KNOWLEDGE AS A KEY RESOURCE CONTRIBUTING TO THE DEVELOPMENT OF ECO-INNOVATIONS BY COMPANIES-SUPPLIERS OF ENVIRONMENTALLY SOUND TECHNOLOGIES¹

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Abstract: Challenges arising from global warming and climate change has realized the need to ensure wide development and diffusion of environmentally sound technologies. The aim of this study is to obtain new knowledge about sources contributing to the development of eco-innovations by companies that are suppliers of environmentally sound technologies in Poland. The objective is to show the importance of knowledge for the development of these novelties. Moreover, the paper aims to present and characterize the origin of the knowledge accumulated within the studied companies. The research uses qualitative methods and it is based on in-depth, semi-structured interviews, and a multiple case-study. It presents the sources contributing to the development of eco-innovations, which are specific to the companies-suppliers of environmentally sound technologies in Poland. The results confirm that, among others, knowledge accumulated within the company, including experience and skills of innovators, is essential for developing new ecological solutions. The results also demonstrate that companies-suppliers of own, innovative environmentally sound technologies devote considerable attention to knowledge management. Thus, the knowledge these companies acquire is fully and widely used in the eco-innovations development process. Moreover, this paper reveals ways in which such companies acquire different types of knowledge.

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Introduction

In the 21st century, many companies envisage growth opportunities in emerging trends, such as innovativeness, knowledge accumulation, and sustainable development (Azzone & Noci, 1996; Bansal & Roth, 2000). Moreover, in recent years, issues of environmental responsibility and sustainable development have been the topic of discussions and debates among policy makers, academic institutions, and businesses. For these reasons, among others, many companies have started to undertake activities directed towards ecologically sustainable and innovative development (Cleff & Rennings, 1999). Following these trends, the literature in fields of innovation management, technology management and environmental management emerged a new concept, namely eco-innovation, which, according to Kemp and Pearson (2007), is defined as:

The production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organization (developing or adopting it) and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives (p. 7).

The aim of this paper is to show the importance of knowledge for the development of eco-innovations in Polish companies-suppliers of environmentally sound technologies and to characterize the sources of the origin of such eco-innovations. Moreover, the paper aims to present and characterize the origin of the knowledge accumulated within the studied companies.

Knowledge as a Determinant of Eco-Innovation Development

There are four main groups of forces deriving the development of eco-innovations: market, technology, firm specific factors, and regulation (Figure 1; Horbach, Rammer, & Rennings, 2012). It is difficult to assess which of these groups of determinants is crucial for the creation and development of eco-innovations, because empirical studies present different approaches towards this issue (Hart, 1995; Porter & Van der Linde, 1995; Brunnermeier & Cohen, 2003; Rehfeld, Rennings, & Ziegler, 2007; Horbach, 2008; Kammerer, 2009; Demirel & Kesidou, 2012; Triguero, Moreno-Mondéjar, &

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Davia, 2013). However, firm specific factors, including, in particular, knowledge resources accumulated in the company and experience and skills of its employees, are continually viewed as some of the most important determinants. It is challenging to evaluate the knowledge gathered within a company because such knowledge is dynamic, and the value of knowledge varies, depending on the time, place, and manner in which it is used. In order to be valuable for the company, knowledge must be embedded in context. Without the context, knowledge is merely an information, the meaning of which is difficult to define (Nonaka, Toyama, & Konno, 2000).

In the literature it is not easy to find a generally applicable definition of knowledge. Nevertheless, the one proposed by Probst, Raub, and Romhardt (2002) appeared most popular and widely used. According to these authors, knowledge is the collection of skills and abilities used by individuals to solve problems. This collection involves theoretical and practical elements, along with rules and guidelines of conduct based on information and data (Probst et al., 2002, p. 35).

Knowledge can be perceived in three different ways: as a resource, as a product and as a constraint (Tuomi, 1999). Companies usually treat knowledge as a resource, as knowledge is subject to processes of identification, accumulation, sharing, and protection within the organization. Companies often seek to accumulate knowledge to form new knowledge within the enterprise and enable independence from individual employees who primarily hold such knowledge. When viewed as a product, knowledge is a result of business activity, such as products and services that are developed using the knowledge of employees. Finally, knowledge may also be a constraint because it can adversely affect the performance of the company, for example, when knowledge forms the basis of conclusions that are drawn mistakenly or when inappropriate decisions are made by employees based on their previous experience.

From a company's point of view, there are many important topics concerning knowledge, i.e., its formation, availability, sharing, assimilation, value, and management. There are different ways in which companies can acquire the knowledge essential for running the business. First, they can obtain new knowledge from research and development activities. For many companies, research and development activities are the primary means of both creating and developing products and services, as well as creating new knowledge within the company, essential in terms of further development. Such activity of enterprises will foster their absorption capacity by supporting more effective identification of valuable new knowledge outside the organization, and promoting its absorption,

assimilation, and use for commercial purposes (Cohen & Levinthal, 1990). Other opportunities to gain new knowledge can include, among others, hiring new employees, market research, analysis of the company's environment, competition monitoring, interpreting industry reports and press, and establishing contacts with potential customers, suppliers, and distributors; as well as keeping in touch with existing customers, suppliers, competitors, partners, and distributors, along with maintaining relationships with advisors, mergers, and acquisitions.

