

Modeling driving forces and results from implementing environmental actions in manufacturing sector : a country comparative analysis

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ABSTRACT

The objective of the research is to develop a model of driving forces and results from environmental initiatives in European manufacturing companies. This project, initially called Business Environmental Barometer (BEB), started in 1993 as a Nordic project (Wolff, 1995). In 1995 it expanded to five European countries (Belz and Strannegård, 1997).

The data used in this research was collected in 1997, based on a standardised questionnaire sent to a representative sample of manufacturing companies of 12 countries. 16500 companies were contacted from which we received more than 3000 answers. Descriptive results are presented in a DGIII-EU report (Kestemont and Ytterhus, 2000).

The main research hypotheses are the following: Environmental problems and stakeholders are influencing the companies to develop environmental actions and to implement environmental management systems; these environmental initiatives will influence the economic and environmental goals of the company.

In this presentation, we estimate the links between driving forces and results from environmental actions in the manufacturing sector, identifying the overall trend in Europe. Three countries are compared with the overall trend, from North, Mid and South Europe (Norway, Belgium and Italy respectively).

We develop multivariate statistical procedures and we use the structural equations modeling approach to test the model.

The outcome is that there is no unique European model to explain the links between the driving forces and the results from environmental actions. Based on the three country cases, we are able to differentiate and to discuss the model findings.

KEY WORDS : stakeholders, environmental management system, structural analysis.

1. INTRODUCTION

During the last years environmental management has become increasingly important, both in theory and practice. We have seen the introduction of environmental management systems and their associated standards, environmental auditing and reporting and new tools focusing on the environmental performance of products such as life cycle assessment. The nineties might be characteristic as the place of standardization and professionalisation in the field of environmental management (Belz and Strannegård, 1997).

The shift in the perception of the state's role as a major regulator to a more deregulated factor, could be one explaining factor of the introduction of new tools for the improvement of the environmental performance in companies. The command and control regime with emphasis on "thou shall not" is changed into a shared responsibility perspective with a "let us work together approach" (Bandi, 1998).

Another explanation could be changes in the environmental challenges as these have moved from industrial emissions (from pipelines and chimneys) to more diffuse and mobile source like solid waste, transport and agriculture. These changes have created a need for market and information-based instruments in addition to legislation. Still directive-based regulations like emission standards are important instruments to reduce pollution problems from point sources.

The EU's Fifth Environmental Action Program supports more use of market-based instruments and self-regulatory instruments, i.e. information-based tools and voluntary agreements.

Environmental activities started in the manufacturing sector mainly in the production areas such as saving energy, reducing harmful substances and installing environmental "friendly" technology. To reduce the problems on the biophysical level, legislative instruments were implemented.

The environmental challenges on the socio-economic level are often analyzed by the stakeholder approach (Dyllick, 1992). The stakeholder view argues that all groups, which have an interest in the company, should be taken into account if the firms want to survive in the long run. Relevant stakeholder groups are for example employees, suppliers, environmental and consumer organizations in addition to the traditionally focus on customer and competitors.

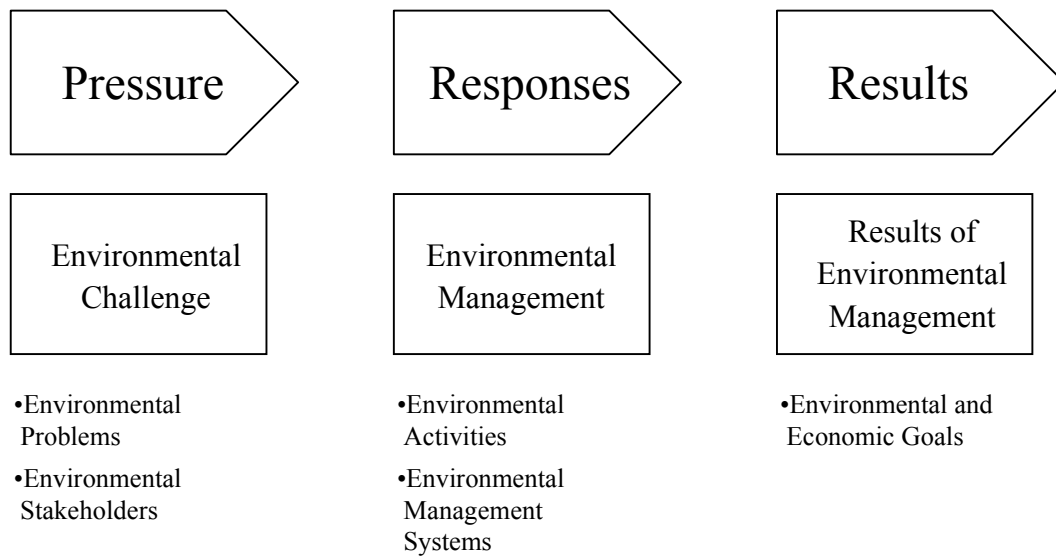
The appropriate tools for improving the environmental performance of firms are often based in life cycle assessment. In this context an intermediary like a retailing company or a tour operator could influence both the supply and demand side. Service providers could manage downstream activities through the purchasing functions with significant power by for example claiming environmental criteria on their suppliers. To influence the upstream activities, consumer's choices could be influenced through marketing and education initiatives.

