Collaboration and Innovation in Sweden and Bulgaria: A Study of a Mature Industry

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Abstract

Nowadays, creation, exchange and transfer of knowledge (CETK) are turning into the most significant activity for companies. This article sheds light on Swedish and Bulgarian companies within a mature industry in terms of their knowledge flows for collaboration and innovation. Companies from the two countries as well as Small and medium enterprises (SMEs) and large firms are compared. Quantitative and qualitative research methods are combined. A set of variables which have a positive relationship with the companies' research and development (R&D) activities and innovation is developed.

It was found out that the set of variables employed can predict the innovation and R&D of companies, laying of electrochemical and conversion surface treatments with functional and decorative purposes (ECSTFDP) for the sample. In both countries innovation and R&D are positively affected by places for knowledge exchange followed by collaboration factors and market situation. However, the factors for collaboration and interaction are the most important for increasing the innovation activities in companies with ECSTFDP, irrespective of size, age and country of operation. Moreover, the article reveals the vital role of the social element in the CETK, which is also emphasized in the knowledge management literature. Furthermore, it illustrates that companies are influenced by the number of factors in this collaboration and actively evaluate the trade-offs from it. Additionally, the dynamics of the market is setting the pace and degree of newness of innovation and R&D activities.

Keywords: collaboration, innovations, mature industries

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1. Introduction

Contemporary economic development is characterized by rapid technological change leading to knowledge creation that highly intensifies the competition between

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companies (Castells, 2000). Emphasis is given to technological development causing accumulation of knowledge or higher levels of comprehensiveness of information. New products, processes, technologies and interrelations, different from the previous ones in nature, type, status and quality, keep emerging. Castells (2000) emphasizes the fact that inputs for all industries are transformed from material to knowledge and information based. Besides, the industry in the so called developed economies is being transformed from one processing raw materials and production to one of a post-industrial society, based on processing information and knowledge. Competition and collaboration acquire new dimensions, and often the saying "One for all, all for one" is of paramount importance for intensive knowledge flows aimed at creating successful innovation. In line with these changes, many researchers have argued that as business has become more global, increasingly competitive and turbulent, both markets and hierarchies display inefficiencies as modes of organizing production of both goods and services (Miles and Snow, 1992; Powell, 1990). Therefore, these changes along with globalization and technological advances, are a source of uncertainty for the enterprises. Consequently, network organizational form emerges which balances the flexibility of markets with the predictability of traditional hierarchies (Achrol, 1997; Miles and Snow, 1992; Powell, 1990; Snow, Miles and Coleman, 1992). Companies become more dependent on their participation in strategic alliances, networks for collaboration, etc. In order to grow and survive they must go beyond organizational boundaries as a mechanism for creating new knowledge and innovation that would allow them to create and maintain a sustainable competitive advantage.

The scientific thought within knowledge management, dedicated to creation, exchange and transfer of knowledge (CETK) for collaboration and innovation, are mostly aimed at industries characterized by intensive research and development (R&D) activities, such as information and communication technologies (ICT), telecommunications equipment as well as biotechnologies. Additionally, the ability and willingness of the partners as well as the incentives to share knowledge-based capabilities attract great attention (e.g. Goyal and Moraga-González, 2001). In these studies patenting is frequently used as an indicator for measuring innovation activities and performance (e.g. Sampson, 2007). Furthermore, the majority of the main contributions within collaborative networks investigate high-tech industries where the pace of development is rapid and innovative performance is vital, thus pushing companies to look for alternatives of the in-house R&D activities (e.g. Hagedoorn, 2002; Sampson, 2007). However, the results and implications of these studies are contingent to the context the empirical investigation is carried on and most relevant to the high-technology industries and large firms (Sampson, 2007). Evidently, the mainstream literature in both fields is focused on large organizations and high-tech industries while small businesses and mature industries have been neglected (see, Andersson and Karlsson, 2004; Sampson, 2007; Wong and Aspinwall, 2004).

