, like in the case of end-of-pipe technologies.

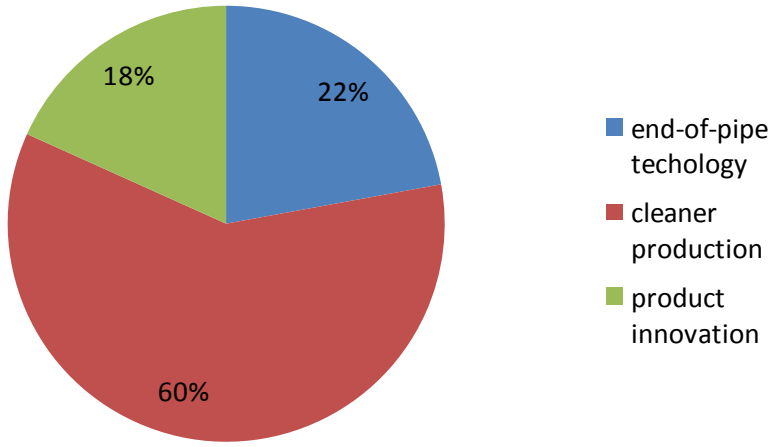

FIGURE 5: TYPE OF INNOVATION

In the case of 102 innovations, companies reported also the innovativeness.

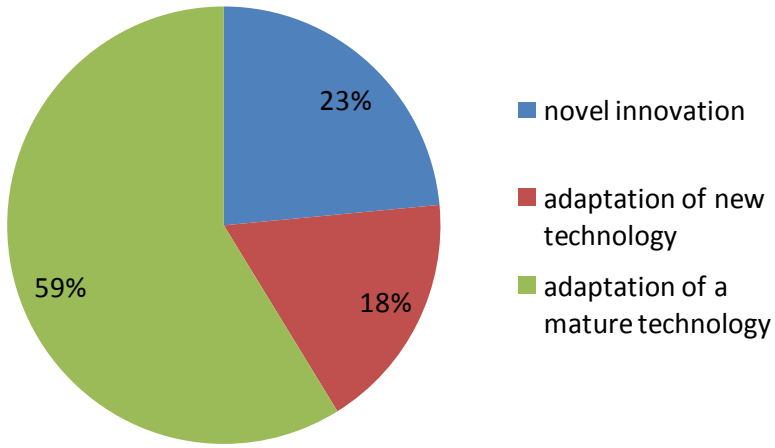

FIGURE 6: NOVELTY OF THE ENVIRONMENTAL INNOVATION

My analysis targeted mainly the factors affecting the novelty of environmental innovations.

From the database I've created a variable called "environmental improvement". This variable is created by the aggregation of the 9 environmental categories in the interview (namely: energy efficiency, material efficiency, amount of waste material, toxicity of waste material, air pollution, water pollution, soil pollution, toxicity of products, toxicity of raw materials). I've found that on 94-99% significance level (depending on the limit of categories), the more novel an environmental innovation is, the bigger is the environmental improvement.

The effect of the novel innovations could even be multiplied, because novel innovations can be adopted by other companies. This underlines the importance of novel innovations,

which are although lower in number, but cause bigger environmental improvement. Within novel innovations, the companies reported 8 innovations, which were patented. I've analysed the difference between patented novel, and non-patented novel innovations. Although the sample size in this specific analysis is very low, we can have the assumption, that environmental improvement can be even slightly better with patented novel innovations on a 60-76% significance level (depending on the limit of categories).

Novel innovations tend to be more the type of cleaner production than end-of-pipe technologies on a 93% significance level, which is logical, because the company has better understanding of his own technology as the filtration technology.

There are two variables representing the efficiency of the company. One measures efficiency by the average age of technologies, the other by the elasticity of production capacities. Overall I've found that the novelty of innovation is only slightly dependent from the efficiency of the company on a 69%-82% significance level (depending on the variable, the number and limit of categories).

I've found that novelty of innovation is independent from the revenue and the size of the company, measured by number of employees and revenue (dependency on a 1-50% significance level, depending on the number and limit of categories).

V. Conclusion

I have found that in the Hungarian chemistry sector the majority of innovations are also environmental innovations. About three-quarter of all environmental innovations are adaptations of an existing technology. These adaptations contribute hugely to the environmental improvement of the companies. Novel innovations, although lower in number, seem to have bigger influence on environmental improvement than adaptations, and taking into account that these can be adapted by other companies, shows the real significance of them. About one-third of novel innovations is patented, and give about 8 % of total environmental innovations. As these have the potential to improve the environment radically, even more than the novel innovations on average, their significance can't be underestimated.

Novel environmental innovations are only slightly dependent from the size of the company. It means that all companies, even the small ones (with probably lack of significant financial resources) should be able also to innovate and not just to adopt existing technologies. Novel innovations are also only slightly dependent from the efficiency of the companies, so even the ones with older or less flexible technologies should be able to find the way to innovate. To be able to capitalise on their own strengths, companies should strive to move even more towards achieving cleaner production type innovations, instead of using end-of-pipe technologies.

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EXAMINATION OF POSSIBLE FINANCIAL IMPACTS RELATED TO CLIMATE CHANGE FOR HUNGARIAN TOURISM ORGANIZATIONS

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Abstract: ***Tourism has a significant role and growing importance in Hungary within the economy as one of the decisive factors of regional development. Climate is a pivotal factor in tourism's vulnerability and ability to sustain the recent employment rate. Meanwhile, tourism contributes to effects leading to climate change (especially so by increasing GHG emissions resulting from the energy use of transport and tourist facilities). It is important to prepare for the future by taking this interrelation into account. Nearly all of the assumed effects of climate change have an impact on tourism either directly, by influencing climate and weather conditions, or indirectly, by modifying tourist traffic in regions determining demand trends, thereby impacting our own tourist traffic. These impacts (as well as the climate change mitigation and adaptation) influence the costs and benefits of organizations in the tourism sector. This paper examines the interactions between climate change and tourism organizations. This year a survey was carried out among the above-mentioned stakeholders. In the frame of our research, Hungarian tourism experts and representatives of different tourism associations were asked about the possible mitigation and adaptation activities and impacts of climate change. The main goal of this paper, particularly based on the results of our primary research, is to give a widespread review about the financial impacts related to climate change in case of distinct tourism organizations.***

I. INTRODUCTION

Climate change is no longer a theory; it is supported by a wide scientific consensus. In fact, this worldwide problem has made its way from the realm of scientist to that of political decisionmakers. The effects of our changing climate cannot be escaped by Hungary, and our analysis must contain economic and social aspects as well.

The interrelations between tourism and climate change have long been a subject of analysis. Tourism, as a dynamically changing, open system, is also integrated into the environment. As a result of this relationship, tourism is influenced by the factors of external systems, but it also impacts its environment. The tourism industry covers the entire planet, and is therefore subject to the effects of global changes. Climate change belongs to the group of effects that also incudes globalization, technology innovation, urbanization, and environmental changes, yet it is still of extraordinary importance in the case of tourism. The natural environment, including climate is a tourism resource that affects the establishment of the system itself, therefore this relation is one of extraordinary dependence.

In this paper we will highlight the interdependence between climate change and tourism, as well as adaptation and mitigation opportunities. The choice of topic is supported by the role of tourism in the economy and regional development as well as its potential to generate and sustain employment.

The aim of our analysis is to investigate the financial (cost-benefit analysis) consequences of climate change and their manifestations in the case of service providers and different organizations based on international and Hungarian literature and using a concrete survey (empirical case study). It was also our aim to provide a solution to the current situation through the tools provided by environmental accounting.

II. CLIMATE CHANGE AND TOURISM

Societies have always had to respond to climate variability and extreme weather events. Many have developed ways of coping with floods, fires and droughts. Recent experience of weather extremes has given these efforts new motivation within countries as well as at the European level and all over the world. Whilst climate change is a new driver for action, mitigation and adaptation will in many cases be implemented by regulatory modifications of the existing policy frameworks for floods, droughts and the management of water quality. All these symptoms can lead to significant impacts also on the tourism sector. The vulnerability of different tourism destinations is usually depending on the strengths of the potential impacts and also on the adaptive capacity of the area.

The IPCC defines adaptation as "adjustments in natural or human systems in response to actual or expected climate stimuli or their effects, which moderate harm or exploit beneficial opportunities". [1] Adaptation to climate change takes place through adjustments in human and natural systems to reduce vulnerability in response to observed or expected changes in climate and associated extreme weather events [2] It involves changes in perceptions of climate risk and in social and environmental processes, practices and functions to reduce potential damages or to take advantage of new opportunities. Adaptation is a cross-sectoral, multi-scale and trans-boundary issue, which requires comprehensive and integrated modeling methodologies. [3]

Mitigation refers to actions that are able to reduce the man-made causes of climate change e.g. reducing emissions of greenhouse gases, such as CO2, through energy efficiency and using sustainable solutions of transport and energy.

Both adaptation and mitigation efforts are essential part of addressing challenges and opportunities associated with climate change. Adaptation mainly addresses the impacts and opportunities related to climate change. Mitigation refers the efforts to limit the human-induced causes of climate change. Moreover the costs of inaction are considered to be much higher than early action related to the possible effects of climate change (Stern, 2006) [4]

Mitigation and adaptation are closely related and should be considered together rather than separately. Sustainable tourism also can play important role both in adaptation and mitigation strategies according to the precautionary principle causing several positive externalities and synergic effects.

Investigating the relations of climate change and tourism only became a prominent area of research in the 1980s, but earlier works dealing with these issues have been published, paving the way for future research. The first international conference to deal with tourism and climate change was organized by the WTO (World Tourism Organization) on 9-11 April, 2003 in Djerba, Tunisia. Among the 140 attendees were professionals, organizations and representatives of the economic and civil sphere from 45 countries. The topics on the agenda were climate change in general, how it is affected by tourism, international organizations dealing with these issues, examples, best practices and case studies on adaptation and mitigation. An important output of the conference was the "Djerba Declaration on Tourism and Climate Change" calling on stakeholders and experts in the field to conduct research, support the efforts to make tourism more sustainable and to raise awareness about the topic. The venue for the second such conference was Davos, Switzerand (1-3 October, 2007).

In 2009, WTO and UNEP (United Nations Environmental Programme) published a

report titled “Climate Change and Tourism. Responding to global challenge”.The first section presents the international debate on the subject containing the Agenda of the Davos conference and another declaration titled “Davos Declaration: Climate Change and Tourism – Responding to Global Challenge”, while the second in a technical report reviewing the most important scientific results.

The number of publications on tourism and climate change started growing from 2000 onwards, as international organizations, the WTO and the Environmental Programme of the UN started to realize the strategic importance of the topic.

On global level, this process is catalyzed by developing countries vulnerable to climate change, whereby they consider tourism to be one of their possible windows of opportunity from an economic perspective. However, climate change will likely have a more profound on these countries. Similarly to climate change, the development of mass tourism also threatens the natural resources and cultural heritage determining the attractiveness of tourist destinations. Therefore, sustainable, soft and eco-tourism have also become important and preferred areas of development. Apart from forecasting political, social and demographic changes, analyzing the effects of climate change on tourism is thus also necessary for defining these areas [5] This is pivotal for adaptation and mitigation related to the environmental impacts resulting from mobility and accommodation demands, as well as other activities at the destination.

Reviewing the national and international literature, it is clear that the integrated, complex analysis of the factors determining tourism is incomplete, as the studies dealing with climate change merely mention the role of other factors.

The interrelations between tourism and climate change include multiole distinct effects. [6]

Firstly, there is a direct connection between tourism and climate change, as the latter modifies one of the basic resources of tourism (weather conditions) thereby impacting supply and demand simultaneously. Extreme weather events, changing seasonality and related additional heating and cooling costs fundamentally change the opportunities of the tourism sector. Furthermore, by looking at the situation from the demand side, it is obvious that new climatic conditions lead to new preferences and travel decisions. Looking at demand and supply as a whole it is evident that the effects described above lead to changes in travel patterns that affect the tourism sector by causing market changes for products, activities and destinations. The other aspect of the direct connection is tourism-related emissions caused by travel, providing amenities and other services that contribute to climate change.

The second group of effects includes indirect factors (natural resources affected by climate change such as biodiversity, water, landscape) that may have a detrimental effect on certain tourism types. Medical risks in this case should also not be ignored since changing temperatures, extreme weather conditions, droughts or floods can cause diseases and pandemics to spread faster and further.

The third aspect constitutes the economic, social and political conditions. Political decision-makers, realizing the gravity of the problem, have implemented measures to decrease pollution, while economic and social can change as a result of climate change. Since tourism is often a significant driver of the economy, its decline may cause serious economic and political instability, thereby intensifying other serious global issues such as poverty or terrorism, which opens another feedback loop to tourism development.

In summary, it is clear what a complicated system tourism and climate change create. Tourism activities are causes and victims of changes at the same time, while also being key to possible solutions.

III. THE ECONOMIC SIGNIFICANCE OF TOURISM AND ITS VULNERABILITY TO CLIMATE CHANGE IN HUNGARY

Tourism affects multiple sectors of the economy and social strata. In a statistical sense, tourism is a virtual sector of the economy, the result of the cumulated effort of several sectors, since Hungarian and international classifications do not include an entry labeled "tourism". That makes it hard to assess its role in the economy, its contributions to GDP and employment potential. The table below (table 1) shows the most recent data.

TABLE 1: THE ECONOMIC SIGNIFICANCE OF TOURISM IN HUNGARY
SOURCE: [7]

TOURISM	**DIRECT**		**TOTAL**	
	BILLION FT	%	BILLION FT	%
GDP 2005	978	5.2	1 654	8.8
	THOUSAND PEOPLE	%	THOUSAND PEOPLE	%
EMPLOYMENT 2005	303	7.9	482	12.6

Hungarian toursm trends can be determined based on tourist traffic in commercial and private entities (including rural tourism). In 2009, 78% of tourist nights have been spent at commercial institutions (more than 18 million nights, approx. 7 000 patrons, whis is about 6% decrease compared to the last base year). Looking at the situation from the revenue side, the decrease is 8.6%. According to experts, [8] this tendency is expected to slow in 2010, which is supported by the latest information brochure on inbound tourism issued by the Hungarian Central Statistical Office for the January-August time frame. However, domestic tourism, responsible for 54% of tourist traffic in 2009, continues to decline.

The trends of domestic tourism indicate that trips are distributed across the country. Domestic tourists prefer travelling more often but for shorter durations and within their region (one-day trips and long weekends, often self-organized). In summary, Hungarian tourism trends show correlation with climate change. Individual perceptions about the weather are important in making trip decisions, especially so in the case of short, individually organized trips. Therefore, adaptation to climate uncertainities is in the core interest of Hungarian tour operators.

In 2003 the Hungarian Ministry for Environment and Water Management and the Hungarian Academy of Sciences have launched a joint research project of the title of "Global climate changes, Hungarian impacts and responses". It is called "VAHAVA". (The name "VAHAVA" of the above mentioned project is an abbreviation of the first letters of the Hungarian words changes – impacts – responses (VÁltozás – HAtás - VÁlaszadás)). This project meant the conceptual basics of the Hungarian National Strategy for dealing with climate change. In relation to the "VAHAVA" Research Programme it is worth mentioning that presumably the warming of the climate, the droughts will be stronger, as well as the seemingly damages, the frequency and intensity of extreme weather events will be increasing in the Carpathian Basin of course in Hungary as well. The climate of Hungary is being affected by impacts arriving from three directions: continental

effects arrive from the East, Atlantic from the West and Mediterranean from the South. Owing to these meteorological events various years and seasons are highly variable. It is not too rare that there is drought, floods, inland inundation and frost damages in the same year, sometimes at the same place as well.

The Hungarian Climate Change Strategy (2008-2025) is focusing on three main areas as mitigation efforts, adaptation possibilities and climate consciousness in the different economic sectors. [9] It can be stated that the tourism sector is not given due attention in the above mentioned strategy. Thus it is also underpin the importance to deal with the tourism organizations according to climate change.

The vulnerability of Hungarian tourism to climate change has only been in the focus of a few studies; the above-mentioned VAHAVA project only addressed the most important processes in its final report, containing no regional research. On the national level, both the negative and the positive conseqences of the changes in weather conditions impact tourism. Seasonal changes may eliminate some forms of tourism, also forcing tour operators to develop alternative products. Complementary to national approaches, pressures and responses must also be investigated on the regional and local levels. The Budapest University of Technology and Economics, Department of Environmental Economics conducted a comprehensive analysis on the subject in the first half of 2010. We have assessed the vulnerability of tourism in different regions, conducted an attitude analysis of environmental and tourist organizations and evaluated tourism development tools from the aspect of adaptation and mitigation. In the following, we will present some of the results of our analysis.

