ECO-INNOVATIONS IN THE CHEMICAL INDUSTRY: MOTIVATION FACTORS AND BARRIERS

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Abstract

The chemical industry is considered as one of the most important sectors from an environmental point of view. As a result, many chemical companies have been at the forefront of both using innovative technologies and up-to-date environmental management practices. However, the sector faces an ever increasing pressure from its stakeholders and there is still a long way to go towards a sustainable chemical sector.

This paper looks at the chemical industry in a transitional country, Hungary, where both big multinational firms and local SMEs are active on the market. It discusses the environmental innovation practices of chemical companies (including the adoption of new solutions as well as their development) based on the results of an empirical survey[1]. The survey 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.

The factors influencing the introduction of environmentally friendly solutions are explored in the framework of Ajzen's (1985) theory of planned behaviour. The first group of factors is the attitude concerning the behaviour in question, which in our case depends on how companies evaluate the environmental and economic effects of environmental innovations. Second, the social norm, which means the percieved pressure from various stakeholders to improve environmental performance. Finally, percieved behavioural control refers to the extent to which firms feel able to engage in environmental innovation given their existing financial, human, etc. resources.

[1] The survey was carried out at the Corvinus University of Budapest in the framework of the ACT CLEAN project under the Central Europe Programme of the European Union.

The paper examines how the above factors are connected with firms' actual innovation activity, aiming to identify the conditions which would lead them to engage more intensively in the introduction of environmentally friendly products and technologies.

Keywords
environmental innovation, innovation diffusion, chemical industry, theory of planned behaviour

1. 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 social and economic 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 studies the diffusion of environmental innovations in the Hungarian chemical sector through an empirical survey. The production as well as the use of chemicals usually involves significant environmental effects, innovations to reduce these effects are therefore especially relevant for the industry. Our analysis extends both to the innovation activity of chemical firms, as well as to the underlying motivation factors. By looking at actual developments introduced by the companies in recent years, it is possible to examine not only the intensity, but also the direction of the innovative activity (end-of-pipe or preventive solutions, what environmental issue is addressed, etc.) The starting point for analysing the motivation factors is Ajzen's (1985) theory of planned behaviour, adapted by Montalvo (2002)

to the area of environmental innovations. The next section contains a brief review of the literature, followed by the presentation of the survey and the results. Section 5 contains the conclusions.

2 Factors influencing the diffusion of environmental innovations

Innovation can be defined as any new idea (be it of scientific, technological, organisational, financial or market nature) that leads to the introduction of new or improved products or services. Innovation therefore goes further than invetion, as it also includes the successful market introduction of the novelty. (Dodgson et al., 2008) Besides the creation of innovations, their diffusion is also an important research area. Here, the work of Everett Rogers plays a seminal role, who created a general model describing the process of adopting innovations, the different groups of adopters, as well as the factors influencing the adoption decision. (Rogers, 1962) From a diffusion perspective, everything is considered an innovation that is percieved as new by an individual or an organisation – novelty from the pont of view of the adopter, rather than absolute novelty becomes the criterion. Since we wish to examine the adoption as well as the creation of environmental innovations, the term innovation will be used in this sense throughout the rest of the paper.

In Rogers' model, information plays the key role in the diffusion of innovations – the more knowledge is available on the solution in question, the more easily it will be adopted by others. This of course presupposes that the nature of the information is positive, that is, the characteristics of the innovation in question are sufficiently attractive. According to Rogers, the factors influencing diffusion 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).

It can be seen that these five factors are all characteristic to the innovation whose diffusion is under observation. In our case, the analysis is not focusing on a specific innovation (for example, the use of water based instead of solvent based inks), but the receptiveness of companies to environmental innovations as a whole, and the factors influencing this receptiveness. From this perspective, the theory of planned behaviour developed by Icek Ajzen (1985) offers some valuable insights, summarising the factors effecting a person's (or an organisation's) intention to act – a theory whose explanatory power has since been verified across a wide range of issues (see Montalvo, 2002 p. 37).

According to Ajzen's model, behavioural intentions are influenced by three main factors: first, attitude, which depends on the actor's beliefs about the consequences of the behaviour in question, and the desirability of these consequences. Subjective norm refers to the

expectations of relevant players, and the induvidual's intention to meet them. The third factor is percieved behavioural control, meaning to what extent the actor feels able to perform the behaviour in question (past the behavioural intention, actual behaviour is of course also influenced by the actual, not just by percieved behavioural control).

Environmental innovations are innovations which result in a decrease of the environmental burden caused by the economic activity. According to the classification of the OECD, these can be either product, process or organisational innovations, and process innovations can be further grouped into end-of-pipe and cleaner production (also called preventive) type developments. (Frondel et al., 2007) Our paper only deals with technological (product and process), and not organisational innovations (such as, for example, the introduction of environmental management systems), we therefore use the term environmental innovation in this sense.

The determinants of environmental innovation can be grouped into characteristics of the firm, its environment, and the new technology (Del Río, 2009). Factors internal to the firm include for example the management's environmental commitment, environmental strategy and attitude towards risk, the life cycle of the technology used, as well as the human and financial resources necessary for innovation (the size of the firm can be decisive in this regard). (Del Río, 2009; Kemp & Volpi, 2008)

The characteristics of the firm's environment include market factors (buyers, suppliers, competitors), as well as any pressure by the authorities, NGOs or the population to improve environmental performance. Among the environmental factors, Rothenberg and Zyglidopoulos (2007) emphasize the importance of munificence (the abundance of resources necessary for the firm's operation) and dynamism. They assume that in environments low in munificence, amid the fierce competition, firms will only focus on investments with immediate return, neglecting the environment. Dynamic (rapidly changing, uncertain) environments however are supposed to encourage the fast uptake of new solutions.

It can be seen that some of the factors above are associated with all types of innovations, while others are specifically related to environmental innovations. Since the factors are partly common, companies which are generally innovative are usually also more active in the field of environmental innovations (Rothenberg & Zyglidopoulos, 2007). Among the factors specific to environmental innovations, environmental regulation is perhaps the most important and the most widely researched (Del Río, 2009; Kemp & Volpi, 2008).

Ajzen's (1985) theory of planned behavior was applied to the field of environmental innovations by Montalvo (2002). In his model, the attitude factor is composed of firms'

opinions of the economic effects of environmental innovations, and the environmental risks associated with their operation. The social norm is equivalent to pressure from various stakeholders to improve environmental performance, while percieved behavioural control is characterised by the companies' technological capabilities, human and financial resources influencing the ability to introduce environmental innovations. While Montalvo examines these factors in much depth and detail for firms of the in-bond industry on the US-Mexican border, he does not compare them with the actual environmental innovation activity of these companies.

In Hungary, a large sample survey was carried out by the OECD in 2003 looking at the environmental practices of manufacturing firms (Kerekes et al., 2003). Although the main forcus of this survey was on environmental management tools, technological innovation, as well as some of the motivation factors described above was also touched upon, allowing for some interesting comparisons with our research.

3 Survey and sample characteristics

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. 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.