2. HYPOTHESES AND CONCEPTUAL FRAMEWORK

The research hypotheses underlying the research are based on the following assumptions:

- Business leaders and managers are not only driven by mere economic considerations when taking decisions about their business. The decision-maker's actual decisions are influenced by values. These values are an outcome of personal socialization, experiences and social contingencies. There is a lot of empirical research evidence that supports the assumption that "soft" factors influence strategic decision-making (Wolff (1982)).
- Another set of influencing factors is what the respective industry logic is and thus what competitors do. In the global economy companies are less and less coupled to "nations", they rather tend to compare themselves with other businesses both inside and outside their industry.
- Finally, in a rational world, rational instruments for decision making are needed. Decision-makers do prefer clear hierarchies of alternatives when confronted with a decision. With regard to the environment, this demand on rationality quite often rather creates problems than solves them. "External costs" and other concepts are not suited to support simple decision making requirements. Environmental decision making is rather complex, has to be conducted without previous experience and references and therefore requires a lot of innovation and tolerance for quasi-rational modes of deciding (Kestemont and Ytterhus (2000)).

To structure the relationship between the variables of interest, we use a three-step model :



The research hypothesis of this paper is based on the following : Environmental problems and stakeholders are influencing the companies to introduce environmental actions and environmental management systems. These environmental initiatives will again influence the economic and environmental goals of the company.

Our main hypothesis is : *The higher the environmental pressure is, the more the company will pursue in offensive actions. And the more important these offensive approaches are, the more benefit the firm will gain.*

2.1. THE BUSINESS ENVIRONMENTAL BAROMETER

To map the development in the “greening of business”, a number of national surveys were carried out in the beginning of the 90s (e.g. Kirschgeorg, 1990). There were also a few international surveys on the subject (e.g. McKinsey, 1991). But systematic and longitudinal international studies on environmental management were missing. To fulfill this need, the Business Environmental Barometer (BEB) started in 1993 as a Nordic project (Wolff et al, 1995). Participants in the first round in 1993 were business schools and universities from Denmark, Finland, Norway, and Sweden. Denmark went out of the BEB network in 1995, but Switzerland and Belgium joined (Belz and Strannegård, 1997). During 1997 the BEB expanded and renamed IBEB (International Business Environmental Barometer). It was conducted in 12 European countries and supported financially by DGIII (DG-Entreprise from the European Commission) (Kestemont and Ytterhus, 2000).

The mission of the BEB is to contribute to the improvement of environmental management and environmental performance of business and industry through providing research-based information and stimulating dialogue related to environmental issues; and more specifically, by

- producing multinational research,
- tracking changes in business and industry over time,
- publicizing developing trends.

The strategy to accomplish the mission involves

- inviting outstanding research institutions to participate in the BEB network,
- conducting national surveys on a period basis in accordance with the Barometer standards,
- making international comparisons,
- establishing the BEB as a benchmark for business and industry,
- widely publicizing the empirical results,
- stimulating dialogue to promote improvement in environmental management and environmental performance of business and industry.

4. RESEARCH DESIGN

Data has been collected using a highly standardised and structured written questionnaire, mainly measured on a Likert scale.

In each country, a first step was to define the population from which the sample of companies had to be extracted and the derived sample had to be considered with respect to the industrial structure of the country.

The second step was to select the companies to be contacted. As the business structure is not the same in all countries, the sampling procedure had to respect the differences, in order to provide with a representative sample of companies for each country.

The survey was carried out by post, targeting designated respondents within each firm (usually CEO's). Each member Institute of the IBEB was responsible for the administration of the questionnaire in their country¹ and the questionnaire was translated in the appropriate language. The time period of the survey was May-October 1997.

Univariate statistical analyses provides with information about the sample. An exploratory factorial analysis leading to the identification of unobservable constructs/concepts is developed as the first step of the multivariate analysis. Then measurement and structural models are estimated in order to provide with causal paths. SPSS and LISREL have been used for analysis.