IV. BACKGROUND OF THE ANALYSIS

The Budapest University of Technology and Economics, Department of Environmental Economics conducted a study in 2009 and 2010 contracted by the Ministry of Environment and Water and the Ministry of Local Government on the effects of climate change on Hungarian tourism and the possible avenuas of adaptation and mitigation. The analysis included a survey to investigate the knowledge and attitude of the Hungarian tourism sector concerning the relationship between climate change and tourism so that a theoretical guide could be compiled that would also be useful in practice.

The survey was distributed among tourism experts and organizations. In the end, the responses of 26 entities were evaluated (experts agreed that this can be considered representative since all of these institutions integrate the opinions of multiple expert groups). The questionnaire contained open and closed questions, including some referring to the institution and position of the respondent. Closed questions included those aiming at creating an order of preference (on a scale of 1 to 5), ant those requiring direct answers.

V. RELEVANT QUESTIONS AND RESULTS

The results of the primary research through the questionnaires represent the effects of climate change on the tourism sector and adaptation and mitigation opportunities well. The results are also suitable for further evaluation by the tools of cost-benefit analysis (especially relenvant results, from relevant topics, questions, which are showed in table 2).

TABLE 2: EXAMINED RELAVANT TOPICS FROM THE QUESTIONNAIRE
SOURCE: OWN EDINTING

	EXAMINED RELAVANT TOPICS FROM THE QUESTIONNAIRE
1.	vulnerability of tourism compared to other sectors.
2.	competitiveness of tourism is influenced by climate change
3.	effects of climate change on tourism in Hungary in the next 20 years
4.	relation with adaptation activities
5.	relation with mitigation activities
6.	barriers to better adaptation
7.	barriers to mitigation

The first issue to clarify is what stakeholders believe about the vulnerability of tourism compared to other sectors. The weighted order of preference was mostly led by industry. Second place was taken by transport and spedition; agriculture came third, while tourism was only fifth, meaning that respondents did not consider tourism to be one of the most significant sectors (7 were listed). It was also interesting to see what respondents thought about how the competitiveness of tourism is influenced by climate change: "domestic effects of weather and climate change" scored 87, while "the effects of climate change on foreign destinations" scored 92 on a scale of 130. The results put these factors to the end of the order of preference, behind "income conditions of the population", "changes in the natural environment", "quality of domestic accommodation" and others. The distribution of answers paints a different picture. "The effects of climate change on foreign destinations" was rated 4 (on a 1 to 5 scale) by 50%, which is considerable. In summary, our results show that based on the order of preference, our respondents see water pollution as the most important issue, while climate change is at the end of the list, just before loss of biodiversity.

The next group of questions pertained to the effects of climate change on tourism in Hungary in the next 20 years. More than half of respondents (54%) thought that the effects of climate change will be mostly negative, 31% thought they will be neutral, and 15% believed they would be positive. (Figure 1 shows the relation of answers.)

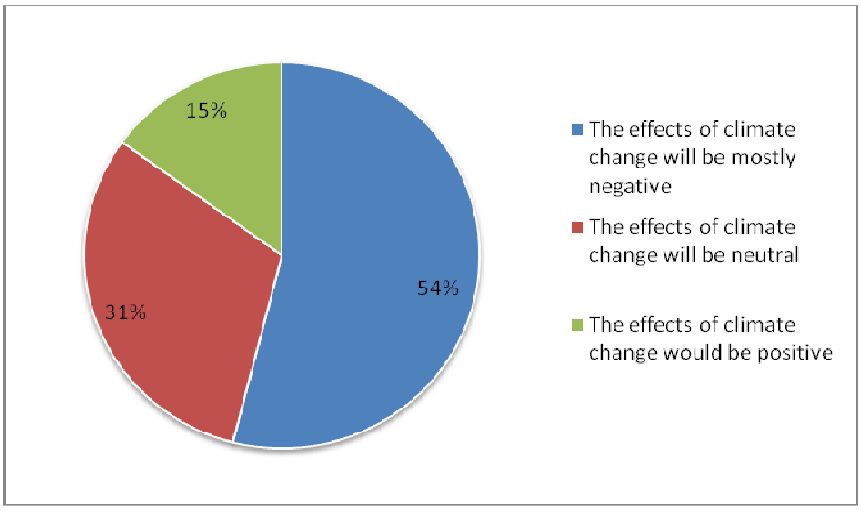

FIGURE 1: EFFECTS OF CLIMATE CHANGE ACCORDING TO THE RESPONDENTS
SOURCE: OWN EDITING

According to our respondents, the future of Hungarian tourism will be most strongly be influenced by the increasing popularity of sustainable and ecotourism, followed by the eco-labeling of accommodation and trip and destination choice of tourists. These are followed by changes in seasonality, and, as a result of exteme weather events, the dwindling of open-air activities as well as trekking.

The questionnaire also aimed to gather responses on adaptation and mitigation. Most respondents (60%) evaluated the work of their institution as being indirect from the aspect of adaptation, 12% considered it independent (having no effect at all). 28% reported that their institution performs adaptation activities; most of them also cited concrete examples.

Most respondents (61%) evaluated the work of their institution as being indirect from the aspect of mitigation, 9% considered it independent (having no effect at all). 30% reported that their institution performs adaptation activities; 86% also cited concrete examples.

When asked about the barriers to better adaptation, responents set the following order:

1. Conflicts of interest and the lack of cooperation
2. Lack of resources
3. Lack of long term planning
4. Lack of knowledge regarding adaptation opportunities
5. Uncertainty about impacts
6. Climate change is not a real threat to the sector

When asked about the barriers to mitigation, responents set the following order:

1. Conflicts with business intersts
2. Lack of resources
3. Lack of long term planning
4. Lack of motivation for long-term investments
5. Transport is key, but tourism is no authority on that subject
6. Domestic tourism is insignificant compared to international tourism

We have highlighted questions that may be taken into account by tourism operators when dealing with business costs and benefits of climate change. Based on the questions and answers above, it is evident that respondents positioned climate change-related issues at the end. The open questions revealed that respondents do carry out adaptation and mitigation activities, even if they are not aware of it, therefore they would make good use of advice and incentives to continue their work.

VI. Evaluation of the relationship between tourism organizations and climate change from the aspect of cost-benefit analysis

The questions in our primary research do not always lead to conclusions on costs and benefits. Our research is not a sufficient basis to review an entire economic regulation system, but the degree of contribution of different sectors to climate change is worth considering.

Some of our questions were related to the cash flow of tourism organizations. We will demonstrate how the operation of tourist organizations is dependent on circumstances through an example. Knowing Hungarian conditions and based on the factors included in the questionnaire, changes in income levels, natural environment and accommodation quality have a negative impact (loss of revenues). However, these mentioned factors also have postitive impact (increase of revenues) if changes in income level is positive, changes in natural environment means self-reformation and accommodation quality is a positive attribute. In this case it can be supposed that the climate change may be emphatic among impact-factors.

Questions associated with adaptation and mitigation allow for more concrete conclusions regarding costs and benefits related to climate change. Respondents have given the following practical examples of their adaptation-related activities:

- Energy-saving systems
- Eco-friendly waste management
- Using eco-friendly detergents
- Use of local resources

These measures have associated costs, but can result in savings and revenues as well.

Looking at the above as costs, it is clear that they constitute environmental costs. [10] Energy-saving systems fall under “Preventive environmental protection costs”, while eco-friendly waste management is part of “Waste and emissions management” and eco-friendly detergents fall under “Material costs of emission which are not get into product”. Our recommendation, based on our analysis on tourism organizations is that adaptation activities should be individually considered among environmental costs and benefits. This may facilitate the adoption of environmental accounting amid stakeholders of tourism.

We have come to similar conclusions about mitigation activities. 30% of respondents carry out mitigation activities that also constitute environmental costs under the “Preventive environmental protection costs” cost type, with their respected associated costs and benefits. Mitigation-related costs and benefits should be dealt with individually in the scope of environmental accounting.

The greatest barrier to adaptation and mitigation activities is the lack of financial resources, meaning that these measures are associated with costs by most institutions. This has led us to conclude that raising awareness among stakeholders about the benefits and advantages (not only to individuals, but also on a global scale, for the public good) related to these activities would be necessary, since short term (directly at the institution) and long term (social and environmental) benefits do not appear in their accounting systems.

VII. CONCLUSIONS

In our study we have outlined the relationship between tourism and climate change, the possible effects of climate change and the economic significance of tourism in Hungary. We have investigated the opinions of stakeholders concerning the expected effects of climate change in this under-researched area of tourism, whether the consider the problem relevant and how important

they consider adaptation and mitigation options as described in international literature, including their views on associated costs.

We have concluded that, despite wide publicity, the topic is characterized by skepticism and knowledge deficit. Adaptation is not intentional; willingness is determined by available financial resources.

While answers to several questions may not reflect it, respondents consider the impacts of climate change to be relevant when we look at the survey as a whole, while they are also convinced that tourism has a significant effect on climate change. Another important conclusion is that stakeholders require advice and incentives for the execution of their adaptation and mitigation activities. Adaptation and mitigation activities consume resources (environmental costs) but may also generate revenues while also having indirect benefits (resource use, cost and emission savings). These, however, may go unnoticed by an economic entity if their accounting system is not set up to handle macro-level benefits.

VIII. ACKNOWLEDGMENT

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ENVIRONMENTAL INNOVATIONS IN THE HUNGARIAN CHEMICALS SECTOR – THEORY AND PRACTICE

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Abstract: ***The development and diffusion of environmentally benign technologies – whether sufficient on its own, or only an element of the solution – can play an important role in overcoming the environmental challenge. The determinants of the introduction of these technologies by firms have therefore been subject to much attention in the literature. Some have focused on firm internal characteristics, while others emphasize the importance of external factors such as environmental regulations or the emerging demand from environmentally conscious consumers. There are also models which attempt to integrate the above factors or show their varying influence regarding different types of eco-innovations (ie. product or process changes, end-of-pipe or preventive solutions).***

This paper presents an overview of the literature on the factors influencing the introduction of environmental technologies and empirically examines the importance of these factors for chemical firms in Hungary. Previously, research in Hungary has focused on the environmental management practices of companies with little attention to technological innovation. Innovation surveys, on the other hand, contain only superficial information on environmental innovations. The chemical industry is an ideal starting point for research on eco-innovations, as the environmental effects of the industry (related to both the production and the use of chemicals) are usually quite significant. As a result, the sector faces an ever increasing pressure from various stakeholders. The survey presented examines the environmental innovation practices – including both the development and the adoption of new solutions – of Hungarian chemical companies. The research places a special emphasis on examining actual examples of environmental innovations from firms' recent history, providing a highly realistic perspective on the characteristics, underlying motivations and effects of such innovations.

I. INTRODUCTION

The environmental issue, with its increasing severity and global nature of the problems, is often referred to as the greatest challenge mankind has to face in the near future. Although the reality of this challenge is now seldom called into question, many believe there is no reason for serious concern, as scientific development and the resourcefulness of the human race will, as it so often has in the past, produce the necessary solutions in time. Others are not so optimistic, and stress that sustainability cannot be attained without significant sacrifice in our lifestyles, or even a profound transformation of our economic and social structures. At the same time, there is widespread agreement that – whether sufficient on its own, or only an element of the solution – the development of environmentally benign technologies can play an important role in overcoming the environmental challenge.

We therefore need to find solutions which enable the reduction of the environmental burden associated with economic activity. However, it is of course not enough to invent these solutions, they must also become widely used by economic actors. In a profit oriented economic system, it is clear that this process cannot rely solely on the environmental consciousness of market players. Other drivers are also necessary, be it the cost savings associated with improved efficiency, or external pressure from the authorities or other actors. It is therefore vital to understand what motivates companies to develop or adopt environmentally friendly solutions, as well as to identify the barriers to this process.

This paper begins by presenting a review of the literature on the factors influencing

firms' environmental innovation activities. The importance of these factors is then empirically examined for chemical firms in Hungary using the results of a recent survey.

II. Determinants of Environmental Innovation

Environmental innovations (or eco-innovations) can be defined as those innovations which lead to a reduction of the environmental burden caused by the economic activity [1], [2]. It is important to stress that, by this definition, the effect, not the purpose of an innovation determines whether it can be considered environmental in nature. This means that changes undertaken for other reasons (ie. costs savings or improved product quality) can also be considered eco-innovations if their environmental effect is positive. Like innovations in general, environmental innovations are also usually classified as product, process, and organisational innovations [2], [3]. This paper deals with product and process eco-innovations (together referred to as technological innovations). Process innovations can be further subdivided into end-of-pipe and cleaner production-type (preventive) measures [3], [4].

When looking at the factors influencing firms' propensity to introduce (develop or adopt) environmental innovations, we find that some of these are common to innovation activity in general – such as, for example, the availability of human and financial resources or the management's attitude toward risk – while others are specific for eco-innovations – such as environmental regulations or the demand from green consumers, etc [5].

The factors related to environmental innovation found in the literature can be grouped into three main categories: the characteristics of the firm, the characteristics of the environment and the characteristic of the environmental technology in question [4], [5]. Figure 1 provides a summary of these determinants, highlighting those which are specific to environmental innovations. It should be noted that the classification of certain factors as internal or external is not always clear cut – for example, the structure of a certain market or the environmental preferences of a group of consumers may lie outside of the firm's sphere of influence, however, it is the firm's basic decision to choose in which market it operates and which group of consumers it wishes to serve.

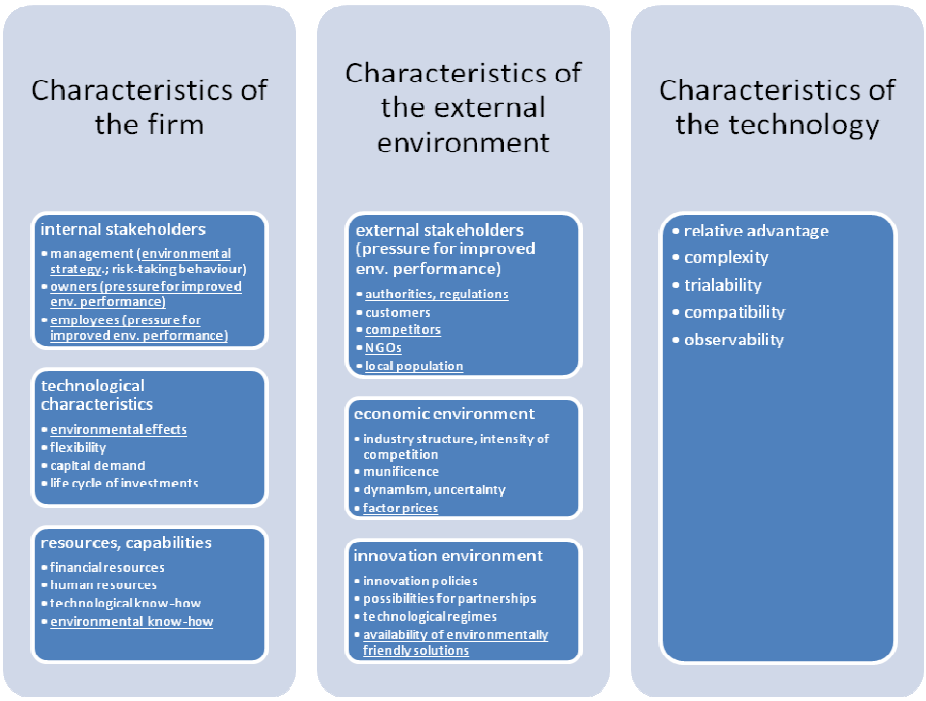

FIGURE 1: OVERVIEW OF THE DETERMINANTS OF ENVIRONMENTAL INNOVATION (FACTORS SPECIFIC TO ENVIRONMENTAL INNOVATION UNDERLINED)

As the introduction environmental innovation often requires significant resources, the commitment of management towards the environment and the firm's environmental strategy clearly play an important role [6]-[9]. The literature on environmental strategies is vast, but the different typologies are usually based on how a company's efforts to protect the environment are related to the legal requirements [6], [10]-[12] – the main question is what determines whether a firm will do only the bare minimum to conform to environmental regulations (or maybe even breach them), or whether it will voluntarily take further measures. The main reasons believed to affect this include the different level of environmental risks linked to companies' activity [11], [12] and the different degree of market opportunities associated with better environmental performance [6], [11]. The level of environmental risks is of course closely connected to the technology used and certain external factors (mainly the location of the plant); and the market opportunities largely depend on customer's preferences. Nevertheless, it is not the risks and opportunities themselves, but the management's perceptions of these factors that is decisive: the studies cited above all show that facilities operating under similar circumstances often show different behaviour toward the environment, including their search strategy for environmental technologies [6]-[9]. This means that there is a considerable subjective element in firms' environmental strategies, therefore, this can be regarded as a distinct factor.