When selecting the sample, the initial aim was to contact all chemical companies in Hungary, with the exception of the pharmaceutical industry, whose characteristics are quite different from the rest of the sector. From the approximately 700 firms registered as chemical companies, we also had to exclude those who, as it turned out, had no real activity or were only engaged in trading chemicals, as well as some companies whom we were unable to seek out because of their geographic location. Contacting the approximately 350 remaining firms by telephone yielded 70 personal interviews, which were conducted by students of the Corvinus University of Budapest after prior training. The sample is quite diverse, consisting of companies of various sizes, fields of activity and location within the country.

Figures 1 and 2 show the distribution of the sample according to firm size (number of employees and revenue). It can be seen that the sample mainly contains small and medium size enterprises (according to EU classification, these are firms with less than 250 employees). The largest group is that of small firms with 10-50 employees, but the sample

also includes many medium-size companies, as well as micro enterprises with less than 10 employees. According to field of activity (NACE classification), firms producing basic organic chemials, paints and coatings, as well as cleaning agents and toiletries are the most important (each providing around 10% of the sample).

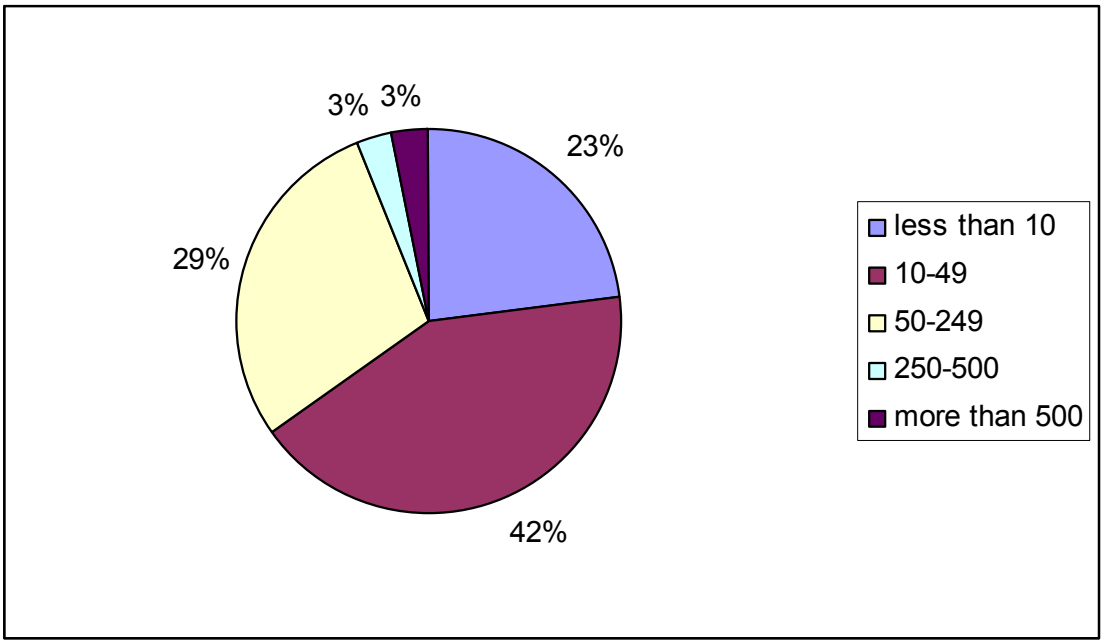

Figure 1: Composition of the sample by company size according to the number of employees

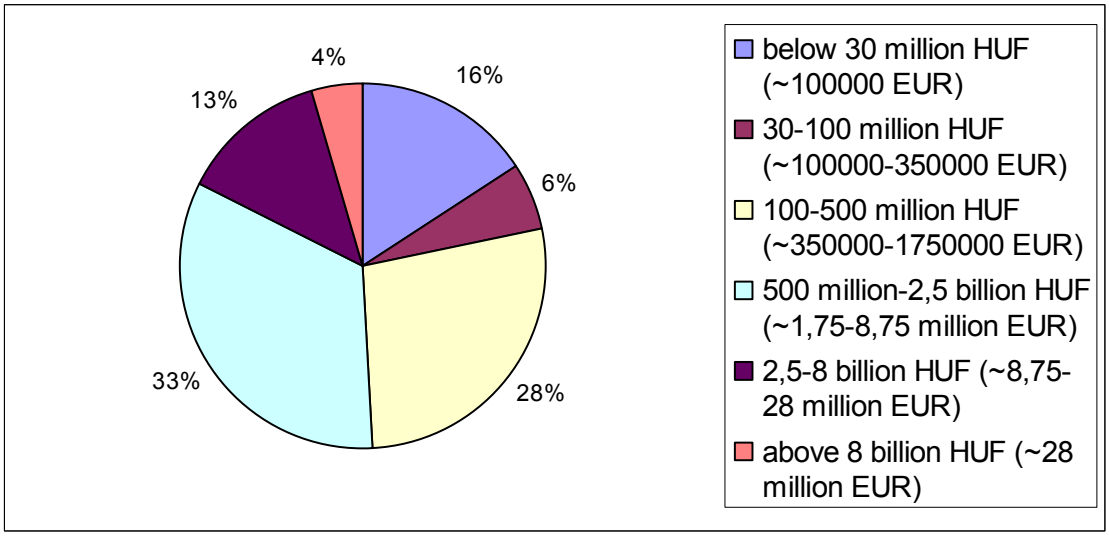

Figure 2: Composition of the sample by company size according to annual revenue

The majority (approximately 70%) of the companies are not in direct contact with consumers, the main buyer groups being wholesalers and other chemical companies. About a quarter of

the firms interviewed are only present on the Hungarian market, but there were also many whose exclusive market was outside Hungary, in the EU (23%) or outside it (11%).

Naturally we considered it important to interview persons within the companies who were familiar with the production processes and the environmental impacts of their firm and would be able to answer questions related to innovation activity. In most cases, we were able to achieve this – as can be seen in Figure 3, in about half of the cases (mainly in case of the smaller firms) we were able to speak to the head of the company, otherwise, it was mainly production or environmental managers who answered our questions.