5. RESULTS

The numbers of questionnaires that have been sent and the responses received in the different countries are given hereafter for the different European countries:

Country	N	Responses	Response Rate	Responses by Company Size (# of Employees)			
				50-99	100-249	250-499	>499
Austria	850	190	22.4%	11	23	35	65
Belgium	3000	364	12.1%	109	122	67	66
France	1915	191	10.0%	39	39	17	96
Germany	1200	155	12.9%	2	13	19	116
Italy	2000	181	9.1%	41	46	58	29
Netherlands	2165	527	24.3%	161	214	81	67
Norway	1005	313	31.1%	108	108	44	31
Portugal	1536	300	19.5%	94	98	68	40
Spain	1500	113	7.5%	1	13	36	55
Sweden	661	336	50.8%	154	70	69	43
Switzerland	800	250	31.3%	75	97	37	30

The following table presents the items that contributed to the measurement of the three concepts of interest. These or some of these will be considered in 1) the factorial analysis, aiming at identifying the under-structures of these concepts ; 2) the structural analysis, aiming at identifying the causal model linking driving forces to environmental actions, and environmental actions to results.

Driving forces	Environmental actions	Results
Competitors	The company has a written environmental policy	Competitiveness
Consumer organisations	The company has formalised a process to identify and assess relevant legal requirements	Corporate image
Customers	The company carries out environmental auditing/reviewing	Cost savings
Distributors	The company has set up measurable environmental objectives	Long-term profits
Management	The company has a program for achieving the environmental objectives	Market share
Employees	Responsibilities to implement the environmental programme have been clearly defined	New market opportunities
Labour unions	The company has an environmental training program	Owner's satisfaction
Environmental organisations	The company has an auditing system to check the functioning of the environmental program	Product image
Banks	Environmental objectives are revised periodically to achieve	Productivity increase

Insurance companies
Voluntary agreements
Local population
National regulators
International regulators
Owners
Press/Media
Scientific institutions
Suppliers

continuous improvement
The company publishes a separate environmental report
The company includes environmental information in its annual report

Sales
Short-term profits
Top management's satisfaction

The results presented hereafter concern the global European model. Additional comments and specificities related to the three analysed countries are presented and discussed in a poster session at the The Ninth International Conference of the Greening of Industry Network (Bangkok, January 2001).

5.1. FACTORIAL ANALYSIS

An exploratory factorial analysis is developed with the aim to identify factors that could be the concepts of the assumed model. Three principal factors were obtained and are presented, with the indicators they are correlated with. We consider here the most correlated items with the factors and those items are relevant in our theoretical model.

Concerning the environmental challenge, the factorial analysis produced a four-factor solution. This was subjected to varimax rotation to allow maximise the sum of variances of required loadings of the factor matrix. The pattern suggested a reconfiguration of the variables into four dimensions (percentage of explained variance 56,72) and the following indicators :

MARKET: Competitors, Consumer organisations, Customers, Distributors, Suppliers

INTERNAL PRESSURE : Management, Employees

EXTERNAL PRESSURE : Press, Banks, Insurance companies, Scientific institutions

REGULATION : National, International regulators

The reliability of the measurement is estimated by using alpha-Cronbach coefficient for all multi-item scales. The respective reliabilities are 0,7818 for the first factor, 0,6992 for the second factor, 0,7342 for the third factor and 0,7598 for the fourth factor.

In environmental management, three dimensions emerged from the factorial analysis (percentage of explained variance 69,19) and the following indicators :

EMS : Written environmental policy, Auditing/Reviewing, Training programme, Check the functioning of the environmental program

BASIC OBJECTIVES : Measurable objectives, Programme for achieving the environmental objectives, Clear responsibilities

COMMUNICATION : Separate environmental report

The respective reliabilities are 0,8089 for the first factor, 0,8699 for the second factor (1 for the third factor, as unique measure).