Very important among the firm-internal factors are the resources and capabilities that a company needs to engage in environmental innovation activity [4], [25]. The availability of these is usually related to the size of the firm, therefore, size is thought to be an important determinant of environmental innovations [4]. SMEs in transition countries (like Hungary) are especially suffering from the lack of capital necessary for cleaner production

investments [13]. Despite the lack of resources, smaller firms may also have certain characteristics such as flexibility and proximity to consumers which may provide advantages in the field of innovation. According to Hansen et al., small firms are able to make use of their flexibility when introducing incremental innovations but face serious difficulties when it comes to larger changes due to the limited nature of their network relations and technological abilities [7].

Further to general technological capabilities, specific environmental know-how is necessary for the implementation of environmental innovations. Indeed, there is evidence that the use of environmental management tools which help in collecting information about the firm's environmental effects and the possibilities for improvement in an organised way is positively connected to environmental innovation activity [13]-[15].

The external factors influencing firms' environmental innovation behaviour are also manifold – one important group are the various stakeholders who may exert influence over the firm to improve its environmental performance. Among these stakeholders, many studies show the public authorities to be the most important source of pressure for increased environmental protection [6], [13], [14], [16], [17]. A theoretical explanation for the importance of environmental regulations for eco-innovations is provided by Rennings and Jaffe who describe the so-called "double externality" problem. Environmental innovations are hindered by two independent set of externalities: the first is inherent to all types of innovation activity (difficulties to entirely appropriate the benefits of innovation), while the second results from the external nature of environmental pollution. These provide a strong rationale for government intervention to increase the level of environmental innovation activity to the socially desirable level [1], [18].

Much research has been carried out to determine what kind of environmental policy instruments would be best suited to promote innovation and constant improvement of environmental performance (this characteristic of regulations is referred to as dynamic efficiency). In general, market based instruments are thought to favour innovation more than command-and-control type regulations [1], [4], [19] – more recently however, the attention has turned from instrument choice to the specific attributes of environmental regulations which may contribute to dynamic efficiency. According to Kivimaa, the gradual and predictable nature of regulations is important to give businesses the time to adapt through innovation, and flexibility of the regulations is also vital in order to allow companies to comply by using different – new – technologies [20].

It is important to point out that the role of authorities in promoting eco-innovations does not stop at adopting regulations – a range of other instruments exists from creating demand through green public procurement, empowering consumers and NGOs [21], as well as supply side policies aimed directly at supporting environmental innovation activity (grants, tax breaks, etc.) [18].

Regarding other external stakeholders, the green marketing literature has emphasized the role of consumer demand for environmentally friendly products [19]. So far, however, the importance of green consumerism has remained rather marginal, and most green products can only expect to be successful in the mass market if they are also able to demonstrate other customer benefits [22]. The relatively limited role of buyers/consumers in promoting environmental innovation is also visible from the fact that most empirical studies show the incidence of environmental product innovations to be significantly inferior to process-related eco-innovations [3], [17], [23]. The influence of other stakeholders such as green

NGOs appears rather limited in most cases [14].

The effect of industry structure and the intensity of competition on innovation is not clear [4], [19]. For environmental innovations, it would appear likely that scarce resources and strong competition (environments low in munificence) would lead firms to cut back on environmental investments, however empirical evidence from Rothenberg and Zyglidopoulos does not support this idea. At the same time, dynamic, uncertain environments appear conductive to innovation [5].

The importance of networks and partnerships are often emphasized in the general innovation literature [24], and also for environmental innovations [7], [16], [25]. Another factor influencing the uptake of innovations is the path dependency of technological regimes – ie. when the infrastructural and institutional embeddedness of a dominant design or technological paradigm prevents new solutions from gaining a foothold [1], [25]. This phenomenon of technological "lock-in" is emphasised in evolutionary economics, and is also clearly relevant for the diffusion of eco-innovations (reliance on fossil fuels is a good example where this "lock-in" makes a shift toward sustainable solutions very difficult) [26].

When firms are considering the adoption of an already existing technology, the characteristics of that technology and the available information will also clearly influence the decision. In his seminal work on the diffusion of innovations, Everett Rogers names five characteristics affecting the uptake of specific innovations. These are: the relative advantage of the new solution compared to existing alternatives, its compatibility with the adopter's systems, its complexity, trialability and observability (meaning how visible it is to the outside world if somebody has implemented the innovation) [27]. For eco-innovations, several studies show that costs savings are indeed an important driver for the introduction of cleaner production solutions [16], [17], [20], [28].

III. ECO-INNOVATIONS IN THE HUNGARIAN CHEMICAL INDUSTRY

The survey providing the empirical basis for the paper was conducted in April-May 2010 in the form of structured interviews with the representatives of Hungarian chemical companies. In order to ensure the relevance of the questions, the questionnaire used for the interviews was tested with the participation of experts from the chemical industry. 350 companies (representing about half of chemical firms in Hungary) were contacted, yielding 70 personal interviews – the sample is quite diverse, consisting of companies of various sizes, fields of activity and location within the country.

The questionnaire was organised as follows: after a first section about the general characteristics and market situation of the companies, we asked about their environmental innovation activity, and finally the factors affecting this activity. The questionnaire contained several open ended questions in order to explore the respondents' opinion as deeply as possible.

Environmental innovation activity was surveyed in two ways: first, we enquired about the proportion of the company's products and processes affected by environmental innovations in the past three years, then, we asked respondents to describe up to three specific eco-innovations implemented during this period.

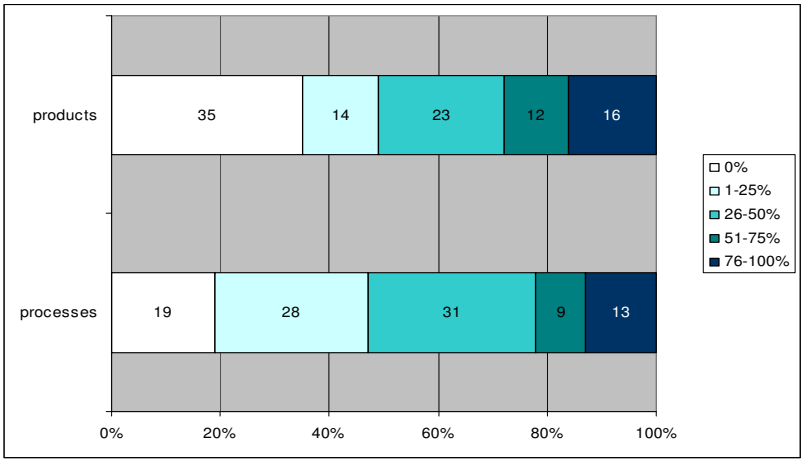

FIGURE 2: DISTRIBUTION OF COMPANIES BY LEVEL OF ENVIRONMENTAL INNOVATION ACTIVITY (EXPRESSED AS THE % OF PRODUCTS AND PROCESSES AFFECTED BY ENVIRONMENTAL INNOVATION IN THE PAST THREE YEARS)

As can be seen in Figure 2, the sample included both companies with very intensive environmental innovation activity as well as firms not engaged in environmental innovation at all. Similarly to many other studies [3], [17], [23], we also found environmental process innovations to be more common than product innovations. The 70 firms interviewed reported a total of 103 specific environmental innovations from the past 3 years – 20% of these were product- related; with the share of cleaner production type measures being double the proportion of end-of-pipe measures among the process innovations.

Regarding the determinants of eco-innovation, the survey concentrated on the role of different stakeholders, firm resources and capabilities, and environmental effects. As the aim of the survey was to examine firms' openness to environmental innovations in general, specific technology characteristics could not be included, but several responses to the open ended questions did reveal cost savings to be an important motivation factor in case of many of the cleaner production-type innovations described.

The effect of company size proved quite interesting: we found that the number of specific innovations mentioned by the companies were significantly correlated to their revenues (c.c: 0.4) and, to a lesser extent, also to the number of their employees (c.c 0.272). This, however, appears to be the natural effect of larger companies having more plants, products, machines, etc. and does not mean that smaller companies are less active in the field of environmental innovation on their own scale – we found namely that the intensity of environmental innovation activity as measured in the proportion of products and processes (as presented earlier, see Figure 2) had no connection with company size.

Firms surveyed have a very favourable opinion of their own environmental effects. On a scale of 1-6, they found their use of raw materials (sample average 3.7) and energy (3.2) to be the highest (which is not surprising, since these represent cost factors) – other effects, such as emissions to air , water and soil were regarded as very low (averages under 2). The perceived level of environmental impacts shows no connection to the level of environmental innovation activity – however, this may be due to the fact that we only have information about the current levels of environmental impacts, which may have been higher before the innovations were introduced.

Looking at the role of different stakeholders, firms clearly felt the strongest pressure to improve environmental performance coming from the regulating authorities (average 4.6 on a scale of 1-6). From the other actors, only the role of internal stakeholders seems important (average 4.1 for management and owners, 3.2 for employees) – the civil society (2.4) and customers (2.7) do not represent a serious influence for most companies.

It is interesting that, although weak in general, customer and NGO pressure was nevertheless significantly related to the intensity of environmental innovation activity. The effect of regulatory pressure, on the other hand, did not have significant explanatory power, perhaps because companies are subjected to it to a similar degree. We did, however find that regulatory pressure in specific areas was related to the incidence of innovations aimed at treating that specific problem. Thus, it seems that regulatory pressure was able to generate innovation in the areas of waste, emissions (air, water, soil), as well as the efficiency of raw materials use and the toxicity of products. (However, the connections are fairly weak, the correlation coefficients range from 0.24 to 0.34.)

The perceived availability of resources and capabilities necessary to carry out environmental innovation was also measured on a scale of 1 to 6. Firms surveyed feel able to monitor their environmental effects and identify ways for improvement (average 5.0), and they also have the necessary human resources (4.9). What they reportedly lack most are internal (3.4) and external (3.0) financial resources. These indicators – with the exception of the ability to access external financing – are weakly but significantly correlated to the indicators of innovation activity.

We also asked respondents in a direct open ended question what they regard as the necessary preconditions for their firm to increase its environmental innovation activity (Figure 3). In accordance with the previous questions, the majority named the improvement of their financial circumstances. Several respondents specifically mentioned the necessity of better possibilities to obtain grants and support, as they feel that such schemes are currently very difficult to access for smaller companies. Many cited regulatory pressure as the only thing that would motivate them to improve their environmental performance – which of course does not mean that they consider the increased stringency of environmental regulations desirable. The number of those completely rejecting environmental developments was low, but several respondents stated that there was no need to improve their environmental performance since they comply with all regulations and do not pollute.

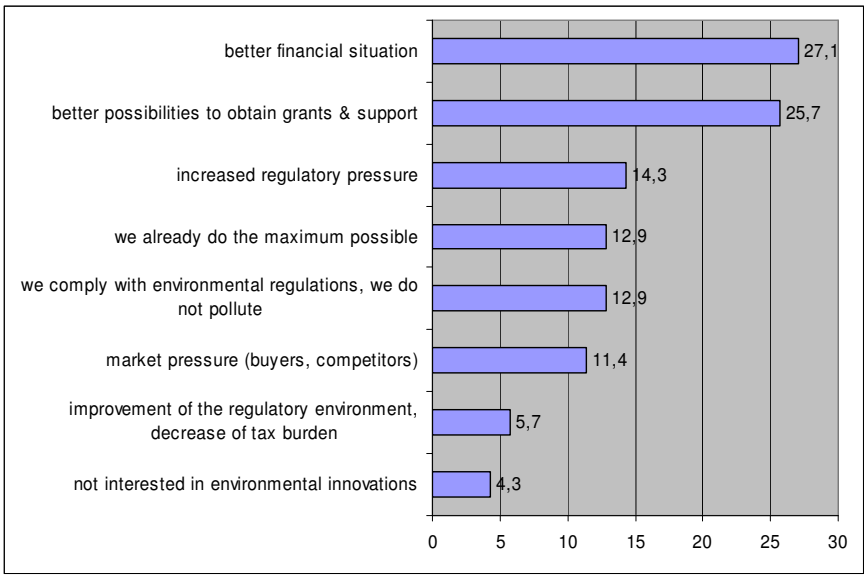

FIGURE 3: NECESSARY PRECONDITIONS FOR THE FIRM TO INCREASE ITS ENVIRONMENTAL INNOVATION ACTIVITY (ANSWERS CODED FROM AN OPEN ENDED QUESTION, WHERE EACH RESPONDENT HAD THE POSSIBILITY TO NAME MORE THAN ONE CONDITION)

IV. CONCLUSIONS

The literature lists a wide variety of factors which may influence firms' decision to engage in environmental innovation activity. These can be grouped into the characteristics of the firm, the external environment and (in chase of adopted innovations) the characteristics of the technology in question. This paper examined the relevance of some of these factors for chemical companies in Hungary. We found several determinants connected with the level of innovation activity, but none of these had very strong explanatory power. It seems therefore that the propensity for environmental innovations is the result of complex interaction between several factors.

The level of environmental innovation activity among the surveyed firms was very diverse, with environmental process innovations generally outnumbering product related changes. This corresponds to results found in the literature as well as the fact that most companies as yet do not encounter significant environmental demands from the side of their buyers.

Most companies consider their own environmental effects to be rather low, with the exception of material and energy consumption, which are also cost factors and which many therefore strive to reduce through efficiency improvements. As for the other environmental impacts, most firms are only confronted by these in the form of regulatory requirements, which gives rise to the perception that regulatory compliance is equivalent to the absence of pollution.

It is interesting that pressure from NGOs and customers, although perceived to be weak in general, are nevertheless related to innovation activity, meaning that those few companies which have already encountered pressure from these groups are making efforts to improve their environmental performance as a result. Regulatory pressure was generally perceived as strong by the respondents and was found to be related to innovation activity in specific issue areas.

Contrary to our expectations, the size of firms does not seem to influence the level of innovation activity. Knowledge of the company's environmental impacts, access to environmentally friendly solutions and the availability of human resources are all important for innovation, but are not measurably connected with company size. The perceived adequateness of the firm's financial resources is connected to the firm's revenues, but not firm size as expressed by the number of employees.

The role of money is very interesting in the light of our findings. From the responses to the open ended question, it seems to have a paramount role in expanding environmental innovation activity, but does not seem as important when looking at the quantified relationships. It appears therefore that the availability of financial resources is a necessary precondition of environmental innovation but not sufficient on its own. While it may be simple to justify the neglect of environmental investments by the lack of funds, in the absence of other motivation factors it is far from certain that more resources would be allocated to the area even if the financial situation improved.

Overall our results point to the conclusion that – as long as the expectations of civil society and the market in this regard are relatively low – next to environmental regulations it would also be useful to strengthen and direct general innovation policy to more effectively promote environmental developments.

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EMA IN PRACTICE

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Abstract:

The case study presents the EMA system within Nitrokemia 2000. The company was an important private enterprise within the Hungarian chemical industry, applying 54 technologies in 5 different divisions.
The former accounting system did contain only the theoretical costs of waste-water treatment for different products. The new accounting system focused on the end-of-pipe costs: like waste-water, hazardous waste treatment, as environmental costs. These costs have been calculated based on measurements and production data, and have been listed under variable costs. Several additional costs have been displayed under utility costs.
The newly applied MFG/PRO software had the advantage of capturing material flows both in monetary and physical terms.

This provided a good base for:

- Preparation of regular monthly reports;
- Preparation of yearly budget forecast
- Controlling the operation of the technologies;
- Making strategic decisions regarding products and projects.

The positive impact of these can be further improved by broadening the environmental costs displayed in the accounting systems. The suggestions have been prepared.

ROLLING OUT CORPORATE SUSTAINABILITY ACCOUNTING: A NEW SET OF CHALLENGES FOR SUSTAINABILITY ACCOUNTING

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Abstract: Improving corporate environmental and social performance has been addressed by an increasing number of companies in the past three decades. Whereas initial measures focused on a qualitative understanding of the impacts of the company on the environment and society, more recent accounting research on measurement practice has concentrated on highlighting the linkages between environmental (and later social) and economic performance. Sustainability accounting, furthermore, has developed to support corporate sustainability management, as an approach to generating and using sustainability information. Albeit somewhat lagged, a newer stream of sustainability accounting is being developed to support management in making informed decisions.

No previous publications, however, provide a (conceptual) deliberation on the implementation process, obstacles and approaches how corporate sustainability accounting can be introduced and established throughout a company.

Based on previous publications, the following paper attempts to identify the challenges in the roll out phase of corporate sustainability accounting. It examines previously identified challenges – both sustainability accounting related as well as general considerations in the roll out process. The results derive motivation for further research on this specific challenge and also address the issue in a manager-compatible language, delivering concrete recommendations.

I. STATUS OF CORPORATE SUSTAINABILITY ACCOUNTING RESEARCH AND PRACTICE

Existing literature on corporate sustainability has been focusing on examples of how sustainability management activities can result in improving financial performance as well as on demonstrating that companies are able to contribute to social and environmental development at little or no additional cost. In order to convince managers of these effects and linkages, researches initially resorted to environmental (initially ecological) accounting [5] to capture these linkages and present them in a convincing manner.