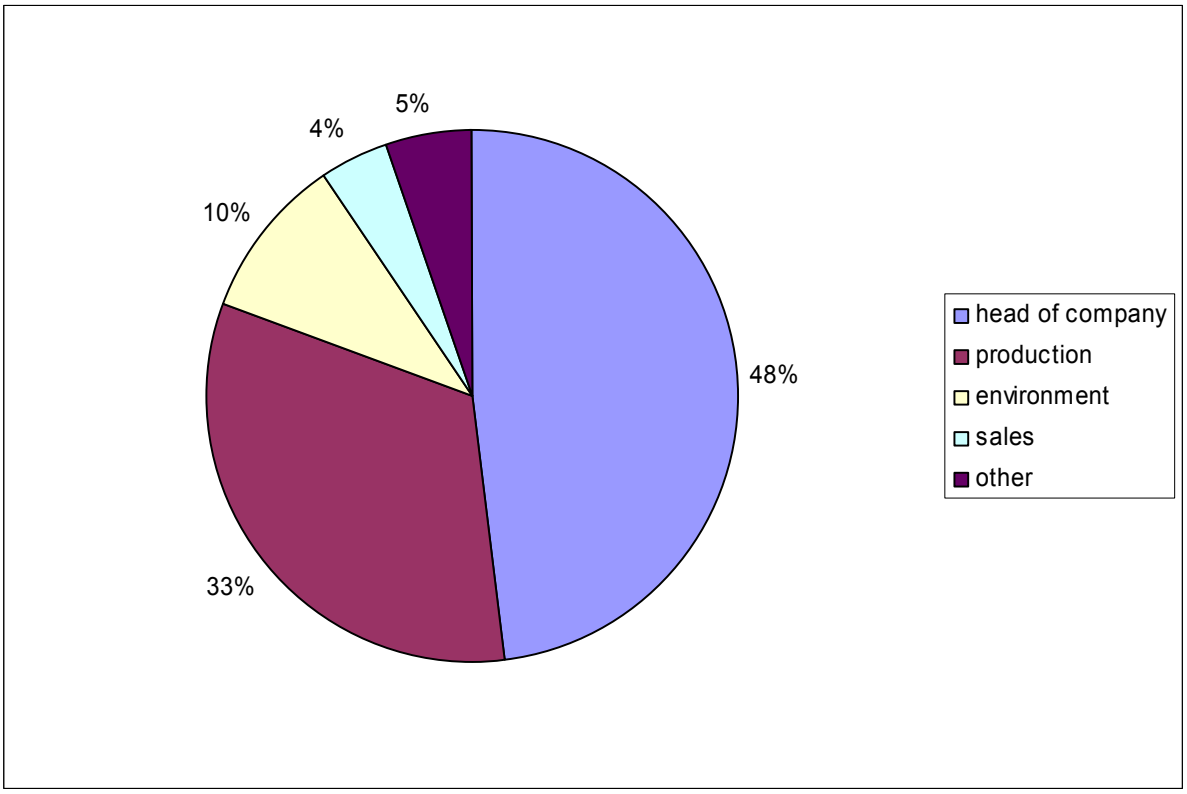

Figure 3: Position of the respondent in the company

4 Empirical results

4.1 Environmental innovation activity

After the general characteristics of the companies, we examined their innovation activity. First we asked about innovations in general, then environmental innovations. We attempted to characterise the intensity of the innovation activity by looking at the percentage of the companies' products and processes that were affected by innovations in the past three years. It can be seen (Figure 4) that, in case of all innovations, there was no significant difference in the frequency of product and process innovations. The distribution of the companies was

fairly even, meaning that the proportion of companies innovating intensively, less or not at all was nearly the same.

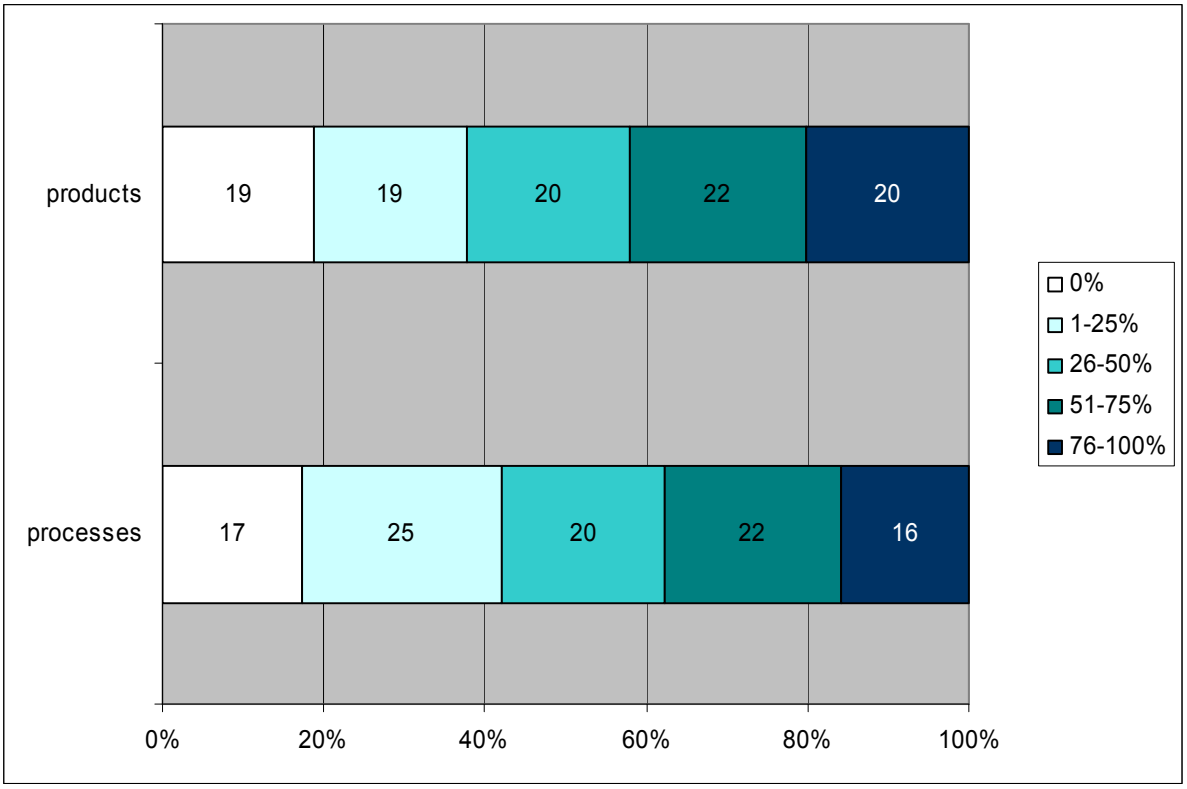

Figure 4: Distribution of companies by level of innovation activity (expressed as the % of products and processes affected by innovation in the past three years)

The share of processes and products affected by environmental innovations was naturally smaller than for all innovations, and it is also apparent that environmental product innovations are less common than environmental innovations affecting the production processes (Figure 5). It is important to note that, as defined earlier, we characterised environmental innovations by their effects, not their purpose. This means that we classified as environmental innovations not only developments aimed specifically at protecting the environment or complying with environmental legislation, but also those motivated by other reasons such as modernisation or the reduction of imput costs, in case these produced some kind of environmental benefit as a ”side-effect”. This fact was specifically called to the attention of our respondents, and – as reported by the interviewers – it happened several times, that, after the interpretation was clarified, the respondent reported a higher share of environmental innovations. This indicates that many companies, though they enage in environmental innovation, are not necessarily aware of it.

We found a connection of medium strength between overall and environmental innovations in case of products (correlation coefficient: 0.508) as well as processes (c.c.: 0,481, both were significant on a 99% level). As for the relationship between environmental product and process innovations, the connection was somewhat stronger (c.c.: 0.638).