From a companies' point of view, knowledge sharing is similarly important to knowledge acquisition, in terms of both the processes within the organization and the activities within its surroundings (Grandori & Kogut, 2002, p. 226-227). The transfer of knowledge between organizations may occur through various types of activities, e.g., mobility of human resources between organizations, mutual relations of competing companies, or imitation that leads to new knowledge (Testa, 2013). The process of knowledge sharing typically consists of three phases: 1) the intentional or unintentional transfer of knowledge, 2) the receipt of knowledge from customers, and 3) knowledge assimilation and absorption. The last phase is important because without it, knowledge is ineffectual. It is the special skills and abilities of the new holder of knowledge that helps them understand the usefulness of knowledge and its true use (Testa, 2013).

A companies' ability to identify knowledge resources and its effective use are the most important skills for a company aiming to build a competitive advantage based on knowledge. One of the most difficult elements of such a strategy is the distinction between knowledge resources that need to be kept secret and those that can be made freely available, when working with other companies. At the same time, it should be noted that effective knowledge management does not always have to involve expanding its inventories (Boisot, 2013), but rather should relate to the efficient use of those already existing (Ihrig & MacMillan, 2013).

Figure 2: Elements and processes of knowledge management

The benefits of knowledge management can be identified at various levels. Most commonly, they relate to the company and its employees, as well as its surroundings, which is the market in which it operates. Benefits for the company, among other factors, are: improved efficiency and management flexibility; ease of implementing new initiatives; business development; rapid response to changes in the environment; increase of innovation and creativity of employees; increase of efficiency and flexibility of the management and initiatives of the organization; greater flexibility in matching the business in market needs; and improved adaptation to customer expectations. The benefits of knowledge management from a company's employees' point of view include, as examples, self-realization, self-development, increased creativity, basic access to knowledge, a possibility to acquire

new skills, and increase of self-esteem (Barney & Clark, 2007). The main beneficiaries of knowledge management in companies from the perspective of the market are customers, suppliers, and competitors, as well as all other entities operating within the market.

A model of key elements and processes of knowledge management that include knowledge identification, acquisition, development, distribution, usage, and preservation can be summarized as deliberations about knowledge within enterprises. It should be noted that these processes are interdependent, which means an effect on one impacts another (Figure 2).

Research Methods

This paper presents the results of in-depth interviews and a multiple case study that was grounded on theories embedded in the literature, which was widely reviewed.

The aim of the literature analysis was to identify determinants contributing to the development of eco-innovations and to understand their specific characteristics and importance for enterprises. The conclusions drawn were the basis for the design of the empirical part of this study, i.e., in-depth interviews and multiple case study.

The first part of the qualitative research was based on in-depth, semi-structured, and semi-standardized interviews. The interviews were conducted with representatives of a purposefully selected sample of forty Polish companies that were suppliers of environmentally sound technologies and winners of the first three editions of the project: GreenEvo - Green Technology Accelerator, conducted by the Ministry of the Environment.

The main criterion for sample selection was success in developing and introducing their own original and eco-innovative products to the market. The companies were evaluated by independent experts, who assessed the originality, ecological significance, and environmental impact of their eco-innovative products, as well as their potential for development. The companies that formed the sample had distinguished themselves from other companies as suppliers of eco-innovative products, interested in both, local, and international markets.

Enterprises in the sample were located across Poland. They represented six broad areas of environmentally sound technologies, i.e., renewable energy sources (10 firms), waste management (9 firms), energy efficiency (9 firms), water and wastewater management (7 firms), biodiversity protection (3 firms), and air protection (2 firms). The study was conducted using a fifteen-page script, which consisted of detailed questions concerning the activities of the companies and their relations with other market players. The script was treated as an instrument of ordering the course of conversation (Gudkova, 2012) that helped interviewers to interact freely with the representatives of the companies to gather detailed information about the selected companies. The final way of formulating the questions, as well as their order, was formed by taking into account the answers of interviewees to preceding questions (Babbie, 2008). The interviews were recorded, transcribed, anonymized, coded into a code book, and analyzed in line with the grounded theory (Konecki, 2000; Glaser & Strauss, 2006). The purpose of this part of the study was to define whether knowledge is crucial for development of eco-innovative products developed by companies that supply environmentally sound technologies in Poland.