In turn, increasing recognition has been observed by companies with various examples of creating business cases for sustainability [6], i.e. using internal information to identify and create such business cases. Yet, the examples appear somewhat sporadic; too much attention has been paid to copying good practice from other companies rather than recognising further potentials.

Yet, there are examples of novel approaches, although these have been examined only exploratively. A forthcoming publication on the practice of corporate sustainability accounting [2] reveals that sustainability pioneers have been systematically engaged with various practices that can be related to sustainability accounting.

II. A SYSTEMATIC APPROACH TO SUSTAINABILITY ACCOUNTING

Some companies are expectedly more advanced than in their sustainability accounting practices than others. As the above literature review reveals, different focus is set depending on what stage the company is at: a company that has just started looking into sustainability accounting is more likely to be focused on identifying relevant performance indicators, figuring out (efficient) ways to produce the required information and/or looking for the informational value of existing sustainability information.

More advanced companies, on the other hand, are more likely to be refining existing practice by e.g. increasing the departments and people involved in producing and using sustainability information, increasing the number of aspects and linkages they look for, etc. So once the benefit of sustainability accounting has been recognised, several aspects need to be considered in order to optimise its effects, including convincing senior management of necessary changes and getting the support of various employees. As suggested above [2] senior management is rarely engaged into the sustainability management of the company, although they do not seem to obstruct related activities. Yet, further involvement of senior management may have positive effects on sustainability accounting, e.g. by granting additional resources, motivating people and even reconsidering core business activities.
Employee involvement is often a very important aspect too, as sustainability accounting requires cross-departmental cooperation. A main problem with this appears to be the lack of resources in supporting (i.e. other than the sustainability) departments to provide the required information in the required form, and on the other hand, the unwillingness of other departments to be subordinate to the sustainability e.g. by formally agreeing to produce certain information.
The following Figure (1) presents the timeline of the development of corporate sustainability accounting

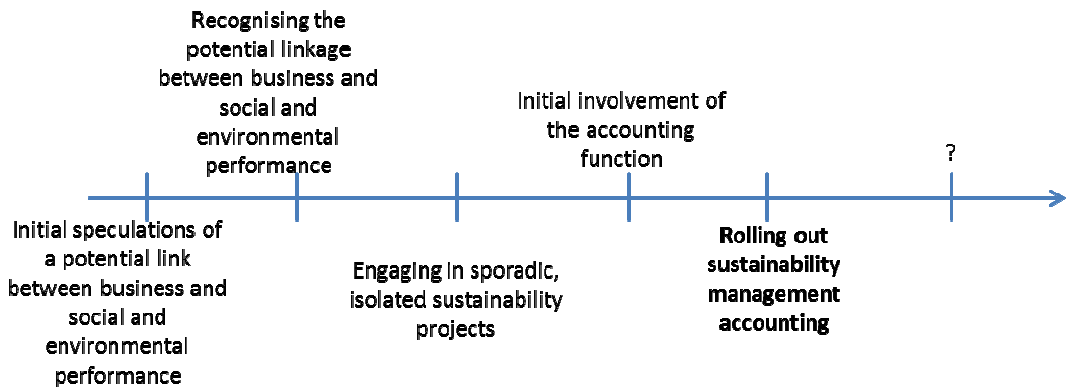

FIGURE 1: STAGES IN THE DEVELOPMENT OF CORPORATE SUSTAINABILITY ACCOUNTING

This paper thus focuses on the last stage identified in the above figure: the roll out phase of sustainability management accounting. For this, the following chapter explains organisational as well as content-specific ones in the roll out phase of corporate sustainability accounting.

III. SPECIFICS OF SUSTAINABILITY ACCOUNTING ROLL OUT

As suggested above, there are two types of considerations to be paid attention to in the roll out of corporate sustainability accounting: organisational and content-specific ones. The former are presented first.

Organisational aspects

As part of Chain Management Theory, the roll out process has been described in various business contexts in literature. A recent publication [3] provides an overview of the basics of the roll out process. The authors identify the general steps in the process and argue in favour of a three step process. The considerations in this section thus rest on this idea. Furthermore, the largely underestimated importance of formal project management [2] is also introduced and discussed below.

The model for the roll out process described in [3] rests on three decisive steps: preparation of the roll out project, involving senior management and subsequently involving employees. The preparation is particularly critical in terms of available resources as the operational aspects of the roll out have been documented to be very demanding. This means that a clear understanding of the needs of the roll out process needs to be achieved. For example as the involvement of various departments is needed, these need to be provided the necessary support and it needs to be made sure, that available capacities for the required tasks are available within these departments. As [2] reveals, this is often not the case thus hampering the advancement of the roll out project.

The involvement of senior management has also been identified for the process. Due to the often conflicting nature of sustainability management with financial performance, the support of the senior management is only partly granted. In other words, by the nature of their functions, managers support processes and measures that can be legitimised in front of stakeholders (mainly shareholders) thus a clear and tangible cost-benefit analysis needs to produce supporting information. One crucial task of the project manager is thus the identification of a list of (expected) benefits, ideally including short-term ones as well as such expressible in monetary units. For example, a company-wide sustainability accounting is likely to uncover further business cases for the company and additionally result in a reputation improvement.

The involvement of the employees has also been identified as a critical factor in developing a company-wide sustainability accounting [2]. The importance of their involvement can be summarised in several points. First, their support is indispensable, as they are often the only providers of related information and therefore they need to be involved rather than having other functions produce the same information. Second, their involvement is essential as they are familiar with the content behind the information they provide, i.e. before information consolidation takes place. In other words, the original providers of information may be in the position to provide further related information, as the roll-out team may not be aware of the existence and/or relevance of such information.

Content-specific aspects

Several content-related aspects of the sustainability accounting roll-out process need to be given a thought too. On the one hand, the information flows need to be designed in view of potential providers, managers and users of the available information. This means that involving departments not only in the provision of information but also making it available to them can be an incentive for their involvement and thus contribute to their supportiveness. As previously identified, the involvement of various departments generating information is particularly important; for the reasons outlined above their involvement in making use of such information is crucial too.

Based on an environmental management accounting framework developed by Burritt et al. [4], a few further recommendations in regard to the information needed can be provided. On the one hand, more attention needs to be paid to future-orientated information. For the

roll-out process this means providing the possibility of relating the potential impacts for each department so that an overall integrity is achieved – a main objective of an overreaching sustainability accounting system. Another particularly important function of such a system is linking monetary and physical data, which appears to be the case in few companies only [2]. The frequency of data and information generation is a further important aspect to consider. On the one hand, regular data generation, collection and use are likely to increase the efficiency of the process. On the other hand, however, limiting the scope of the system to such information renders it unable to take into consideration other decision situations as identified in [4]. Last but not least, the anticipated and partially established focus on short term information [2] needs to be expanded to include mid and long-term information.

IV. CONCLUSIONS

With the increasing number of companies reporting sustainability engagement and the possible contribution of the sustainability manager [1], sustainability leaders appear to have reached a stage at which the roll out of sustainability accounting is the next step to take. Yet, this process has been observed to present a serious challenge for businesses for the reasons outlined earlier in this paper. Against this background, a suggestion – one possible approach – to tackling this challenge is presented. The main message of the argumentation is that in practice the roll out of sustainability accounting is a complex process – an aspect often overlooked – that requires professional project management as well as the full support of senior management and employees. These conclusions provide a basis for managers to consider in their next steps (or even earlier in their sustainability accounting practice, cf. Figure 1). Also, further research is required to identify further specific properties that need to be considered in the roll out as well as examples of good practice in tackling these.

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SIMULATION OF CARBON-DIOXIDE EMISSION BY OPTION MODEL

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Abstract: ***Estimation of carbon emissions is very important not just for companies but also for governments and policymakers. In this paper I provide an emission estimation model for an energy-producing company based on spot market prices. The company will produce energy and emit carbon-dioxide at a given time point if its margin for emitted CO2 dominates the prices of emission rights. The estimated emissions at a given time point can be calculated as an option of related assets prices (electricity, gas, emission rights). The prices of underlying assets behave according to Geometric Brownian motion. The production decisions of company and its emissions are modeled using a Monte Carlo framework. The resulting distribution is similar to the sum of autoregressive Bernoulli random numbers. For easier forecasting of expected cumulated emissions a logistic type emission function was fitted to the result of simulations.***

Keywords: EU ETS, forecasting emission, simulation, real option

I. INTRODUCTION

For reaching the aims of the Kyoto Protocol, The EU established an internal market (Emission Trading Scheme - EU ETS) for trading with emission rights. Firms operating in this scheme must have a good forecast of their carbon emissions in order to correctly handle their emission rights portfolio. Without a good estimation they can face serious problem at the end of year: if companies hold too many emission rights this means a loss of opportunity costs, while if they hold too few emission rights this can mean a potential penalty fee and a decrease in allocated rights the following year. In this article I present a general framework for forecasting emission of a given time period. I use an option-based decision model for a power generator facility. After the options are evaluated by Monte Carlo framework, we can get the distribution function of emission (also mean and variance). Based on the simulation results, a simplified, regressed function is presented to reduce the calculation time needed.

1.2 The basis of production decisions: margins on production

If an energy producing company operates on basis of long term production contracts, various uncertainty is decreased (the price and quantity of output is fixed). In this case the emission can be calculated and planned based on contracted quantities and technological parameters. Without long term contracts, decisions about production depend on prices of relevant assets (electricity, combustion material, emission rights) in the future.
In the following we assume a simplified profit-seeking energy producing company with only one available technology (open cycle gas turbine). This company sells its output (electricity) and purchases its inputs (gas and emission rights) on the spot market.

At every time step (practically, each day) the firm can freely decide about its production. Production decisions will be determined by the current profitability of production. If producing electricity generates a profit, the firm will operate, and if not, it will not generate electricity on the given day.
If the revenue of the firm is TR, variable costs are divided into three parts (cost of combustion material (F), cost of required emission rights (Q), and other variable costs (TVOC)), we have the following conditions for production:

$$TR - F - TVOC > Q$$

1.3 Decisions based on per unit revenue and cost functions

The condition is defined at the level of the company (in EUR), expressed in units of produced electricity (or per emitted CO2). For calculation per unit values we need carbon intensity parameters.

The carbon intensity (δ) of the energy generating firm shows the emitted carbon dioxide per unit of produced electricity. It can be decomposed as a product of the carbon intensity of the input fuel (I), reciprocal thermal efficiency (e) and end of pipe cleaning ratio (c).

$$\delta = I \cdot \frac{(1-c)}{e}$$

Production conditions per electricity unit produced will be the following:

$$S_{POWER} - \frac{S_{GAS}}{e} - VOC - I \cdot \frac{(1-c)}{e} \cdot S_{EUA} > 0$$

Where VOC means other (excluding fuel and emission) variable costs, S means the spot price of power, gas and emission rights (EUA).
In energy markets different spreads are calculated (e.g. Abadie – Chamorro 2008). Spark Spread is calculated for gas burning generators. It is equal to the price of electricity minus the cost of required gas. Dark Spread is the same calculation for coal burning facilities. If we calculate also using the required numbers of emission rights we get Clean Spark Spread (gas burning) and Clean Dark spread (coal burning). The production condition presented above is similar to the Clean Spark Spread, but it also contains the other variable costs.
We can rearrange the condition of production to unit of emitted carbon dioxide:

$$\frac{1}{I \cdot (1-c)} \cdot (e \cdot S_{POWER} - S_{GAS} - e \cdot VOC) > S_{EUA}$$

The firm will operate if the margin (without emission rights) per emission unit is higher than the price of emission rights.
The margin per emission right determines the reservation prices of emission rights. This is not the generally-known negative gradient MNPB function (e.g. Kerekes, 1995), but over the short term a horizontal line. This is closer to Löfgren's interpretation (Löfgren 2000), where the difference between revenue per unit (p) and average variable production cost (AVC) is constant.

1.4. Company Emissions

Based on these conditions we can create a decision variable (Φ) with two potential values: in case of production, 1 and in case of non production, 0.

$$\Phi = \begin{bmatrix} 0 \ if \ \frac{1}{I \cdot (1-c)} \cdot (e \cdot S_{POWER} - S_{GAS} - e \cdot VOC) =< S_{EUA} \\ 1 \ if \ \frac{1}{I \cdot (1-c)} \cdot (e \cdot S_{POWER} - S_{GAS} - e \cdot VOC) > S_{EUA} \end{bmatrix}$$

If we are interested in sums of decisions in a period we can derive the cumulated decision variable (Ω):

$$\Omega(T) = \sum_{t=1}^{T} \Phi_t$$

As can be seen, the margin determines whether a given installation produces or not on a given day. It is assumed that after any production decision emissions are totally determined by technology (carbon intensity and capacity) parameters which are supposed to be constant over the modeling time interval. Capacity determines the output of electricity in the case of production. For this aspect it is not the theoretical maximum, but the actual available capacity (e.g. Lesi - Pál 2004) that is important, which accounts for the necessary maintenance and production down time. The potential daily produced energy (DPE) in MWh can be calculated as product of available capacity (using 24 hours).

If the technical parameters are fixed, the total cumulated emissions for a given period can be easily calculated by multiplying the cumulated decision function, daily potentially produced energy and output carbon intensity:

$$E(T) = \Omega(T) \cdot DPE \cdot \delta$$

Because cumulated emissions can easily be calculated from the cumulated decision function, available capacity and carbon intensity (these last two items are steady in the model), in the next sections emphasis and effort will be put on modeling cumulated decision function (Ω).

II. A SIMPLIFIED EMISSION MODEL BASED ON BERNOULLI NUMBERS

In this section I present a simplified simulation for explaining the behavior of the cumulated decision variable. This simplified model does not contain any market factors, but only demonstrates the resulting distributions of cumulated independent/dependent variables.

For modeling decision variables the Monte Carlo method was used. Based on the Monte Carlo principle (e.g. Mooney 1997) in random samples the probability density function and moments can be assessed by actually drawing lots of random samples and observing their behavior. This creates a pseudo-population which resembles the real world in all relevant aspects.

Daily production decisions can be defined as a Bernoulli random variable, with values 1 (production) and 0 (non-production). If RND is a uniformly distributed (between 0 and 1) random variable, then the daily decision variable (Φ) can be expressed as follows:

$$Y_t = RND\,, \qquad \Phi_t = \begin{matrix} 1 \; if \; Y_t < p \\ 0 \; if \; Y_t < p \end{matrix}$$

Its expected value and variance will be the following:

$$E(\Phi) = p\,,\; Var(\Phi) = p \cdot (1-p)$$

For estimating sums of decisions for a period (T), we have to cumulate daily decisions variables as defined before: ($\Omega_T = \sum_{t=1}^{T} \Phi_t$).

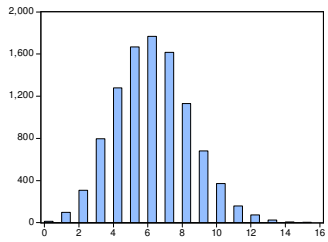
The density function of the resulting cumulated decision variable (Ω) will depend on the interdependencies of production decisions made on consecutive days.

In the following I show the results of simulating three possible production probabilities (p): 20%, 50% and 80% in two different situations (i.e. independent / dependent daily production decisions). The number of simulations was 10000; the number of days (length of period) was 30 days.

2.1 Independent daily production decisions

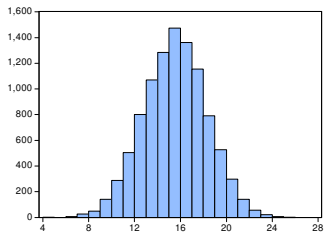
By supposing independency of daily production decisions, sums of Bernoulli variables result in a Binomial distribution. In the case of a larger number of variables it tends to a normal distribution (e.g. Chevallier 2006). Simulation results of the independent case produce the following:

p = 20%



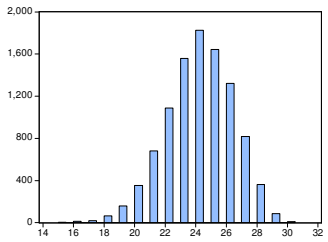
Mean	6,05
Std. Dev.	2,20
Skewness	0,25
Kurtosis	2,9966
Jarque-Bera	103,58
Probability	0,00%

p = 50%



Mean	15,04
Std. Dev.	2,77
Skewness	-0,02
Kurtosis	2,9263
Jarque-Bera	3,10
Probability	21,19%

p = 80%



Mean	24,01
Std. Dev.	2,20
Skewness	-0,28
Kurtosis	2,9912
Jarque-Bera	127,11
Probability	0,00%

FIGURE 1: HISTOGRAMS OF CUMULATED INDEPENDENT BERNOULLI VARIABLES

In the independent situation the means of distributions (expected values) tend to the multiplication of the number of days (d) and production probability (p).

$$E(\Omega_T) \rightarrow d \cdot p$$

Based on form of histograms and skewness parameters we can see that a low production probability (p) pushes the distribution left, while a high p causes a right-skewed distribution.