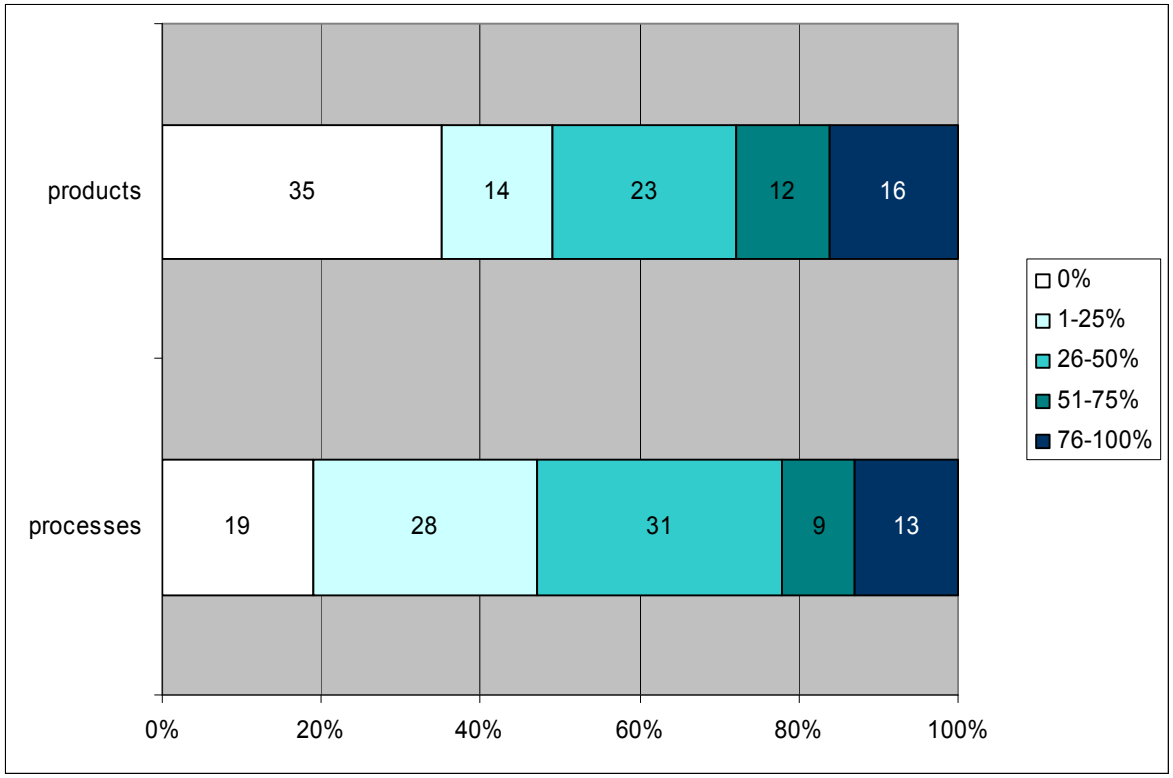

Figure 5: Distribution of companies by level of environmental innovation activity (expressed as the % of products and processes affected by environmental innovation in the past three years)

After examining innovation activity in general, we askd respondents to present three specific environmental innovations introduced at their company in the course of the past three years. 10 companies were not able to cite any environmental innovation from this period, the others presented a total of 112 innovations (9 of which had to be excluded because they did not qualify as environmental innovations). The classification of the renmaining 103 innovations can be seen in the next figures (Figure 6, 7 & 8). Classifying the innovations was done based on a short description provided by the respondents, and on their environmental effects. (For each innovation, we asked a set of questions as to how it affected the firm's environmental performance across several dimensions: energy efficiency, the efficiency of raw materials use, air- , water- and soil emissions, the amount and hazardousness of waste generated, as well as the toxicity of the products and the raw materials used. For each

dimension, respondents were asked to assess on a 5 grade scale whether these effects increased or decreased as a result of the development in question.)

As shown in Figure 6, more than three quarters of the 103 specific innovations were process-related, with cleaner production measures in the clear majority over end-of-pipe developments. These findings are consistent with the results of the 2003 OECD survey which found that process innovations, especially cleaner production developments were dominant in all countries observed (Frondel et al., 2007), with these shares being especially large in Hungary: 89.5% for process innovations and 74% for cleaner production measures within process innovations (Kerekes et al. 2003). It seems therefore therefore that these trends are not heavily dependent on firm size (the OECD sample only included firms with 50 or more employees, while 65% of our sample did not reach this size) or industry (the OECD sample was drawn from a wide range of manufacturing industries, with chemical firms only providing 12% of the sample).

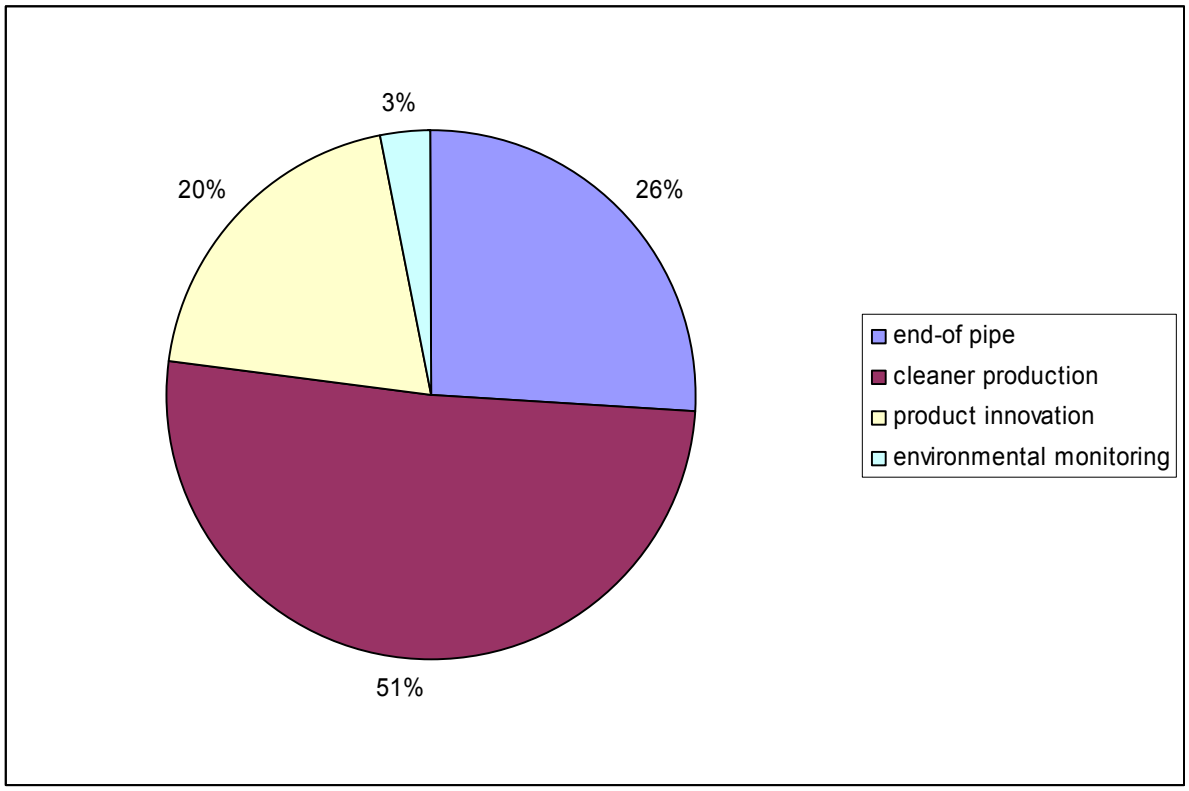

Figure 6: Distribution of specific environmental innovations by type

Within end of pipe innovations (Figure 7), measures to decrease air and water pollution were the most common (some companies started using air filters or waste water purifiers in the past three years, while others were already engaged in upgrading these technologies). Several companies introduced new solutions for the safe storage of hazardous materials,

which clearly has a special importance for the chemical industry which is often using harmful substances.