On the contrary, Tunzelmann and Acha (2005), based on data from Organization for Economic Co-operation and Development (OECD), point out that a relatively small part of the value added is due to the high-tech industries, while the remaining part is generated by medium and low-level technological productions. Additionally, there are countless articles identifying small and medium enterprises (SMEs) as the main drivers of a national economy growth. It suggests that SMEs with medium- and low- level technological production also have a significant contribution both to development and growth of the economy. Surprisingly, even studies concluding that the collaboration game is dominated by high-tech industries from developed countries, have identified peaks in low-tech R&D partnering during certain periods (e.g. Hagedoorn, 2002). Nevertheless, these studies identify a trend of decreasing share of low-tech industries in R&D partnering. This fact does not necessarily mean that low-tech industries have unimportant role in the innovative activities. Instead, one could explain this with the fact that these industries rely predominantly on incremental innovation which does not require high R&D costs and allows firms to collaborate informally.

The deficiency of empirically based research on low-tech production within the area of knowledge flows (CETK) for collaboration and innovation as well as collaborative networks indicates a gap which the authors believe is important to be addressed. Therefore, in this article there is an investigation of the knowledge flows for collaboration and innovation in a quite different, mature type of industry, which, at first glance, seems non-dynamic and is defined as low technological - laying of electrochemical and conversion surface treatments with functional and decorative purposes (ECSTFDP)[1]. By intentionally choosing the empirical context, there is an effort to reveal why and how firms in this under investigated context collaborate for innovation. This mature industry is characterized with tacit nature of knowledge which makes its transfer within the collaboration difficult, with uncertain level of success. As a result the industry is characterized with a loose appropriability regime which makes the use of patenting as a measure for innovation activity and performance inapplicable (see Sampson, 2007 for a discussion on patenting as a measure). Instead, there is an interest to see which variables have the biggest influence on collaboration and innovative activities. The study includes both horizontally and vertically related partners as well as other organizations such as universities and research institutions as opposed to Sampson (2007) and Goyal and Moraga-González (2001) amongst others.

The choice made is based on the structural idea of knowledge-based economy which is seen as analytically useful by Cooke and Leydesdorff (2006). It links the knowledge creation to the knowledge exploitation system and repulses the perception that only industries with heavy concentration of knowledge assets should be in the focus of research. Furthermore, innovative performance is critical to corporate outcomes no matter how technology intensive the industry is. The choice of a single industry is reinforced by the recommendations in the Frascati Manual by OECD (2002) that every research should be grouped into separate industries. It helps the collection of data and at the same time

[1] See OECD (1997) Revision of the High Technology Sector and Product Classification, OECD, Paris.

takes into consideration the specific characteristics of every industry or production type. Additionally, Hagedoorn (2002) points out that most empirical studies on R&D partnerships and other forms of inter-firm collaboration have a cross-sectional nature. However, as he further explains, the literature suggests that partnerships are somewhat sector-specific as the propensity to enter into partnerships differs from industry to industry. This further supports the choice of a single industry.

The ECSTFDP offers surface treatment by thin metal or oxide layers with specific properties for a broad range of industries. The coatings are primarily applied on metal parts but also on plastic, composites, glass, etc. The manufacturers perform the finishing after the parts have been given their geometrical form. The surface treatment process is a sensitive one which is directly related to the fact that the quality of the final finish is complex to control. This industry has a long history and has been developed a long time. However, the past centuries craftsmanship, is quite different from today's advanced technology. The modern ECSTFDP has developed an extremely diverse scope of techniques and processes, heavily relying on innovation, for coating and protecting virtually all possible materials (BSTSA, 2007). Additionally, there is an understanding among the industry actors that CETK are vital for sustaining the competitiveness of the industry. Furthermore, the ECSTFDP companies are narrowly specialized in a limited set of all available techniques and processes. However, in order to meet and exceed their customers' demands they need to be able to offer the full range of surface treatment processes which will not be possible without collaboration with other actors from the industry. All these indicate that ECSTFDP is characterized with abundant knowledge flows between various interested parties within and outside the industry (Paskaleva, 2008).