2.2 Dependent daily distributions

Let us assume that the consecutive distributions are dependent. A good example is an autoregressive (AR(1)) process defined below:

$$Y_t = Y_{t-1} \cdot 0.9 + RND \cdot 0.1$$

Based on a simulation with 10.000 repeats, the sum of 30 variables ($\Omega_{30} = \sum_{t=1}^{30} \Phi_t$) will have the following distribution:

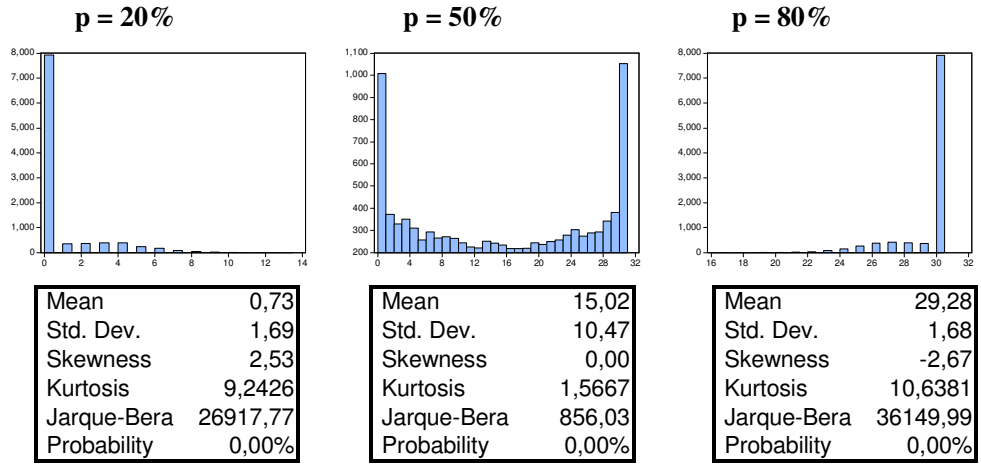


FIGURE 2: HISTOGRAMS OF CUMULATED AUTOREGRESSIVE AR(1) BERNOULLI VARIABLES

As we can see, the *p* probability determines the form of distribution. If p=20% (the expected value of production for a day is 20%) the distribution is skewed left: zero production has the maximum probability. In case of p=80%, we can see the opposite: the probability of every day production is the largest and the distribution is skewed right.
In case of p=50%, the distribution takes a "bath" form. The probability of extreme values (no operation at all or daily operation) is high while in the middle there are low probabilities.

3. MONTE CARLO SIMULATION OF PRODUCTION DECISION FUNCTIONS THROUGH AN OPTION MODEL

3.1.1 Modeling one dimensional price processes

By assuming a weak form of market efficiency, the price process of a traded asset has a Markov characteristic; only the current price is relevant for estimating future trends and historical prices are not important (e.g. Hull 1999).
A Wiener process a special Markov process defined as follows:

$$\Delta z = z(t) - z(0) \sim \varepsilon\sqrt{t} = N(0,t), \text{ where } \varepsilon = N(0, 1)$$

The incremental changing of a Wiener process is a standard normal distribution with an expected value of 0, and variance of t.

Geometric Brownian motion has the following form:

$$dS = S\,\mu\,dt + S\,\sigma\,dz$$

By using Ito-lemma the logarithmic rate of returns has the following process:

$$d\ln S = (\mu - \sigma^2)\,dt + \sigma\,dz$$

Simulating the stock price (which logarithmic return follows geometric Brown motion) can be performed through the following steps:

1. Determining model (μ, σ) parameters
2. Calculating initial cumulated log return
$$\eta(0) = \ln(S(0))$$
3. Calculating consecutive cumulated log returns
$$\eta(t) = \eta(t-1) + \left(\left(\mu - 0.5 \cdot \sigma^2\right) \cdot dt + \sigma \cdot \sqrt{dt} \cdot \varepsilon_t\right)$$
4. Determining stock price from log return
$$S(t) = e^{\eta(t)}$$

As an alternative the stock price can be calculated not by cumulated but actual log return and last price:

$$\gamma(t) = \left(\mu - 0.5 \cdot \sigma^2\right) \cdot dt + \sigma \cdot \sqrt{dt} \cdot \varepsilon_t$$

$$S(t) = S(t-1) \cdot e^{\gamma(t)}$$

The two methods of calculation give the same results because of log returns' additive characteristics ($e^{r_1} \cdot e^{r_2} = e^{r_1 + r_2}$).

3.1.2. Modeling multidimensional price processes

Modeling multidimensional price processes is done in a very similar way as for one dimensional cases - the main difference is that we should consider the role of correlation which modifies the stochastic members of the processes.

The key to modeling is to generate correlated multivariate normal distributions; the theoretical background for doing this is based on Glasserman's work (Glasserman 2003).

The multivariate normal distribution is $N(\underline{\mu},\Sigma)$, where $\underline{\mu}$ is a vector which captures expected values and Σ is the covariance matrix with elements of $\Sigma_{ij} = \sigma_i \sigma_j \rho_{ij}$

In the case of non-correlated standard normal distribution the covariance matrix is an identity matrix (the variances are 1, correlations are 0) which can be written as $Z \sim N(0, I)$.

Multivariate normal distribution has a linear transformational characteristic. If we multiply the multi dimensional distribution by a matrix (A) we produce the following:

$$X \sim N(\underline{\mu}, \Sigma) \Rightarrow A \cdot X \sim N(A \cdot \underline{\mu}, A \cdot \Sigma \cdot A^T)$$

Based on this, a multivariate correlated normal distribution, $N(\underline{\mu},\Sigma)$ can be defined by a linear transformation of $Z \sim (0, I)$, as follows:

$$X = \underline{\mu} + A \cdot Z \Rightarrow X \sim N(\underline{\mu}, A \cdot A^T) = N(\underline{\mu}, \Sigma)$$

The problem is simplified to factorization of the covariance matrix: $\Sigma = A \cdot AT$, which can be performed using the Cholesky method.

Based on a covariance matrix, the steps for simulation of multivariate price processes will be the following:

1. Factorization of covariance matrix: where $\Sigma = A \cdot A^T$
2. $\underline{\eta}(0) = \ln(\underline{S}(0))$

3. $\underline{\eta}(t) = \underline{\eta}(t-1) + \left(\left(\underline{\mu} - 0.5 \cdot \underline{\sigma}^2\right) \cdot dt + A \cdot Z \cdot \sqrt{dt}\right)$

4. $\underline{S}(t) = e^{\underline{\eta}(t)}$

As an alternative method we can use a correlation matrix (C), where the items in the matrix are the correlation between given assets: $C_{ij} = \rho_{ij}$

For calculation we also need to decompose the correlation matrix. Let we define the result of Cholesky factorization as $C = B \cdot B^T$

The correlation matrix handles only the "direction" of relations between price movements; we also need variances to handle the volatility. Let we suppose a diagonal matrix (D) which contains variances of processes as follows:

$$D = \begin{bmatrix} \sigma_1 & 0 & \dots & 0 \\ 0 & \sigma_2 & \dots & 0 \\ \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & \sigma_n \end{bmatrix}$$

The covariance matrix can be calculated from diagonal variance matrix and correlation matrix:

$$\Sigma = D \cdot C \cdot D = D \cdot B \cdot B^T \cdot D = A \cdot A^T, \qquad \text{where } A = D \cdot B \text{ and } A^T = B^T \cdot D$$

In this case the third simulation step will be the following:

$$\underline{\eta}(t) = \underline{\eta}(t-1) + \left(\left(\underline{\mu} - 0.5 \cdot \underline{\sigma}^2\right) \cdot dt + D \cdot B \cdot Z \cdot \sqrt{dt}\right)$$

3.2. Base data for simulation

For Monte Carlo simulation two types of data are required:

- Market data of three underlying assets (gas, electricity, EUA)
- Technological parameters of the power generator

Market data origins from the following sources:

- Spot price of electricity (EUR/MWh) from Nordpool 01.01.2008 – 11.30.2009 daily system price
- Spot price of gas (EUR/MWh) from Nordpool 03.05.2008 – 11.30.2009
- Spot price of EUA (EUR/tCO2) from Bluenext 03.05.2008 – 11.30.2009

Based on data the initial price (11.30.2009), the average and standard deviation of daily logarithmic returns are the following:

	Initial price	Log return	
		Average	StDev
Electricity	35,55	0,00032831	0,06472673
Gas	10,45	-0,0003303	0,06213667
EUA	13,16	-0,0018147	0,02700848

TABLE 1: MARKET DATA OF UNDERLYING ASSETS FOR SIMULATION

The covariance matrix is the following:

	Power	Gas	EUA
Power	0,00418955	0,00029356	-9,31E-05
Gas	0,00029356	0,00386097	-0,0001932
EUA	-9,31E-05	-0,0001932	0,00072946

TABLE 2: COVARIANCE MATRIX

Concerning technological parameters, there is no "market price"; every installation is different. I assumed an open cycle gas turbine with 38% thermal efficiency and 0.53 tCO2/MWh output carbon intensity without end of pipe cleaning. The carbon intensity of input gas was 0.2014 tCO2 / MWh, other variable costs were 3 EUR/MWh, while the daily capacity in case of production was 2400 MWh.

3.3 Expected values of daily production decision variable

Based on market parameters and technological parameters I simulated decision functions for 150 days with 50000 repeats.
For storing simulation results we can use matrices with simulation number (*s*) for number of rows and simulated days (*d*) as number of columns. In our model, matrices will have 50000 rows and 150 columns. A given row means a potential realization (for example price process), while a given column means the possible values related to a given day (we can define histograms based on this).
Matrix $S_{s\cdot d}$ contains the modified margin (or modified clean spark spread) for potential production of 1 MWh of electricity. If the given element is negative it means that company does not produce power that day. If the given element is positive, the company produces power, realizes the margin and emits CO2.
Matrix $\Phi_{s\cdot d}$ contains the production decisions. Its elements can be 0 or 1. The connection with matrix S is the following:

$$\Phi_{ij} = \begin{matrix} 1 \ if \ S_{ij} > 0 \\ 0 \ if \ S_{ij} \le 0 \end{matrix}, \text{ for every i and j}$$

The production decision variable (Φ) can have two values (0 or 1). Its expected value for a given t day (average of a given matrix column) will be between 0 and 1, and it can be calculated as an average of given column of matrix Φ:

$$E[\Phi(t)] = \frac{\sum_{s=1}^{50000} \Phi_{st}}{50000}$$

Based on simulation we get the following expected values for the daily production variable by day:

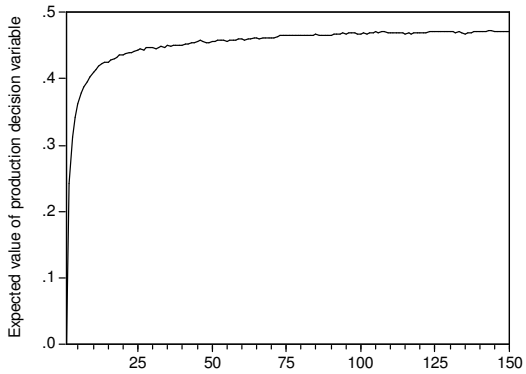


FIGURE 3: EXPECTED VALUE OF PRODUCTION DECISION VARIABLE

As we can see for the first day the expected value is 0 (the initial margin is negative), while for the following days the stochastic characteristic creates a non-negative margin value that increases the expected value. The form of the function over the longer term in the simulated case is almost constant, and is determined by drift parameters of Geometric Brown motions of underlying log returns.

3.4 Expected values and probability density functions of the cumulated production decision variable

The expected production between first day and a given day can be computed from cumulating daily production. Suppose that matrix $\Omega_{s\cdot d}$ contains the realizations of the cumulated production decision variable. Its elements theoretically can be integers between *0* and *d* (number of days). We calculate the cumulated production decision in time *t* by summarizing horizontally elements of Φ:

$$\Omega_{ij} = \sum_{n=1}^{j} \Phi_{in} \text{ , for every i and j}$$

The expected value of the cumulated production variable will be the following:

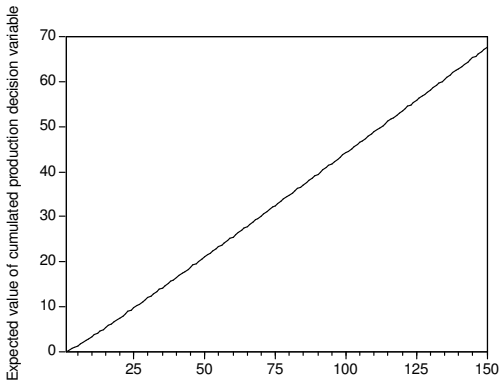


FIGURE 4: EXPECTED VALUE OF CUMULATED PRODUCTION DECISION VARIABLE

In this case the cumulated function is very close to linear, because the expected daily production variable is nearly stable over the longer term (see Figure 3).

Based on simulation results we can create histograms showing the probability density function of the cumulated decision variable for a given interval starting from the first day. For the first 150 days the cumulated daily decision variable takes the following distribution:

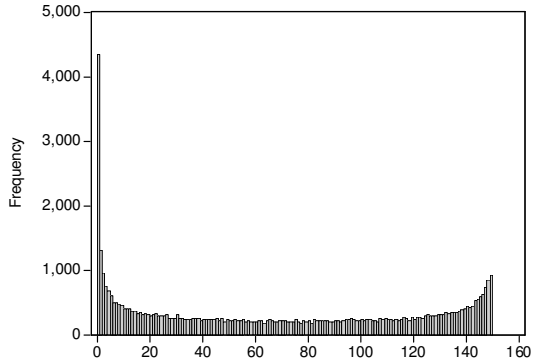


FIGURE 5: PROBABILITY DENSITY FUNCTION OF THE CUMULATED PRODUCTION DECISION VARIABLE OVER 150 DAYS

The form of the graph is left-skewed, so the probability of extreme values are greater (the histogram takes a „bath" form). The result is similar to the simplified estimation model of cumulated dependent (AR(1)) Bernoulli numbers.

Descriptive statistics of density function are the following:

Mean	67.67110
Median	64.00000
Maximum	149.0000
Minimum	0.000000
Std. Dev.	52.59002
Skewness	0.140321
Kurtosis	1.520890
Observations	50000

TABLE 3: STATISTICS OF THE PROBABILITY DENSITY FUNCTION OF THE CUMULATED PRODUCTION DECISION VARIABLE

The distribution mean is 67.67, which is equal to the expected value of the cumulated production decision variable.

To calculate estimated emissions of carbon dioxide the cumulated production decision variable has to be multiplied by daily potentially produced energy (DPE) and output carbon intensity (δ).
The expected emission over 150 days will be 67.67 days x 2400 MWh/day x 0.53 tCO2/MWh = 86.076 tCO2.

Based on the probability density function the empirical cumulative distribution function (CDF) can be calculated:

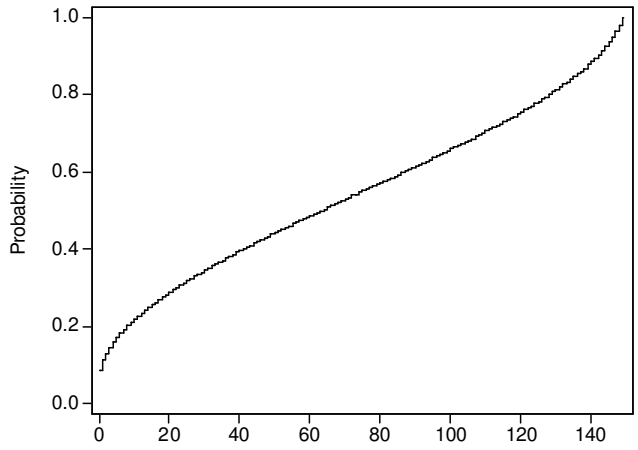


FIGURE 6: SIMULATED CUMULATED DISTRIBUTION FUNCTION (CDF) OF CUMULATED PRODUCTION DECISION VARIABLE AT 150 DAYS

Based on the simulated CDF, the probability of any intervals can be calculated. If we assume that the simulation represents the real production decision phenomena, by increasing the number of simulations (sample size), the cumulated distribution function will be closer to the ”real” CDF, and emission intervals will be better estimations of real intervals.
Based on the current simulation, upper and lower bound (defined by two-side equal probability) for emissions can be defined as follows:

Probability (p)	12,5%	25,0%	37,5%
Lower bound: X | CDF(X)=p	2 083	17 784	45 176
Upper bound: X | CDF(X)=1-p	176 450	151 215	117 604

TABLE 4: PROBABILITIES AND EMISSION INTERVALS IN TCO2 BASED ON EMPIRICAL CDF

Based on simulation the emission will be between 2083 and 176450 tCO2 (with probability of 75%), and with probability of 25% the emission level will be between 45176 and 117604 tCO2.