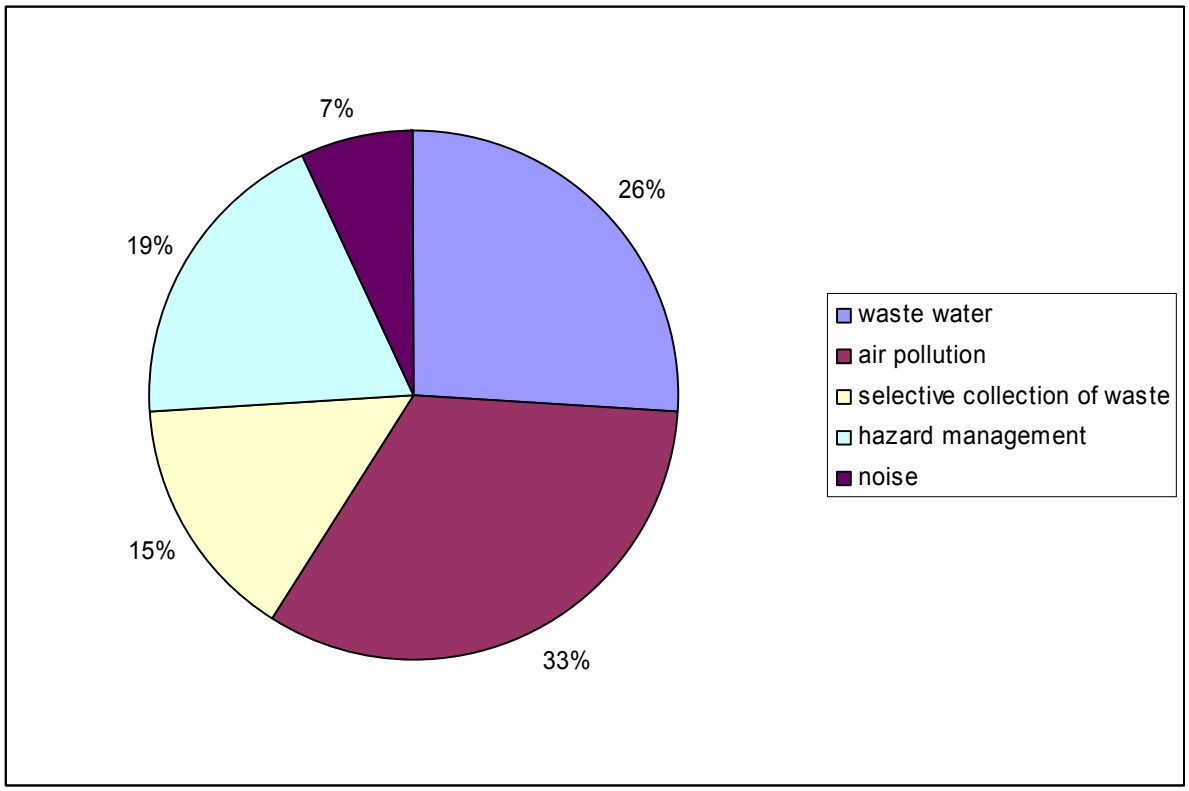

Figure 7: Distribution of end-of-pipe innovations

Cleaner production innovations (Figure 8) were not always connected with a specific environmental area, many of them (30%) had multiple benefits (such as more efficient use of inputs, less emissions and waste) resulting from the modernisation of a piece of equipment or the re-designing of a process. Among the more targeted innovations, energy efficiency improvements and water-related innovations were the most common, followed by developments to reduce or re-use waste. Reducing the use of solvents appeared as a special area – about a quarter of product innovations also served this purpose, while the rest were very diverse.