The second part of the research was driven by a desire to make a thorough and detailed characteristics of knowledge that are essential for eco-innovative product development in the Polish companies that supplied environmentally sound technologies. This was carried out by a multiple case study, which was designed using the approach proposed by Robert Yin (2014) and consisted of the following six stages: planning, design, preparation, data collection, data analysis, and results sharing. The cases for this study were carefully selected based on the following steps:

- analysis of the environmentally sound technology sector in Poland on the basis of Central Statistical Office of Poland data (GUS) and reports available online;
- detailed analysis of the best Polish environmental technologies developed by 63 companies that were winners of the five editions of the project “GreenEvo - Green Technology Accelerator” run by the Ministry of Environment in 2010–2014 (the analysis was based on information and documents available on-line);
- establishment of contact (using telephone and e-mail) with selected companies;

- detailed analysis of the documents and data received from the selected enterprises as a result of the established cooperation;
- expert consultation concerning the purpose of the study and suitability of selected cases;
- a choice of two cases for the case study analysis.

Primary source materials used in this part of the research were: interviews, documents, archival records, direct observation, photographs, videos, and information available on-line.

The Importance of Knowledge for the Development of Eco-Innovation in Polish Companies-Suppliers of Environmentally Sound Technologies

Analysis of qualitative data collected during the in-depth interviews show that the process of creating eco-innovation is often complex and time-consuming, and frequently requires the involvement of practitioners and experts representing various fields of science. Interviewees' statements showed that there were at least some specific determinants contributing to the development of eco-innovations (Figure 3). Among these determinants, knowledge and skills that create the potential of the company, were considered important by 19 of the 40 companies in the sample (47.5%).

It should be noted that other sources contributing to the development of eco-innovations presented in Figure 3 were related directly or indirectly to knowledge (e.g., inspiration from the competition, identifying market needs, and previous experience of the management). The research conducted using in-depth interviews provided data to conclude that knowledge was crucial for the development of eco-innovative products in companies supplying environmentally sound technologies in Poland. Detailed characteristics of the knowledge essential for the creation of this type of innovation was carried out by a multiple case study. The results of this research are presented below.

Resources, in particular, all types of knowledge (including knowledge organization) and the unique characteristics of the organization were crucial for the development of eco-innovations in all selected cases. The research results revealed that core competences and dynamic capabilities of companies were critical for the eco-innovations creation. These tended to be extremely important for the companies that were seen as market pioneers, but nonetheless could not be accurately identified or explicitly enumerated, as they constitute tacit knowledge, which is non-codified and hence extremely difficult to identify. Nevertheless, direct observation of activities undertaken by the participating companies and numerous conversations with company owners and employees helped confirm the existence of this type of knowledge and its key role.

Figure 3: Determinants contributing to the development of eco-innovations

The research provided evidence for the existence of multiple sources of organizational knowledge, which underlined the core competencies and dynamic capabilities of the participating companies. In each case, the experience of the people (owner and key employees) and the company, in various

industries, was the backbone of organizational knowledge. Owners and key employees were crucial in this respect because they brought, to the company, knowledge gained at earlier stages of professional and scientific careers, as well as that acquired from customers, particularly during international delegations.

Among the researched cases, there were two specific types of companies supplying environmentally sound technologies: one supplying final products and the other providing component products (i.e., products forming components of final or other component products). Although the specifics of knowledge management between these companies slightly differed, it was worth investigating the specific differences mainly arising because of the nature of their businesses. The company that was producing innovative machines (final products) was focused on knowledge accumulation and expansion based on their own research and development department, employees' collaboration, employment of skilled professionals, and the collection of client information. The company supplying component products was more willing to cooperate with entities located within its environment (i.e., research institutes and universities) for knowledge accumulation, which often involves consulting external experts and fellow professors. Figure 4 presents a detailed list of sources of knowledge essential for the development of eco-innovations.

Figure 4: Sources of knowledge essential for the development of eco-innovations in companies that supply environmentally sound technologies

The enterprises, regardless of their specific activities, recognized two important groups of scientific knowledge: business knowledge and technical knowledge. The business knowledge was understood as general knowledge about the market and entities present in the market; prices of available products and components; finance; communication; management; customer service; decision making; and problem solving; as well as interdisciplinary knowledge. Knowledge about the necessary law for conducting business was recognized only as essential business knowledge by companies supplying component products. Technical knowledge included fields of science that were relevant to the specific nature of the company (e.g., chemistry, engineering, and mathematics).

The research revealed that, within the activities undertaken by companies in the sample, it was possible to identify all key processes of knowledge management recognized in the model of Probst et al., (2002; i.e., knowledge identification, knowledge acquisition, knowledge development, knowledge distribution, knowledge usage, and knowledge preservation). The detailed characteristics of the cases examined, from this perspective, revealed numerous interdependencies between these processes.

Conclusion

Selected results of qualitative studies, as presented above, provided varying conclusions. Largely, Polish companies that supply environmentally sound technologies devote much attention to knowledge management. Moreover, this study showed that companies cannot always accurately identify and characterize the knowledge resources they hold, despite these resources being successfully used in creating, developing, and improving eco-innovations. At the same time, the studied companies described their sources of accumulated knowledge in detail and were thoroughly aware of such knowledge sources. In addition, knowledge management differs in companies that supply products components and companies that supply final products. Finally, knowledge can be viewed as a key resource contributing to the development of eco-innovations by Polish companies that supply environmentally sound technologies.

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