III. REGRESSION OF EXPECTED FUTURE PRODUCTION AT DIFFERENT MARGIN LEVELS

In this section I provide a simplified way of forecasting the cumulated decision variable (the emission) based on current margin (spread). To provide an example, expected emissions between day 51 and 150 were forecasted.

Let us have a Ψ matrix storing expected cumulated future production decisions between a given day (j) and the last day (d) in the future. Elements of Ψ can be calculated as the difference of cumulated decision variables of last day (d) and $(j-1)^{th}$ day.

$$\Psi_{ij} = \Omega_{id} - \Omega_{i(j-1)}, \text{ if } j > 1$$

$$\Psi_{ij} = \Omega_{id}\text{, if j = 1}$$

After executing the simulation we have data pairs (spread data and cumulated future decisions) for every given day. If we make a chart based on data pairs from 51st columns of matrices S (margin) and Ψ (cumulated future decision) we get the following result:

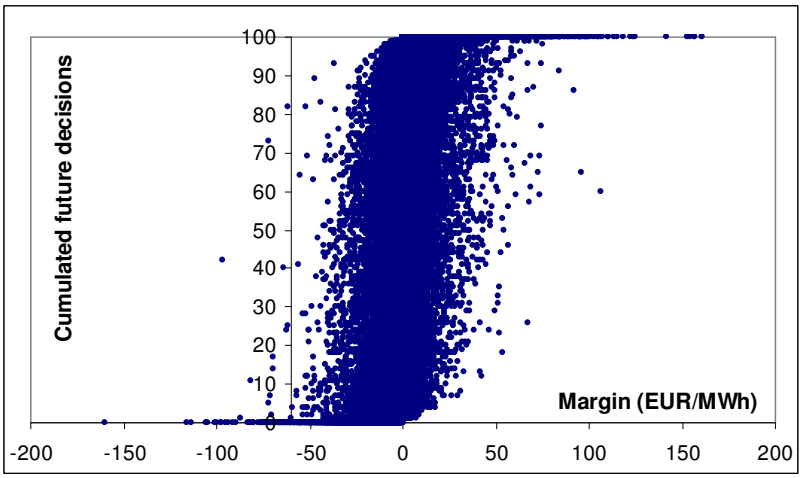


FIGURE 7: MARGINS AND CUMULATED FUTURE DECISION AT DAY 51

The cumulated future decision variable has discrete values (the realizations of daily decision variable can be 0 or 1, their sums can be only integers), while the margin data is non discrete. Assuming that the margin determines the production decision (the independent variable is the margin and dependent variable is cumulated future decision) we need to calculate the conditional expected value of the cumulated future decision. In other words, we need to calculate the average cumulated future decision for every margin value. While margin data is non-discrete potentially only one cumulated future decision value belongs to a given margin value. For calculating an average we need to make groups in margin dimensions. The easiest way to do this is by rounding margin values to integers.

Rounding, grouping and calculation of group averages produces the following chart:

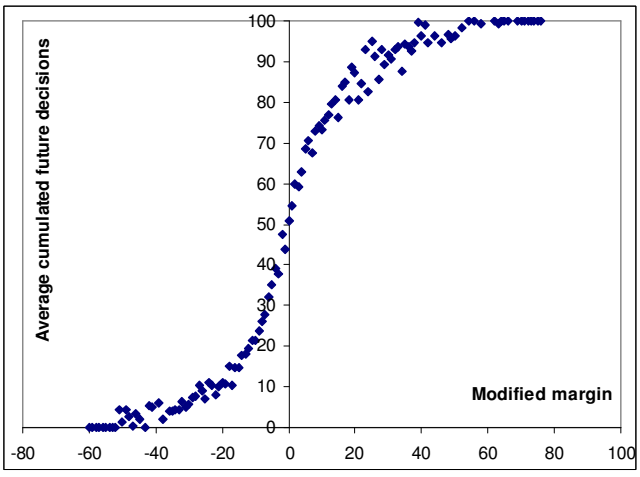


FIGURE 8: AVERAGE CUMULATED FUTURE DECISION PER MARGIN

As can be seen, the function of the future cumulated decision at different margin values is close to the form of a logistic function.
A base logistic function is 1/(1+exp(-t)). Here, we add 6 parameters to the function as below:

$$F(x) = \frac{c(1)}{c(2) + c(3) \cdot e^{c(4)+c(5)\cdot x}} + c(6)$$

For determining the function and its parameters a nonlinear regression was undertaken using the least squares method. To avoid division by zero and simplification it was assumed that c(1)=100 and c(2)=1, c(6)=0. The resulting chart for regressed and simulated data is the following:

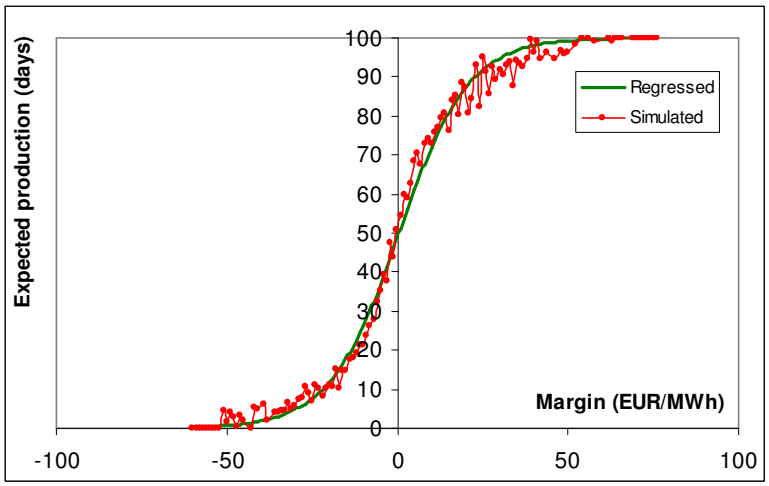


FIGURE 9: SIMULATED AND REGRESSED FUNCTION

The regressed parameters are the following:

c(1)	100
c(2)	1
c(3)	0,985183
c(4)	0,0607101
c(5)	-0,098506
c(6)	0

TABLE 5: RESULTING REGRESSION PARAMETERS

Behind the regressed model there is a simplification: the expected summed value of the (future) decision depends on the absolute value of modified margins and time (i.e. how many days remain until the last day). In the simulation we modeled the logarithmic returns of assets.
If the margin value is 2 EUR/MWh the probability of changing the production decision is not the same at an electricity price of 30 EUR/MWh or at a price of 60 EUR/MWh. At the same margin level the probability of a margin turning negative is higher in case of higher electricity prices (in this case the 1% decrease in electricity price decreases the margin

more). A more precise regression model can be built which accounts for not an absolute but a relative margin.

Based on the regression and technical parameters the firm's expected (future) emission for 100 days will be the following:

$$Expected\ \ emission\ \ (100\ \ days, S) = \frac{2400 \cdot 0.53 \cdot 100}{1 + 0.985183 \cdot e^{0.0607101 - 0.098506 \cdot S}}$$

Based on the function the following chart shows estimated emissions at different margin values:

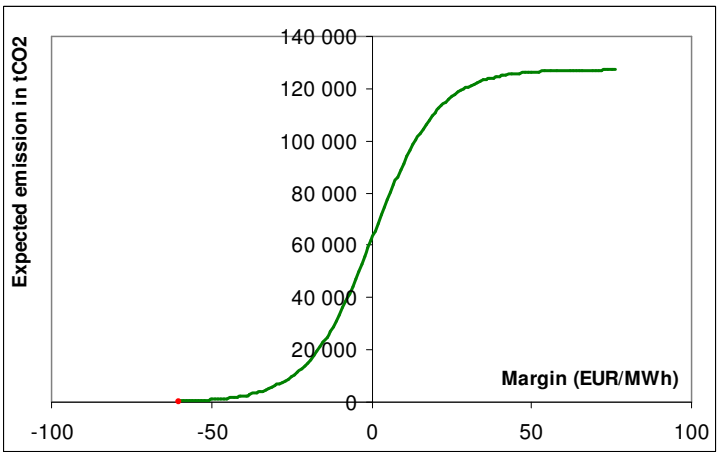


FIGURE 10: ESTIMATED EMISSIONS

IV. CONCLUSIONS

As we have seen, the three-asset option model is suitable for forecasting emission if the company's operates on market on a daily basis (there is no relevant long term contract). With Monte Carlo framework we can calculate the probability density function (pdf) of emission. The pdf of emission in a certain time period has not very common (for example Gaussian) form; it resembles to the density function of cumulated autoregressive Bernoulli variables. The expected emission in a future interval can be calculated in a simplified way based on results of non-linear regression. Further research will be done in two directions: based on the simulations, financial risk (VaR – Value at Risk) can be calculated; with heavier mathematical apparatus an analytical result can be developed for the probability density function of emission.

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CLIMATE CHANGE AND GRI – REPORTING CONGLOMERATES AND ENERGY SECTOR: GREENHOUSE GAS EMISSION REPORTING

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Abstract: ***The future climate scenery has wide effects on societies and on global economy. Enterprises are directly and indirectly affected by changing prices. This may also mean new opportunities for investments and markets. As Schaltegger & Burritt (2010) states sustainability accounting cannot be separated from sustainability reporting and the strategic and operational management. A general principle is that the statements of financial position should include all material financial implications (e.g. Unctad 2008, IASC 2006). Climate change events can have serious material financial consequences. There have been long struggles to develop international accounting frames (e.g. Cook 2009 or MacKenzie 2009).***

In this comparative content analysis study note the aim was to explore to how climate change issues are conveyed into the leading-edge but climate change sensitive industry sector enterprises' financial reports. The Global Reporting Initiative (GRI) is a globally wide multi-stakeholder process. The enterprises reported at the highest application level A+ (GRI G3 Guidelines) are considered to be early adapters. The objective was to explore to which extent the conglomerate and energy sector enterprises presented climate related items in audited annual financial reports. So to say to which extent the reporting enterprises' included also material climate related items.

The findings were that the climate change issues seemed still to be difficult to estimate or not yet to be considered substantial enough. However there were descriptions of possible outcomes for the enterprises especially in the future outlooks concerning both risks and solution oriented business opportunities.

I. INTRODUCTION

The EU Emission Trading System (ETS) has been in operation since 2005. As of 2008 it applies to the 27 EU Member States and members of the European Economic Area – Norway, Iceland and Liechtenstein. As a cap-and-trade program ETS is a market-based approach in which European Union Allowances (EUAs) are used as incentives to reduce emissions. Regulatory bodies establish target for the maximum level of emissions permitted in a time frame. Emissions allowances equal to the national target are allocated free or auctioned to participating organizations. Organizations report their actual emissions at the end of the compliance period and deliver an equivalent number of allowances.

Organizations that emit less than their target will have excess allowances; those that exceed their target must acquire additional allowances. Additional or excess allowances can be purchased or sold directly between companies or through markets. ETS currently covers over 10,000 installations in the energy and industrial sectors which are collectively responsible for close to half of the EU's emissions of CO2 and 40% of its total greenhouse gas emissions. As the same time the international accounting frames have been slow to develop, e.g.:

"IASB / FASB September 2010

… The FASB and the IASB tentatively decided that purchased and allocated allowances should be recognised as assets.

… Although the FASB decided that a liability exists upon the allocation of the allowances, the FASB did not have majority support for any of the views as described in the paper." (http://www.ifrs.org/)

The International Accounting Standards Board (IASB) has issued in 2004 an

interpretation according to a draft interpretation published by Financial Reporting Interpretations Committee (IFRIC) in 2003. The IASB however withdraw the interpretation in June 2005 (c.f. EFRAG 2005). Bebbington & Larrinaga-González (2008) described that for a start the carbon trading creates short-term financial implications from the cost of allocated or purchased allowances and potentially long-term implications as these schemes develop. In addition to EUAs issued by cap and trade schemes (such as the EU ETS), Certified Emission Reductions (CERs) are also available mechanisms provided for the Kyoto protocol. The aspects among others have been debated on the accounting for EUAs (Bebbington & Larrinaga-González 2008): First, considering that the majority of EUAs, are free for the companies affected, the valuation of granted allowances is changing, EUAs has a potential significant impact for some companies. Second, the recognition of assets and liabilities with different valuation bases could produce a volatility of results in some companies.

Or as Cook (2009) noted about the fundamental questions, the allowances granted by government must be recognised separately from the emissions to which they relate in order to reflect the various ways in which the allowances can be used: First, when should the grant be recognised in income and second, should any balance of the grant that is recognised as a liability be re-measured for price changes. Debating followed for the recognition and reporting of the net position with respect to emission allowances. According to this view, only purchased allowances should have an impact on the balance sheet. In the absence of regulation, IETA (2007) found that 60% of a sample of companies affected by EU ETS followed this net approach.

Financial statements and greenhouse gas emission reporting

After IFRIC 3, Emissions Rights was withdrawn; EU emissions trading markets were left without authoritative accounting guidance. As Cook (2009) noted one solution was to maintain the status quo. The accounting would be based on the marginal effect on cost. As long as an entity emitted no more than the amount covered by its emissions allowances, no new cost emerged. This solution relied on netting the benefit of tradable allowances received against the newly created cost of emissions, as though it were dealing with a base line and credit scheme. The circumstances in which costs may be netted against income are however limited both under IASs and under the EU Fourth Directive (ICAEW 2009).

Draft of IFRIC 3, Emissions Rights included e.g. the following proposals:

- Emissions allowances are intangible assets to be accounted for under IAS 38, Intangible Assets. The choice between the historical cost model and a revaluation method would be allowed.
- Purchased allowances are recorded at cost. Allowances received from a government body at no cost or for less than fair value are reported at fair value when received. Allowances recognized under either method are subject to periodic impairment tests. If the revaluation method under IAS 38 is elected, increases in fair value are reported in equity and decreases in fair value are recognized in profit and loss to the extent they exceed the revaluation surplus. The difference is reported as deferred income (a liability) and then recognized as revenue over the compliance period regardless of whether the allowances are held or sold (IAS 20).
- The recognition of a liability and expense for actual emissions should follow the guidance in IAS 37, Provisions, Contingent Liabilities and Contingent Assets. The liability

is measured as the present obligation needed to satisfy actual emissions made through the balance sheet date. It represents the fair market value of allowances to be delivered at the end of the period.

- The netting of assets and liabilities related to emissions was not permitted.

The U.S. accounting practices (U.S. GAAP) for emissions allowances are by the Federal Energy Regulatory Commission (FERC) in 1993. Utilities and other regulated energy companies use the FERC guidance to account for emissions programs designed to curb primarily sulfur dioxide as mandated under the Clean Air Act Amendments of 1990. FERC requires that emissions allowances be accounted for as follows:

- Allowances are reported at historical cost and are classified as inventory. Purchased allowances are recorded at their exchange price while those received from the EPA at no charge have a zero basis.
- The weighted-average cost method is required.
- Periodic expense is recognized based on the historical cost of allowances needed to satisfy actual emissions during the period.

This inventory-based, historical cost methodology has remained the primary source of U.S. GAAP. However, since a large percentage of allowances are presently received from the EPA for free and have a zero cost basis, accounting practices under the FERC guidelines can affect the assets, liabilities, and operating income with respect to emissions.

However the statements of financial position should include all material financial implications (i.e. Unctad 2008, Deegan and Rankin 1997). Transparent presentation will require, as with other items, climate change should be reported in a way that reflects the substance of the transaction, determined by whether a transaction gives rise to new assets or liabilities (IAS 8/FRS 5). Where expense or income is a material item, it may require separate disclosure as part of the profit or loss from ordinary activities. It is often necessary to disclose the accounting policy adopted where environmental issues have a material impact on the financial statements (IAS 8/FRS 18). Materiality of an item in financial statements is normally determined by reference to its size, nature and circumstances. In the case of an environmental item, the impact on a company's reputation can be an overriding factor in determining materiality.

In the United States the Securities Exchange Commission (SEC) explicitly stated 'that fair presentation is not limited to a reference that the statements have been presented in accordance with generally accepted accounting principles (GAAP)' (McEnroe 2007). General disclosure requirements explicitly include forward-looking statements. EU modernization directive 2003/51/EC states: 'Article 51a (c) an audit opinion which shall state clearly the opinion of the statutory auditors as to whether the annual accounts give a true and fair view in accordance with the relevant financial reporting framework and, where appropriate, whether the annual accounts comply with statutory requirements'.