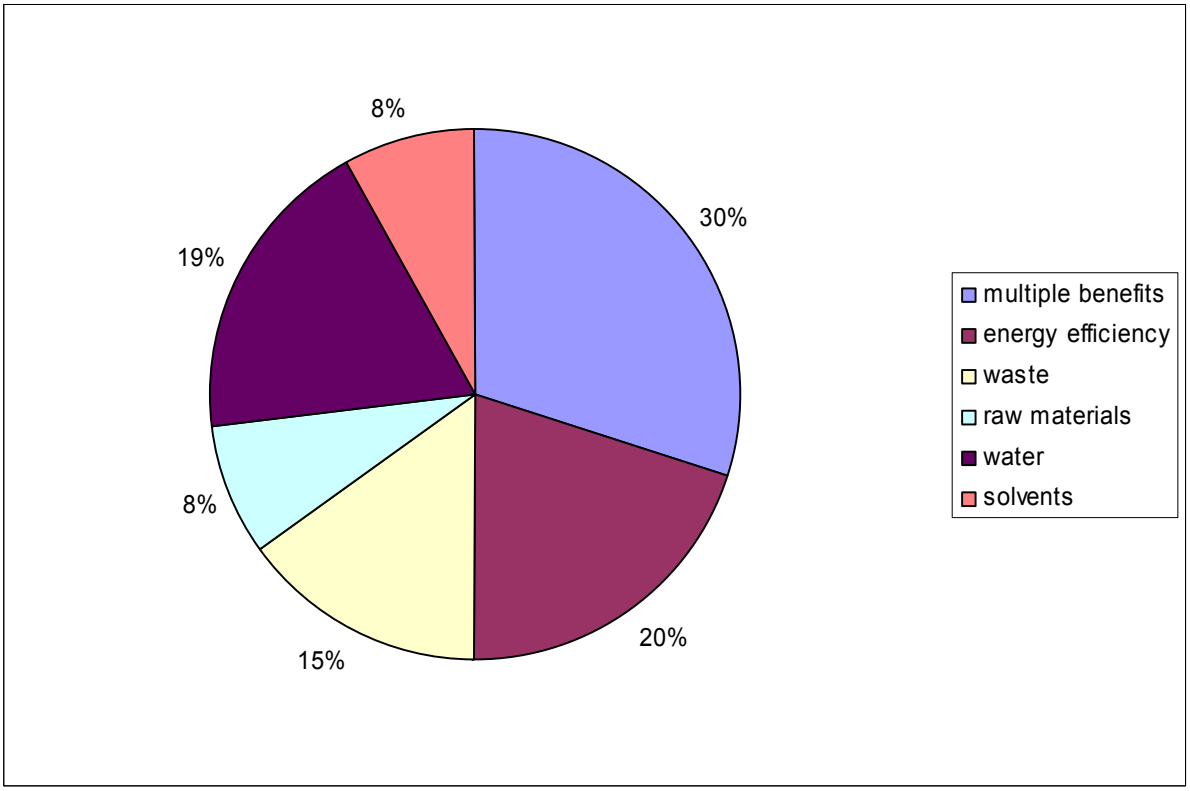

Figure 8: Distribution of cleaner production innovations

The relationship between innovation acticvity and company size proved very interesing. It is generally assumed that smaller companies are less innovative (and are also less able to adopt innovations) due to the lack of necessary human resources and capital (Bellas & Nentl, 2007). Rose and Joskow (1990; in Bellas & Nentl, 2007) however, call attention to the fact that, by looking at the number of innovations, most research is biased towards large companies, since larger companies with more plants, machines and products are inherently more likely to perform some kind of modernisation over a given period of time, if only resulting from the necessary replacement of equipment.

Our results point to the validity of this argument. We found that the number of specific innovations mentioned by the companies is 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). At the same time, the intensity of environmental innovation activity as measured in the proportion of products and proceses (as presented earlier, see Figure 5) had no connection with company size.

4.2 Determinants of environmental innovation activity

The determinants of environmental innovation were examined in the framework drawn up by Montalvo (2002), and were compared to the firms' actual innovation activity.

4.2.1 Attitude factors

The economic effetcs of improved environmental performance have been a subject of much debate in past years, with neither side being able to provide conclusive evidence either for or against the so-called „business case for sustainable development" (see Gunnigham, 2009 and Salzmann et al., 2005 for an overview of this debate in the literature). Although it is unclear what shapes the opinions of corporate decision makers in this regard, whether they see environmental protection issues as an opportunity or a threat is thought to have an important effect on company behaviour. (This relationship is verified for Hungary by Harangozó, 2007.) And, despite the prevalence of the "win-win" paradigm in public debate, the fact that many enterprises do not engage in environmental investments beyond the level necessary to ensure legal compliance indicates that many managers still harbor serious doubts about the effect of environmental efforts on their business. (Gunningham, 2009)

In our sample, half of the respondents had a mixed opinion of the economic effects of environmental innovations, answering that they sometimes provide economic benefits to the company. 22% said that they only increased the costs, while 28% answered that environmental innovations often bring substantial benefits. However, opinions on this isssue only showed a weak connection with the number of innovations mentioned (the correlation coefficient was 0.278) and had no effect on innovation activity as measured as a percentage of new or improved products and processes. It seems therefore that, rather than relying on some general perception, firms evaluate each possible environmental measure individually, and those having a negative opinion on their financial effects may also engage in environmental innovation for other reasons.

The second factor thought to shape firms' attitudes about environmental innovations is how they percieve their possible environmental impacts. Here, while Montalvo (2002) only looks at the overall environmental risk associated with companies' operation, we asked respondents to individually evaluate each kind of environmental effect they generated (measured on a scale of 1 to 6 from negligible to very high). Average values are shown in Figure 9. It can be seen that companies typically consider their raw material and energy use to be the most significant, but tend to have very favourable opinions on the emissions they cause. A possible explanation for this is that companies are mainly conscious of those effects wich appear as cost factors. The other reason could be that, as will be shown later,

many companies seem to equate compliance with environmental regulations to the absence of pollution, which could explain the low estimates of their emissions.

Between the percieved environmental impacts and the level of innovation activty, we found no significant connections. However, this may be explained by the fact that we only elicited information on the current level of companies' environmental impacts, which already reflect the effects of the innovations introduced in the past years. Therefore, we do not have to discard the assumption that high environmental impacts ecourage innovation, since the present level of impacts may be lower precisely due to these innovations.

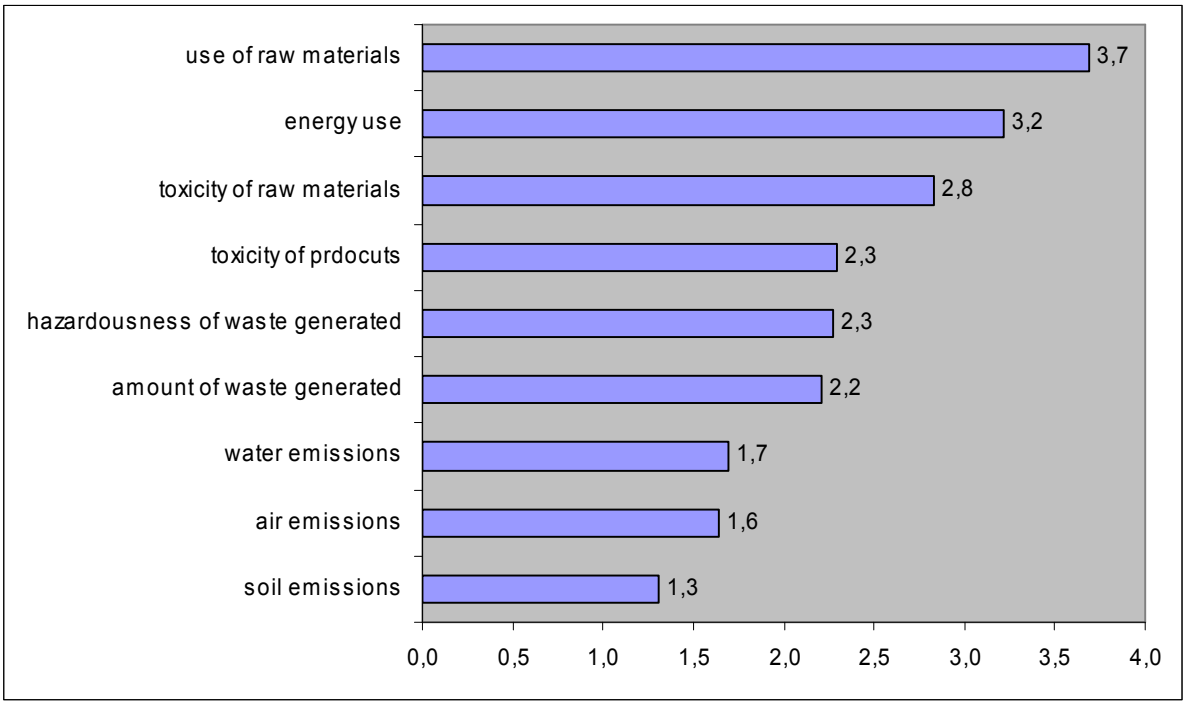

Figure 9: Percieved level of firms' environmental impacts (averages from 1: negligible to 6: very high)

4.2.2 Social norm factors

Figure 10 shows how much various stakeholders encourage the company to improve its environmental performance (also on a scale of 1 to 6). The strongest pressure clearly comes from the regulating authorities. From the other actors, only the role of internal stakeholders seems important, the civil sociey and other market actors do not represent a serious influence for most companies. At the same time, it is interesting that two groups percieved on average to represent a weak influence have a significant explanatory power for environmental innovations: NGOs and the loacal population. It seems therefore that, though in general companies feel little pressure from these gropus, where this pressure does appear, it can be sufficient to prompt action. (It should be noted that our research was

looking specifically at environmental innovations, while companies may also respond to external environmental pressures in other ways, such as issuing environmental reports, introducing environmental management systems, etc.)