The research is set in this background. The main purpose of this article is to shed light on Swedish and Bulgarian companies within ECSTFDP in terms of their knowledge flows (CETK) for collaboration and innovation. The study offers a snapshot of the situation, rather than longitudinal study which can outline historical trends and sectoral patterns as Hagedoorn (2002) does. In his study he outlines some major international patterns within the Triad - North America, Europe and Asia. In that respect, our study could be related to that of Hagedoorn (2002), as we make an international comparison of a sectoral situation in Western and Eastern European firms. However, unlike Hagedoorn (2002) study which looks on formal agreements (contractual agreements and joint ventures), there is a focus on informal forms of collaboration. Within those forms, part is devoted to innovative activities which would lead to the creation of new and/or improved products, services and processes.

The approach adopted employs earlier analytical work, the results from a self-administered questionnaire and in-depth interviews with experts from the industry. A comparative research design is adopted based on a selection of a certain industry (ECSTFDP). Swedish and Bulgarian companies as well as SMEs and large firms in ECSTFDP are compared in order to be able to create a better understanding about a mature industry supplying high-tech industries and outline the competitive position of the companies working with it. A set of specific variables which have a positive relationship with the companies' R&D activities and innovation is also developed. Using them will allow to illustrate companies' knowledge flows for collaboration and innovation.

The outline of this article is as follows: in section 2 there is an outline of the conceptual issues discussed throughout the article, in section 3 there is a description of the method while in section 4 there is a presentation of the results. In the final section there is a presentation of the conclusions, limitations and recommendations for future research.

2. Conceptual issues

As a foundation of every human activity, knowledge is described as a source of competitive advantage and the most powerful engine for innovation and growth for all companies (Cooper, 1998). As such, it has been explored, analyzed and discussed by various branches of science – economics, organization theory and philosophy. Nonaka and Takeuchi (1995) define knowledge as a justified true belief, i.e. containing an interpretation of the individual (knower). Additionally, they make a distinction between knowledge and information by defining the latter as a flow of messages that the receiver uses both supporting the decision-making process and creating new knowledge. Similar distinction is made between knowledge and information flows. Gupta and Govindarajan (2000) note that knowledge flows transfer know-how, consisting of expertise or external market data of strategic value, while information flows equal more to operational information that is structured but lacks interpretation. However, the information flows and the communication processes together build up the knowledge flows used for CETK (Laihonen, 2006).

One important feature of knowledge is that it is fragmented and is not possessed entirely by only one individual, company or organization and only separate parts of it are passed on to those concerned (Cooke and Leydesdorff, 2006). Therefore, interaction between all interested actors becomes a vital process for putting the "knowledge puzzle" together. It does not only enable and facilitate the knowledge exchange and transfer. It is actually within the interaction process, combining and recombining different aspects of the knowledge base, when new knowledge is created. Consequently, the contemporary companies exhibit new properties to stimulate CETK (Laihonen, 2006). A small fraction of those are namely intangibility of inputs and outputs; perpetual interaction with customers, suppliers, lead users and other actors; strong interdependence on experts; constant innovation in a form of product line extensions or business models modifications, etc. All this is made with the sole purpose to overcome knowledge asymmetry. These new properties influence organizational efficiency and performance. They exemplify the strong dependency of any company, including SMEs, by activities beyond the individual organization and the increasing significance of collaboration and network structures for CETK (Chua, 2002). It also implies that knowledge flow term is an important concept for any company no matter high-tech or not.

Alike every human activity, innovations are based on CETK. Additionally, the modern way of viewing innovation is as an interactive, iterative process based on tacit knowledge and skills (MacKinnon et al., 2002) which makes its definition as a completely liner process obsolete. As Darroch and McNaughton (2002) point out innovation is a process of knowledge embedding in products, processes and management. Due to the asymmetric nature of knowledge, parts of it are possessed by various agents (Andersson and Karlsson, 2004). It means that there is not a single organization which is in the position to independently develop the winning innovation. On the contrary, in order to overcome this knowledge asymmetry each company needs to interact and collaborate with other interested actors. Within this process, every organization could be described as a bundle of knowledge (Gupta and Govindarajan, 2000) which is combined and recombined with the knowledge of other actors in order to boost up the innovation process. The most common way described in the literature for taking advantage of these various bundles of knowledge is to actively collaborate and create networks with various interested actors.