IASC (2006) describes information as material if its omission or misstatement could influence the resource allocation decisions that users make on the basis of an entity's financial report. The auditors have used quantitative rules-of-thumb thresholds (Fayx 2007). The consistency in the adoption of materiality thresholds in the financial point of view has been showed low (Chong & Vinten 2007). Also the wider perspective of material environmental disclosure for use of various stakeholders has been in a developing stage (Fayx 2002, Repetto 2005). An enterprise's financial annual reporting includes the financial statements and relevant notes, the audit report, management's analysis, and other

communications. Independent auditors' report globally usually covers at least financial statements and notes, but often also management's analysis or report (e.g. in Northern Europe).

II. OBJECTIVES

The objective was to explore to which extent the conglomerate and energy sector enterprises presented greenhouse gas emission issues climate related items in audited annual financial reports. So to say to which extent greenhouse gas emission issues were regarded material enough to be presented.

III. DATA AND METHODS

The study was undertaken by considering information via the internet. The source of empirical data was register of Global Reporting Initiative; publicly available GRI Reports List. The list is being updated on a regular basis (http://www.globalreporting.org). The enterprises which published annual report in English language (publishing year cross sectional the latest possible 2010) and whose reporting criteria were at the highest application level A+ (GRI G3 Guidelines) and the external assurance was utilized were included in this study. Enterprises without web published externally independently audited annual report or financial accounts were excluded.

The reports (N=21) were inspected with the search-function of the Adobe Acrobat Reader. The independent auditors' reports were examined at the beginning to get information of audited sections of the reports. If a certain section e.g. management report included to the audited pages it was included into this study, otherwise not.

The content analysis practised by determining the presence or absence of greenhouse gas or climate emission items (cf. Guthrie et. al 2008). The presence of an item was given the value '1' or '2' if it was reported, and given the value '0' if not. The enterprise could describe its climate change and especially greenhouse gas emission matters quite widely, but without auditing the presentation in this study was not accepted as a score. All the data collection and analyses were carried out by the author.

TABLE 1: CODING FOR CONTENT ANALYSIS

Category	Coding	Example
No findings of the word "emission"	0	
Qualitative valuations	1	'The Group has adopted a net liability approach to the emission rights granted.'
Quantitative valuations in money terms	2	'Emission allowances" includes ¤ 278 million from the rights of emissions of CO2 freely assigned'

TABLE 2: CONGLOMERATE SECTOR'S ENTERPRISES, REPORTS PUBLISHED IN 2010 A+.

Name of reporting unit (N=11)	Country (HQ)	Stock Exchange listed
Bayer AG	Germany	Frankfurt Stock Exchange, Tokyo Stock Exchange
Danisco A/S	Denmark	NASDAQ OMX Nordic Exchange
Fluidra S.A.	Spain	Stock Exchanges of Madrid
ITC Limited	India	Bombay Stock Exchange
Larsen & Toubro Limited	India	Bombay Stock Exchange
Mahindra & Mahindra Limited	India	Bombay Stock Exchange
Mitsui Seimei, Mitsui & Co.	Japan	Nasdaq Stock Market
MRCB Malaysian Resources Corporation Berhad	Malaysia	Malaysia Exchange
Pirelli & C. SpA	Italy	Borsa Italiana Milan, London Stock Exchange
Reliance Industries Ltd	India	Bombay Stock Exchang, London Stock Exchange
The Siam Cement Public Company Ltd.	Thailand	Stock Exchange of Thailand

TABLE 3: ENERGY SECTOR'S ENTERPRISES, REPORTS PUBLISHED IN 2010 A+.

Name of reporting unit (N=11)	Country (HQ)	Stock Exchange listed
Abengoa Bioenergía S.A.	Spain	Stock Exchanges of Madrid
BP p.l.c.	United Kingdom	London Stock Exchange, NYSE
Edison S.p.A.	Italy	Milan Stock Exchange
El Paso Corporation	Portugal	NYSE
Enagás, S.A. Empresa Nacional del Gas	Spain	Madrid Stock Exchange
Gas Natural BAN S.A.	Argentina	Buenos Aires Stock Exchange
Hess Corporation	United States of America	NYSE
Iberdrola Renovables, S.A.	Spain	Madrid Stock Exchange
Itaipu Binacional	Brazil	Government owned, Non-Profit
MOL Group (MOL Nyrt.) Public Limited Company	Hungary	Budapest Stock Exchange, Luxembourg Stock Exchange and Warsaw Stock Exchange
OMV Aktiengesellschaft	Austria	Vienna Stock Exchange
Petróleos Mexicanos or Pemex, Mexican Petroleums	Mexico	State-owned
Petróleo Brasileiro S.A. Brazilian Petroleum Corporation	Brazil	semi-public, Sao Paulo Stock Exchange, Madrid Stock Exchange, NYSE
Royal Dutch Shell plc	Netherlands	LSE, NYSE, Euronext
SolarWorld AG	Germany	Frankfurt Stock Exchange
Statoil ASA	Norway	Oslo Stock Exchange, NYSE
Suncor Energy Inc.	Canada	Toronto Stock Exchange, NYSE, acquisition of Petro-Canada
Talisman Energy Inc.	Canada	Toronto Stock Exchange
Tractebel Energía S.A.	Brazil	Sao Paulo Stock Exchange
Wärtsilä Corporation, plc	Finland	OMX Helsinki

IV. FINDINGS

The findings were that few GRI-reporting enterprises whose reporting criteria were at the highest application level A+ presented extensively greenhouse gas emission issues

details in their audited financial statements. The notes were the most common sections embodying greenhouse gas emission items. None of the enterprises in these datasets reported numbers in Balance sheet or Income statement; three enterprises presented greenhouse gas emission scheme issues also in the audited Management report.

A. Greenhouse gas emission items presented in the audited management report

One conglomerate (Bayer AG) and two energy sector enterprise (SolarWorld AG and Wärtsilä Corporation) presented information in their audited management report. All enterprises have business oriented solutions for climate change problems. The information included general information of enterprise's efforts towards climate change, i.e. information of emission quantities, certifications, Key Performance Indicators, energy saving, greenhouse gas free energy production, business possibilities etc. Only Wärtsilä Corporation informed that one of its subsidiary falls into the scope of EU Emission Trading Scheme (ETS) because of the heating plant of the factory. Corporation informed also that EU ETS had not had any impact on profitability.

B. Greenhouse gas emission items presented in the audited notes

Principles of Accounting Policies

None of conglomerates offered information of greenhouse gas emission accounting policies. Seven energy sector presented emission accounting information. All of them counted emission allowances as Intangible assets. Two enterprises had adopted a net liability approach to the emission rights granted. A provision was only recognized when actual emissions exceeded the emission rights granted. Where emission rights were purchased from other parties, they were recorded at cost, and treated as a reimbursement right, whereby they are matched to the emission liabilities and remeasured to fair value.

One conglomerate presented on realisation basis in the Other Earnings the Certified Emission Reduction (CER) credits. One energy enterprise presented in Other Revenues and Income but out of the period income, which changed the criteria for reimbursement of the costs incurred to purchase green certificates. These both items were regarded by the enterprises material enough for reporting.

TABLE 4: CONGLOMERATE SECTOR GRI A+ EMISSION REPORTING IN THE NOTES IN 2010.

Name of reporting unit (N=11)	**Accounting Policies**	***Income related***	***Cost related***	***Asset related***	***Liability related***	***Risk management***
Bayer AG	0	0	0	0	0	0
Danisco A/S	0	0	0	2	0	0
Fluidra S.A.	0	0	0(2)	0(2)	0	0
ITC Limited	0	2	0	0	0	0
Larsen & Toubro Limited	0	0	0	0	0	0
Mahindra & Mahindra Limited	0	0	0	0	0	0
Mitsui Seimei, Mitsui & Co.	0	0	0	0	0	0
MRCB Malaysian Resources Corporation Berhad	0	0	0	0	0	0
Pirelli & C. SpA	0	0	0	0	0	0
Reliance Industries Ltd	0	0	0	0	0	0
The Siam Cement Public Company Ltd.	0	0	0	0	0	0

TABLE 5: ENERGY SECTOR GRI A+ EMISSION REPORTING IN THE NOTES 2010.

Name of reporting unit (N=11)	**Accounting Policies**	***Income related***	***Cost related***	***Asset related***	***Liability related***	***Risk management***
Abengoa Bioenergía S.A.	1	0	0	0	0	2
BP p.l.c.	0	0	0	0	0	2
Edison S.p.A.	1	2	2	2	0	2
El Paso Corporation	0	0	0	0	0	0
Enagás, S.A. Empresa Nacional del Gas	1	2	2	0	0	0
Gas Natural BAN S.A.	1	0	0	2	2	2
Hess Corporation	0	0	0	0	0	0

Name of reporting unit (N=11)	**Accounting Policies**	***Income related***	***Cost related***	***Asset related***	***Liability related***	***Risk management***
Iberdrola Renovables, S.A.	0	0	0	0	0	0
Itaipu Binacional	0	0	0	0	0	0
MOL Group (MOL Nyrt.) Public Limited Company	1	0	2	0	2	0
OMV Aktiengesellschaft	1	0	0	0	2	0
Petróleos Mexicanos or Pemex, Mexican Petroleums	0	0	0	0	0	0
Petróleo Brasileiro S.A. Brazilian Petroleum Corporation	0	0	0	0	0	2
Royal Dutch Shell plc	1	0	2	2	2	2
SolarWorld AG	0	0	0	0	0	0
Statoil ASA	0	0	0	0	0	0
Suncor Energy Inc.	0	0	0	0	0	0
Talisman Energy Inc.	0	0	0	0	0	0
Tractebel Energía S.A.	0	0	0	0	0	0
Wärtsilä Corporation, plc	0	0	0	0	0	0

V. CONCLUSION

The future climate scenery has wide effects on societies and on global economy. Enterprises are directly and indirectly affected by changing prices. This may also mean new opportunities for investments and markets. As Schaltegger & Burritt (2010) states sustainability accounting cannot be separated from sustainability reporting and the strategic and operational management.

A general principle is that the statements of financial position should include all material financial implications (e.g. Unctad 2008). IASC (2006) describes information as material if its omission or misstatement could influence the resource allocation decisions that shareholders or other stakeholders make on the basis of an entity's financial report. Climate change events can have serious material financial consequences. The accounting of e.g. the carbon permits of the EU Emission Trading System (ETS) may impact on cash flows, balance sheets and profit and loss calculations, thus there have been struggles to develop accounting treatment (e.g. Cook 2009, MacKenzie 2009, Mete et al. 2010, Ceres 2009). In USA the more transparent presentation of climate change effects was insisted by Securities and Exchange Commission (SEC) interpretive release in 2010.

In this comparative content analysis study the aim was to explore to how climate change issues are conveyed into the leading-edge but climate change sensitive industry sector enterprises' financial reports. The Global Reporting Initiative (GRI) is a globally wide multi-stakeholder process. The enterprises using voluntarily GRI -framework whose reporting criteria and reported at the highest application level A+ (GRI G3 Guidelines). The objective was to explore to which extent the conglomerate and energy sector enterprises presented climate related items in audited annual financial reports. So to say to which extent the reporting enterprises' fair view included also material climate related items.

The findings were the view of disparate accounting solutions like prevailing accounting standards mixture. The greenhouse gas emission allowance schemes and frames are still in their early stages. The climate change issues are discussed, the matters are considered, but disclosures were not easily comparable and materiality views were not quite transparent. The climate change issues seemed still to be difficult to estimate or not yet to be considered substantial enough. However there were serious descriptions of possible outcomes for the enterprises especially in the future outlooks concerning both risks and solution oriented business opportunities. Because these enterprises are multinationals the economic consequences of climate change they experience have global wideness.

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A TYPOLOGY OF CORPORATE SOCIAL RESPONSIBILITY ACTIVITIES IN THE HUNGARIAN SMALL BUSINESS

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Abstract: ***The recent plethora of literature relating to the different aspects of Corporate Social Responsibility (CSR) has tended to neglect the question of what (theoretical and practice-related) relevance CSR has to Small and Medium Sized Enterprises (SMEs). It has long been a subject for debate whether SMEs operate in an intrinsically 'more responsible' way than their multinational counterparts, simply due to their organisational form.***

A recent research project undertaken by Corvinus University of Budapest looked at existing literature within the field of SMEs and corporate responsibility and based on this review implemented an 134 item electronic survey in order to collect a wide range of data on CSR-related issues at Hungarian SMEs. Initial findings from the survey are herewith presented and include results from the use of cluster and factor analysis techniques to provide a typology of CSR activities employed at SMEs. A proposed clustering of SME types is provided, based on engagement with CSR as defined in the paper, and is described through explanatory organisational and attitudinal variables.

Corporate social responsibility, Small and Medium sized enterprises, Small Business Responsibility Behaviour

I. CSR CHALLENGES

A potent mix of factors commonly known as 'globalisation': a combination of economic, technological, socio-cultural, political and ecological changes which have caused increased integration of regional economies, societies, and cultures through an increasingly global and transparent network of communication, transportation, and trade [1] has changed the business landscape over the last few decades. Additionally, research consistently points towards the decreasing tenability of Earth's ecosystems to support a rapidly growing human population [2], and specifies unsustainable patterns of consumption and production as a primary driver of environmental degradation. Primarily as a result of these factors, the corporate sector is now increasingly subject to calls for a higher standard of accountability in 2 main areas of impact of business activities - the natural environment and the 'social environment' (e.g. human rights, labour standards and maintenance of broader 'social capital' [3]) - in addition to the major areas of classical corporate responsibility (profitability, product quality, competitiveness, etc.). Evidence for this is seen not only in the plethora of corporate publications such as environmental, social, CSR and sustainability reports, but also in the recent emergence of numerous governance initiatives such as corporate codes of conduct and CSR policy initiatives (e.g. the EU Green Paper on CSR of 2005 which defines CSR as being "a concept whereby companies decide voluntarily to contribute to a better society and a cleaner environment").

Yet although CSR is no longer a new concept, it remains to some extent a nebulous idea for academics, business managers and stakeholders [4]. The concept of CSR has evolved considerably since it first emerged around the 1950s [5]-[6] and there still remains much disagreement about what the term CSR means and how and whether CSR can or should be implemented or actualised - and indeed *why* it should be understood and utilised [7]. 'CSR' has been interpreted from a variety of theoretical perspectives (e.g. normative, strategic, agency, stakeholder) and has come to encompass many areas of business activity ranging from social (e.g. community programmes), to economic (e.g. employment) and environmental initiatives (e.g. cleaner production or eco efficiency measures). Many definitions (and business engagements) with CSR take a stakeholder perspective [8] while the case for 'strategic' CSR is increasingly being made by both management theorists and practitioners [9]-[10].

Where businesses have opted to attempt to account for calls for a more extended sphere of responsibility in their business models, they have met with mixed levels of both market success and public acclaim. A variety of criticisms of CSR from differing perspectives exist, from that presented in Friedman's classic article of 1970 [11] to concerns over the relation of ecological modernisation to ecological sustainability [12] and views of CSR as a potential barrier to trade. There is no consensus over the role of CSR in relation to a host

of macro level business factors – the potential contribution of CSR to Sustainable Development, employment levels (and social capital in general), ecosystem health, innovation, business competitiveness, etc. [13]. In major part this stems from a critical lack of consensus over the meaning of the terms employed in the CSR discourse – especially over normative terms such as 'responsibility' [14].

II. CSR AND SMES

SMEs are the globally predominant business unit by total number, contribution to GDP and number of employed. Correspondingly, consensus amongst researchers is emerging that the CSR agenda should be broadened from a nearly exclusive focus on multinational corporations to encompass these SMEs (various authors, [ibid 13]- [14]. It is by no means clear that the SME sector is any less or any more 'Socially Responsible' than the Multinational sector, although it is often found that much CSR-type activity in the SME sector remains unpublicised and 'sunken' [ibid, 14]). What is stressed in emerging academic research on CSR is that a new set of definitions and tools and broad research efforts at the macro, meso and micro level are required to address the nature and role of CSR activity in this diverse sector. A summary of CSR in SME areas identified as needing further research is presented below, adapted and extended from an editorial review by Moore [ibid, 13].