The effect of percieved regulatory pressure was not significant – companies generally feel a strong regulatory pressure in environmental matters, but those who do not feel this pressure do not innovate significantly less than the others. However, if we look at specific areas, we find several significant connections. Because of its assumed importance, we included a separate question asking about the percieved regulatory stringency related to each specific environmental issue. This can be compared to how much improvement companies achieved in these areas through the innovations of the past few years. 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.)

Comparing the strength of perceived stakeholder pressure with the Hungarian results of the OECD survey cited earlier (Kerekes et al. 2003), we find that firms in our sample generally felt a weaker influence from all groups, which could be due to the fact that smaller companies may be less exposed to these forces. Regarding the sources of pressure, public authorities were ranked first in both surveys, but there were also differences, notably in the ranking of (non-management) employees which were found to be among the least important in the OECD survey. The bigger influence of employees on environmental performance in our research may be explained by the special situation of the chemical industry, where protecting workers from exposure to harmful substances can be an especially important consideration.

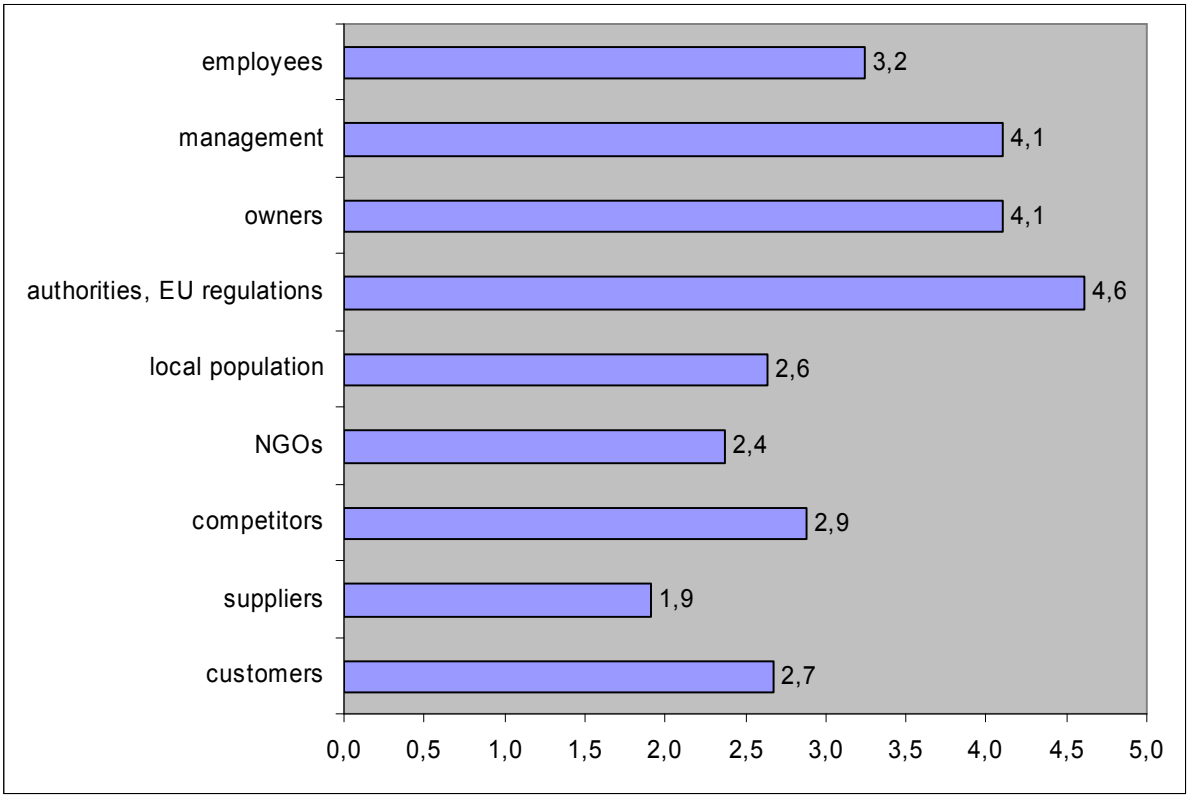

Figure 10: Percieved pressure from various stakeholders to improve environmental performance (averages from 1: negligible to 6: very high)

4.2.3 Percieved behavioural control

The last factor influencing the intention to act is to what extent companies feel able to implement environmental innovations. This depends on the availability of human and financial resources, and also, whether or not companies are in the first place able to monitor their environmental impacts, and to identify and assess the possibilities for intervention. Innovation is also greatly facilitated by the availability on the market of solutions enabling the improvement of environmental performance. It can be seen on Figure 11 (also representing averages on a 1 to 6 scale) that firms regard the availability of financial resources as the strongest limiting factor. These indicators – with the exception of the ability to access external financing – are weakly but significantly correlated to the percentage-based indicators of innovation activity.