Three dimensions present the results for environmental actions with the following indicators (percentage of explained variance 61,27) :

IMAGE : Corporate image, Owner’s satisfaction, Top management’s satisfaction

ECONOMICS : Cost savings, Long Term profits, Short Term profits

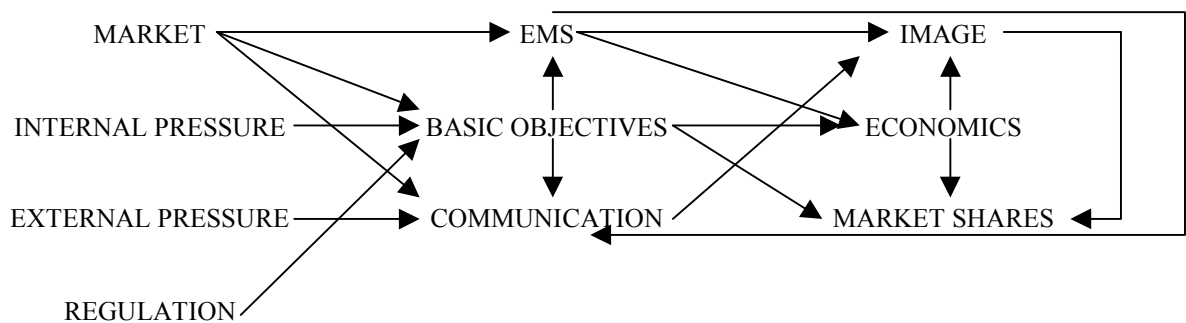
MARKET SHARE : Market share, New market opportunities, Sales

The respective reliabilities are 0,7013 for the first factor, 0,7575 for the second factor, 0,8082 for the third factor.

5.2. STRUCTURAL ANALYSIS

To determine the degree to which each of the directly observed indicators correspond with the unobservable concept it was chosen to be a measure of, a confirmatory factor analysis was performed. We then estimated a measurement model that aims to describe how well the observed indicators serve as measurement instruments for the latent variables (Jöreskog and Sörbom (1989)). We used the statistical technique of structural equation modeling. The polychoric correlations matrix of the measures was used as data entry and the estimation technique was the maximum likelihood method, in LISREL8. All the estimators of the measurement model are significant and present the expected sign for the weights explaining the part of the indicator in the linear relation with the unobserved factor or construct. The goodness of fit statistics of the measurement model is given by : GFI = 0,94, RMSEA = 0,044, AGFI = 0,92, NFI = 0,91 (a review of the guidelines for judging the fit statistics is given in Medsker, Williams and Holahan (1994)).

The structural analysis of the assumed causal model leads to the following Figure. The ten principal factors are given with the statistically significant related paths.



The following Table presents the estimated path coefficients :

From	To	Estimated path
Market	EMS	0,07
	Basic	0,11
	Communication	-0,22
Internal pressure	Basic	0,19
External pressure	Communication	0,22
Regulation	Basic	0,05

EMS	Image	0,41
	Economics	0,61
	Communication	1,10
Basic	EMS	0,89
	Communication	-0,38
	Economics	-0,36
	Market shares	-0,10
Communication	Image	-0,17
Image	Market shares	0,40
Economics	Image	0,34
	Market shares	0,32

The fit statistics are : RMSEA = 0,045 ; AGFI = 0,92 ; GFI = 0,94.

6. DISCUSSION

Global view on a European model of driving forces and results from environmental initiatives in European manufacturing companies has been proposed, and a causal structure has been tested.

In relation to the first part of hypothesis, *the higher the environmental pressure is, the more the company will pursue in offensive actions*, we conclude that the higher the pressure (from the market, internal/external, from the regulation), the more the company is active. But the pressure from the market seems not to enforce the company to produce a separate environmental report.

Concerning the second part of hypothesis, *the more important these offensive approaches are, the more benefit the firm will gain*, some of the links are positive, as those linking environmental management system to image, economics and communication. A company adopting and developing an environmental management system seems to get more positive results. But some negative links are statistically significant : developing basic objectives (setting up measurable environmental objectives, having a programme for achieving the environmental objectives or defining clearly the responsibilities) do not seem to lead to positive results. Similarly, a better image is not gained from the production of a separate report.

These results provide a general overview of global trends in European manufacturing companies. Additional information on the model is developed, focusing more specifically on particular causal links of interest.

Moreover, this model estimated at the European level has been “broken”, by replication of the analysis on different countries. Country specifics appear, suggesting that there is no unique European model and that differentiation has to be considered between countries.

Discussion on the differentiation between countries is the topic of the related poster.

NOTES

1. The participating institutes were: University of Innsbrück (Austria), Université Catholique de Louvain (Belgium), Helsinki School of Economics (Finland), Ecole des Mines de Paris (France), Westfälische Wilhelms-Universität Münster (Germany), The Environment Initiative (Ireland), Fondazione Eni Enrico Mattei (Italy), Tilburg University (the Netherlands), Norwegian School of Management (Norway), Instituto das Tecnologias Ambientais (Portugal), Universidad Carlos III de Madrid (Spain), Gothenburg Research Institute (Sweden), and University of St. Gallen (Switzerland).

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