TABLE 3: CSR AND SMES -RESEARCH AREAS NEEDING FURTHER WORK

Macro/Network Level (SMEs as part of the global economy)	***Meso/Inter Level (SME in the Community)***	***Micro/Intra Level (SME: Intra-Company)***
Sustainable development	*Competitiveness*	*National and Regional CSR Indicators*
Innovation	*Supply chains (SH) – effects of both supplier driven and supplier mandated standards*	*CSR Indicators*
Skills development	*Impact from and on Customers*	*Entrepreneurship*
Social exclusion	*Impact on and from the natural environment*	*Impacts of the owner–manager*
Regional Variations in use of CSR	*Variation within and across industries (size, ownership, Industrial sector, etc.)*	*Selection of tools (drivers and barriers)*
Social Capital	*Effects of industrial clusters, networks, associations*	*Motivating employees*
Global CSR Indicators		

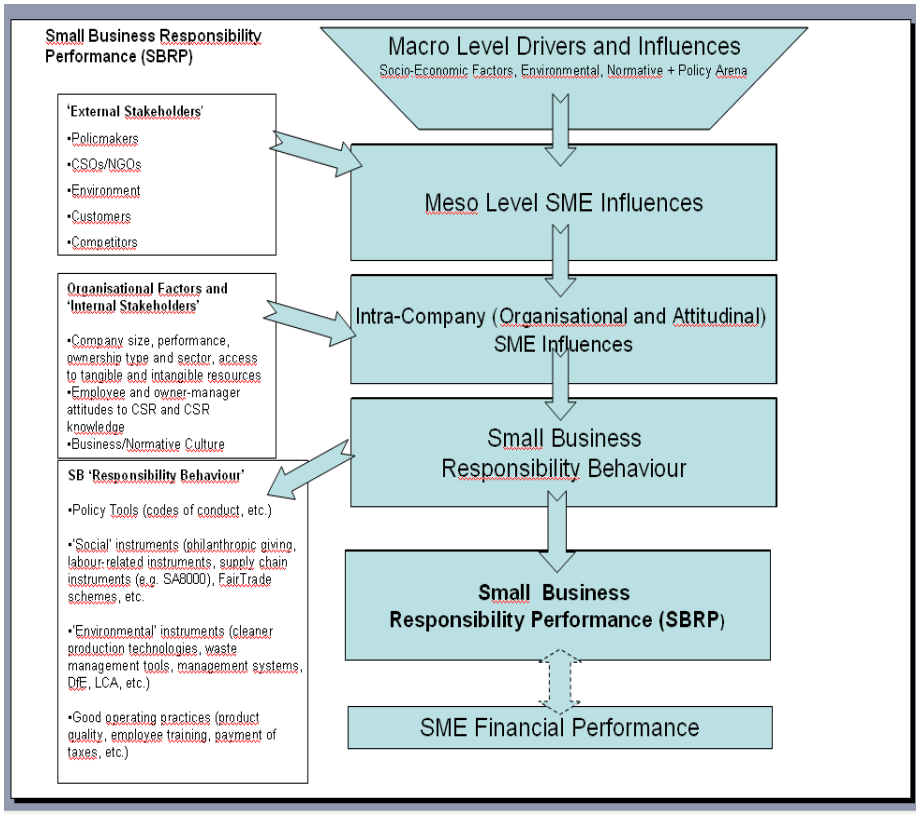
III. METHODOLOGY

As a first research step, a basic model of Small Business Responsibility Behaviour (SBRB) and Performance (SBRP) was elucidated based on CSR and Small Business Responsibility literature in order to assist in identification of dependent and independent variables for which to collect data (Figure **Hiba! A hivatkozási forrás nem található.**).

Following construction of the model researchers at the Corvinus University of Budapest Environment and Technology Department created an electronic (134 item) survey designed to collect data on the Small Business Responsibility Behaviour (SBRB) of Hungarian SMEs. The survey was distributed electronically to approximately 10000 SMEs (with a turnover in 2009 of at least 100000HUF) through a contact list purchased from a commercial provider of business databases during February and March, 2010 as part of a larger research undertaking funded by the EU disbursed through Norwegian-government funds. The survey borrowed in part from an OECD led project based survey of corporate environmental management practices

completed in 2003 involving the participation of researchers from seven different OECD countries [15]. The survey was comprised of 5 sections, in the following order: 1) General Questions Concerning Attitudes to and Knowledge of CSR; 2) Examination of Company CSR Practices; 3) Company Environmental Effects; 4) Company Environmental Management; 5) General Company Data. A total of 290 usable responses were returned (response rate of ≈3%).

1. FIGURE: MODEL OF SBRP



IV. PRELIMINARY FINDINGS

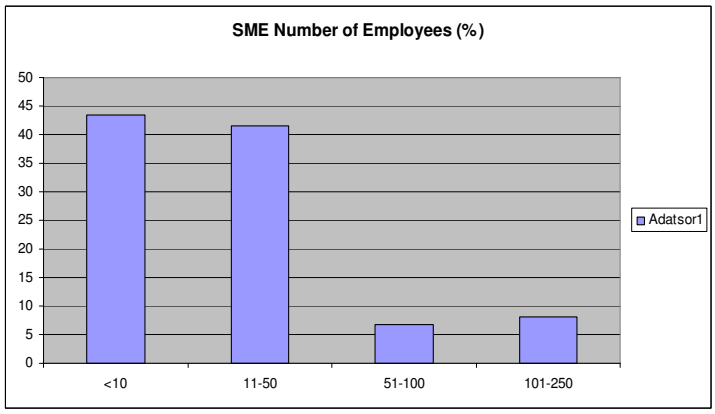
A brief overview of the survey findings to date is presented below.

Organisational Variables

Size

85% of SMEs that returned completed surveys employ fewer than 50 people ('Small' or 'Micro' SMEs) while slightly less than half of the total sample (43%) employ fewer than 10 people (i.e. are 'micro enterprises'). 7% employ between 51-100 people ('medium-sized' SMES and the remaining 8% of SMEs employ between 101 and 250 people (i.e. are 'large' SMEs).

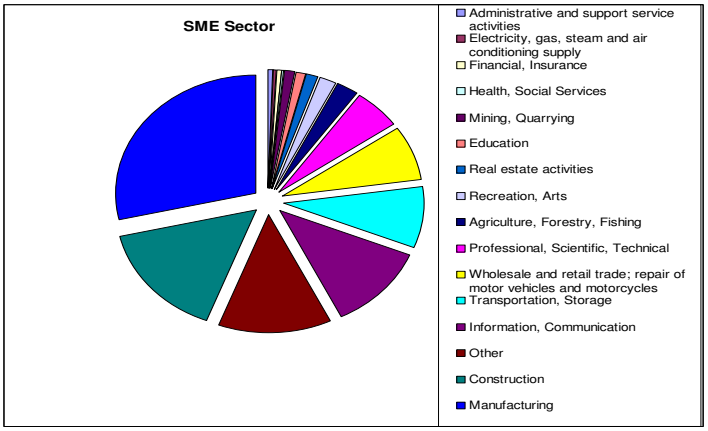
2. FIGURE: NUMBER OF EMPLOYEES EMPLOYED BY SME



Sector

In terms of sector, the highest number (28.6%) of the SMEs surveyed were from the manufacturing sector, followed by significant contributions from SMEs from the construction sector (18.6%), information and communication and transportation and storage sectors.

3. FIGURE: SME RESPONDENTS –SECTOR OF OPERATION (FOLLOWING UN INTERNATIONAL STANDARD INDUSTRIAL CLASSIFICATION SYSTEM)



Performance

8 SMEs reported average yearly sales of less than 10 Mn HUF (36,000EUR), 39 from 10-100Mn HUF (36-360,000EUR), 101 businesses had from 101Mn-1Bn, and 36 businesses had over 1BN HUF (3.6 Mn EUR) of annual income.

From these SMEs, approximately half (≈53%) reported a drop in the value of shipments over the last 3 years, while 22% reported no significant change and 25% reported an increase

Respondents

The majority of respondents to the questionnaire were either senior managers or owner managers (86%).

4. TABLE: IDENTITY AND POSITION OF SURVEY REPONDENTS

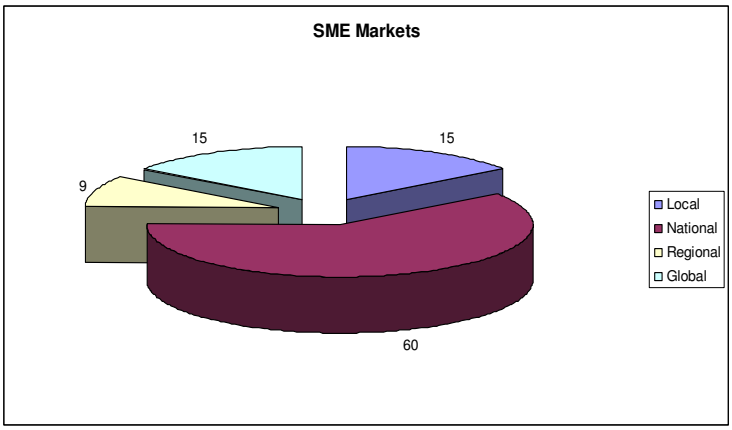
Freq	%	Respondent Position
180	85,7	Senior Management/Owner
11	5,2	Marketing / Sales
6	2,9	Production / operational activities
5	2,4	Human Resources

4	1,9	Finance / accounting
3	1,4	Specialized environmental department (or equivalent)
1	,5	Supply Chain
N= 210	100,0	

Markets

Local markets were the primary outlets for approximately 15% of SME's, while National Markets took the main share of the market for SME's at 60%. Regional Markets (i.e. markets in countries neighbouring Hungary) took 9.5% of the total share and only approximately 15% of SMEs primarily supplied global markets.

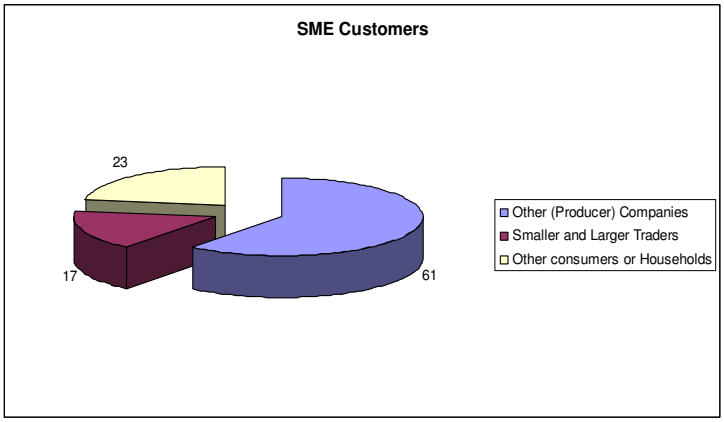
4. FIGURE: PRIMARY SME MARKETS (%)



Customers

The majority of SME respondents reported that other companies were the main customers for their products (60%), with approximately one quarter (23%) of SMEs producing for sale to direct domestic customers, and 17% of SMEs producing for other traders or retailers.

5. FIGURE: SME CUSTOMERS (%)



Small Business Responsibility Behaviour

Regarding responsibility measures at the smaller businesses, the most commonly utilised measures that companies reported using (n≈290) were 'Good Practice' type activities, most of which would be required to be in legal compliance (see 5. Table). "Providing Information on Company Activities and Decisions to Employees on a Regular Basis" (69%), while not a legal compliance issue may be considered a must for operational success, along with Training Activities (56%). "Providing Fair Payment and Working Hours for Employees" (68%), "Avoidance of Corruption" and Complying with all Legal Regulations are also clearly

legal compliance issues, so their frequency of use is not surprising. The question may be raised, however, why did more SMEs not report to performing these basic compliance activities?

5. TABLE: SMALL BUSINESS RESPONSIBILITY ACTIVITY

'Good Practice' Compliance Activities	**%**
1. Providing information on company activities and decisions to employees on a regular basis	69
2. Providing fair payment and working hours for employees	68
3. Avoiding corruption	57
4. Organising training activities for employees	56
5. Complying with all legal regulations	56
'Beyond Compliance' Type Responsibility Activities	
6. Giving extra support to employees (e.g. favourable employee loans, flexible working times, lunch vouchers)	52
7. Sponsoring or donating	48
From these 48%:	
• Regularly (every month)	8
• Less than every month	50
• Yearly	30
• Only very occasionally	12
8. Conducting internal environmental audits	35
9. Having award schemes for employees	30
10. Having an environmental policy	29
11. Use environmental performance indicators	24
12. Involvement in local community initiatives (volunteering, other)	22
13. Having an ethical code/social report	14

Investigation of the relationship of Responsibility activities 1-5 ('Good Practice' activities) with SME number of employees is instructive. Interestingly, there the only strong correlation (P= 0.02) found between these 5 activities and number of employees was found with 'Organising Training Activities'. This indicates that - if self-reporting is to be considered to provide an accurate picture of operational activities on the ground - there was no increased probability that larger SMEs would be involved in 'good practice compliance activities' than smaller ones

4. TABLE: SBRB CORRELATION TO ORGANISATIONAL FACTORS
(SIGNIFICANCE OF P <`0.05 INDICATED)

	Social Responsibility Activity	**Correlation to Number Employees**	**Correlation to Income**	**Correlation to SME Markets**	**Correlation to Customers**
1.	Providing **information** on company activities and decisions to employees on a regular basis	NS	NS	NS	NS
2.	Giving extra **support** to employees (e.g. favourable employee loans, flexible working times, lunch vouchers)	NS	,142	NS	NS
3.	Organising **training activities** for employees	,002	NS	NS	NS
4.	Having **award schemes** for employees	,041	,121	NS	NS
5.	Involvement in local **community** initiatives (volunteering, other)	NS	NS	NS	,081
6.	Having an **ethical code**/social report	NS	NS	,048	NS
7.	Avoiding **corruption**	NS	NS	NS	NS
8.	Complying with all **legal regulations**	NS	NS	,033	,023
9.	Providing **fair payment** and working hours for employees	NS	NS	NS	NS
10.	Sponsoring or **donating**	,05	NS	NS	,024

Typical Types of Social Responsibility Business Activities

'Factor analysis' (Principal Component Analysis, Varimax with Kaiser Normalization) was performed in order to examine interdependencies amongst the SB Social Responsibility Activities (as listed above in 5. Table), and thus determine if there are typical 'types' or sets of activities that Small Businesses undertake. Results indicated that responsibility activities may be categorised into four categories: 1) Responsible Good Practice, 2) Internal Stakeholder Responsibility, 3) Community Support and 4) Ethical Codex.

Responsible Good Practice

The first group of (4) activities that were found to be statistically related were:
'Legal Regulation', 'Providing Information to employees', 'Fair Work and Fair Pay' and 'Avoiding Corruption'. This group of activities may be termed 'Responsible Good Practice' as it includes four activities that are commonly thought of as being primary, but elementary activities that are conducive to good business.

Internal Stakeholder Responsibility

The second related group of (2) activities which the small businesses undertook included the actions of 'Providing Employees with Training' and 'Award Schemes and Support for Employees'. These activities apply to provision of support services and motivatory incentives to employees within the company, and suggest a focus on internal stakeholder demand management.

Community Support

The third group of (2) activities which were statistically related were 'Donating' and 'Community Support'. These activities both relate to the using of company resources external to the company – typically in local community settings. They tend to reflect the satisfaction or manipulation of external stakeholder needs.

Codex

The final responsibility indicator which stood out as being unrelated to the other responsibility activities was having an ethical codex (simply named 'Codex').

Emergence of these sets of responsibility activities informs the suggestion that responsibility activities may in fact not always be undertaken independently of each other and tends to refute claims by authors such as Jenkins et al etc. [ibid. 15] who claim that CSR activities are performed in an *ad hoc* fashion.

AN SR-DRIVEN TYPOLOGY OF SMALL BUSINESSES

Small Businesses Clusters

Cluster analysis was performed to identify which of the groups of responsibility activities the small businesses in the sample were engaged with and also to discern if any responsibility taking pattern could be identified and correlated to variables such as company size, industrial sector or performance. Cluster analysis (Ward Method) revealed that 5 groups of companies could be identified according to their use of the responsibility activities described in the previous paragraph. The first group of companies (Group 1 - Laggers) were found to show very little responsibility activity at all. Cluster 2 companies favour utilisation of the Internal Stakeholder Responsibility group of activities. Group 3 companies focus only on Responsible Good Practice. Group 4 companies also undertake the activities in the Responsible Good Practice group, but also those from the 'Community Support Group'. Group 5 companies are associated with all four groups of social responsibility activities.

No strong correlation between cluster and company size, main market, main customers, income or performance was found to be statistically significant. However, the industrial sector *was* (P= 0,05) found to be significantly correlated with cluster. This finding refutes the hypothesis that size or financial constraints alone (within the SME sector, and for our sample) are primary determinants of responsibility activity and emphasises the influence of the function/primary activity of the business entity on CSR practices. It appears that Hungarian manufacturing SMEs, for example, are statistically more likely to engage in a comprehensive suite of CSR activities than trading SMEs or service-oriented ones.

V. CONCLUSION

Preliminary findings from the survey of Small Business Responsibility activities indicates that there is some internal correlation between SBRP activities that small businesses undertake. This indicates that SBRB in the SME sample analysed may be more predictable, according to organisational variables, than some researchers have previously suggested. Additionally, statistical analysis indicates that distinct clusters of SMEs are identifiable according to their CSR activities. Deeper analysis is required to identify specifically how organisational variables (such as industrial sector, or owner-manager knowledge and attitude to CSR) predict, and potentially influence, such CSR activity in the small business SME sector.

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