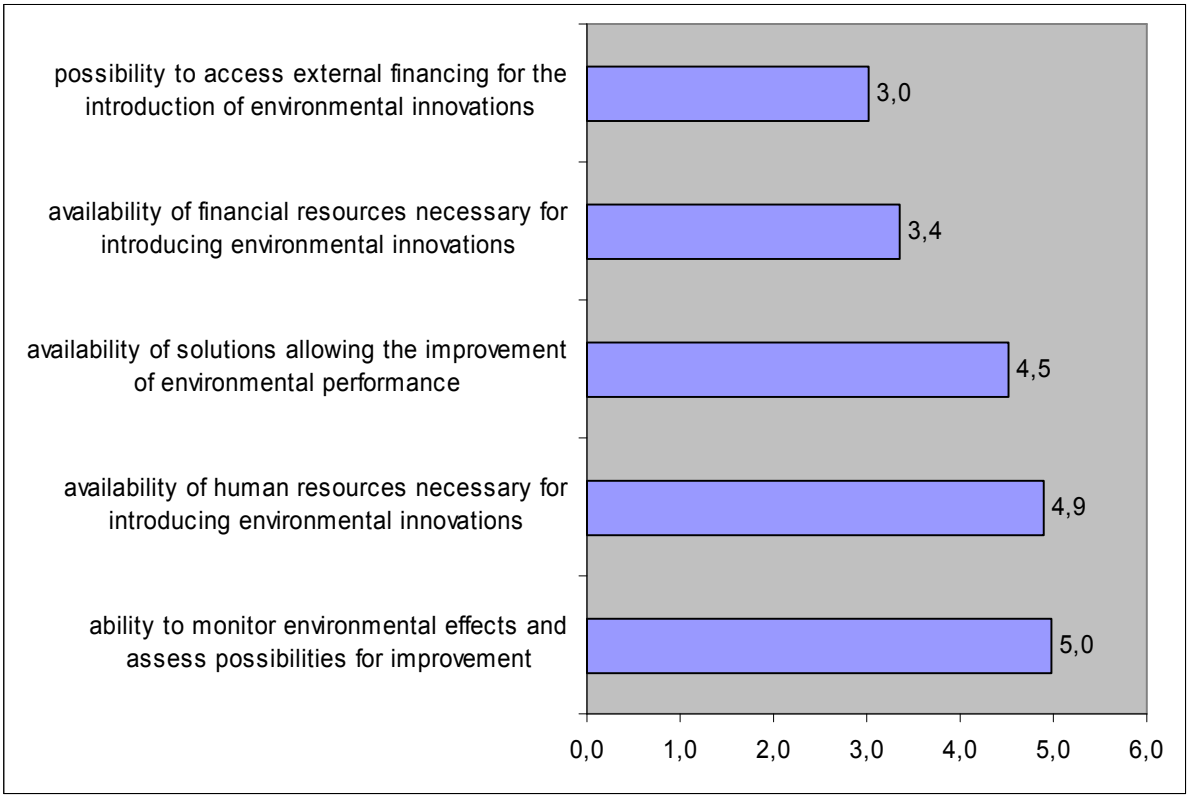

Figure 11: Percieved fulfilment of the conditions necessary for introducing environmental innovations (averages on a scale of 1 to 6)

After examining the motivation factors and the barriers, we also asked respondents in a direct open ended question what they regard as the necesarry preconditions for their firm to increase its environmental innovation activity (Figure 12). In accordance with the previous questions, the majority named the improvement of the financial circumstances. Several respondets 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.

The obstacles to improving environmental practices identified in a survey by the OECD in 1999 (Kerekes et al. 2003) were similar, with financial problems and the lack of governmental support topping the list, however, the lack of appropriate technologies also featured prominently which does not appear so important according to our results. Since the

difference of firm size between the samples would most likely have an opposite effect, it seems that the availability and the access to of environmental technologies have indeed improved over the past decade.

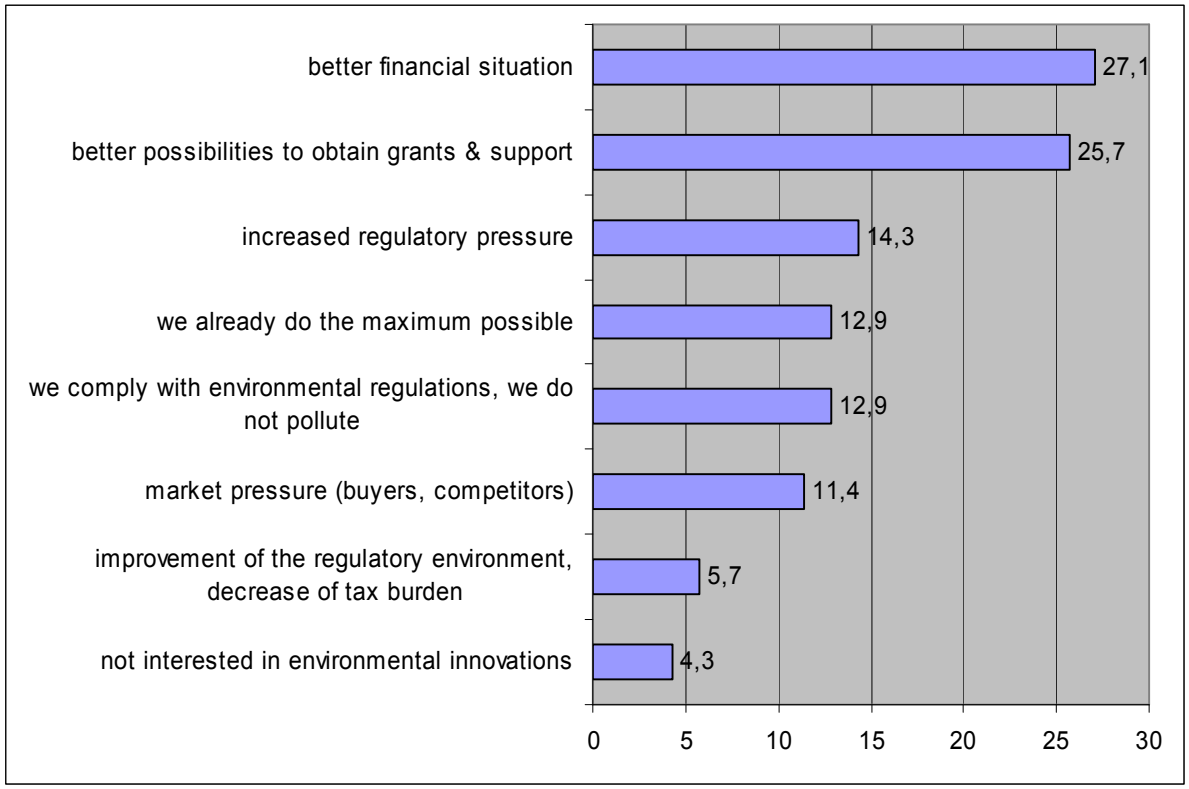

Figure 12: What are the necessary preconditions for the firm to increase its environmental innovation activity? (answers coded from an open ended question, where each respondent has the possibility to name more than one condition)

5 Conclusions

The research presented in our paper provided a full picture about the environmental innovation activity of Hungarian chemical firms. We saw that there are huge differences in the intensitiy of environmental innovation activity among the firms, which we attempted to explain through factors derived from the theory of planned behaviour (Ajzen, 1985). We were able to identify several factors connected with the level of innovation activity, but none of these had very strong explanatory power. It seems therfore that the propensity for environmental innovations is the result of complex interaction between several factors.

It could clearly be seen that companies which are in general more innovative are also more receptive to environmental innovations. Within environmental innovations, process improvements were in the majority, with the dominance of cleaner production type solutions. The number of environmental product innovations is rather small, which 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 cosider 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. Many are also not consciously aware that certain investments realised mainly for economic purposes also bring environmental benefits.

It is interesting that pressure from NGOs and the local population, 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 truly striving to improve their environmental performanece as a result. Regulatory pressure, though much stronger overall, only seems able to push change in the specific areas affected by the regulations. It seems thus that in Hungary (at least in the field of the chemical industry) there is a lack of comprehensive environmental and innovation policy solutions which could motivate environmentally sound operation in general. Gunningham (2009) points to the fact that, beyond applying direct regulatory pressure on companies, the authorities can also indirectly contribute to social pressure through the empowerment of civil society (for example through improved access to environmental infomation or a bigger say in permitting procedures) – an approach that, in the light of our results, could also prove effective in Hungary.

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, but they 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 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 relatioships. It appears therfore 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 definately be useful to strengthen and direct general innovation policy to more effectively promote environmental developments.

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