The research on networks is quite rich, developing the field of study which encompasses many disciplines such as organizational theory and behaviour, strategic management, business studies, public administration, sociology, communications, etc. This is a prerequisite for the existence of variety of definitions of this phenomenon. Despite differences, nearly all definitions imply certain common themes as social interaction (of individuals acting on behalf of their organizations), relationships, connectedness, collaboration, collective action, trust, and cooperation (Provan et al., 2007). Networking also encompasses softer, socialized issues, such as social learning and confidence building through interdependence and sharing of experience (Jack et al., 2010).

In a broad sense, networks for collaboration (NC) are defined as successful organizational structures for the formation, exchange and transfer of knowledge within a specific industry (see, Arbonies and Moso, 2002; Asheim, 2004; Aylward, 2004; Bell, 2005; Bröker et al., 2003; Cappellin, 2003; Cooke, 2003; Orstavik, 2004). Poulymenakou and Prasopoulou (2004) see networks as inter-firm informal collaboration agreements for achieving of common strategic aims within a particular industry. In Bulgaria, The Ministry of Economics introduces the term NC, defining it in similar terms as Poulymenakou and Prasopoulou (2004), as a group of companies and productions related by a common strategic goal within a specific industry (Vanev and Vuchkov, 2006; Paskaleva, 2006; CED, 2005).

NC facilitate the reduction of knowledge discrepancies between less developed industrial enterprises and the other partners in the network. Additionally, participation of industrial enterprises in NC gives them access to scares resources and new markets; reduces costs and shares the risk of new product and process development. It also allows them to maintain costly functions like R&D due to the collaboration efforts within the network. NC are voluntary structures with mutual but fluctuating level of benefits for all participants. They allow the participants to deal with the increasing industrial complexity and the constantly shortening innovation development life cycle. They also provide companies with greater strategic flexibility when facing both minor and disruptive technology changes.

It is believed that the process of CETK is more intensive where there is asymmetry between the abilities and competences of the collaborating companies (Paskaleva, 2006). However, the actors that have mastered the most advanced technology in comparison with the others might have quite a weak incentive to share their knowledge with anyone else (for a discussion see, Sampson, 2007). On the other hand, in its core knowledge is public. Only parts of it can be protected for a limited period of time through patents for example. In addition to that, in case of a disruptive change in the industry, the incumbent companies are usually the ones that first lose their competitive advantage and adapt slowly to the new technology. This implies that any technological advantage of a company might only have a temporary character. Therefore, it is a better option for a company to collaborate for CETK in order to be more flexible and adaptable in case of disruptive changes in the industry. These arguments are part of the learning perspective within the networking literature, i.e. participation in networks provides access to scares information and knowledge recourses that otherwise cannot be obtained and which at the same time improve firms' performance and innovation (Ilinitch et al., 1996; Kale et al., 2000; Kogut, 2000; Oliver, 2001; Powell et al., 1996; Rindfleisch and Moorman, 2001; Rosenkopf and Nerkar, 2001). Within this perspective, researchers argue that inter-firm network structures are not merely benefitting resource acquisition but affect learning and innovation to a large extent (Kogut, 2000; Oliver, 2001; Powell et al., 1996). As Sampson (2007, p. 382) points out "how *much* a firm has to learn and how well a firm is *able* to learn from its partner(s) matter for innovative performance". Most of the empirical studies within this perspective look into high tech-industries and how network collaboration helps high-tech firms to access more diverse sources of knowledge (e.g. Powell et al., 1996).

Despite the big interest in collaboration processes and networking, there is still no agreement when the benefits (learning and innovation activities) for collaborating partners are the highest - when they have relatively similar knowledge base or when they are different but complement each other. Some of the arguments presented are that companies are actually able to interpret transferred knowledge and successfully take advantage of it only if it is close to their existing knowledge base due to their absorptive capacity (Cohen and Levinthal, 1989). As Sampson (2007) points out partners require some sort of common stock of knowledge to utilize knowledge and resources that are not common to both parties. However, the results of this study indicate that firms benefit more from collaboration when they have some, but not all, of the technological capabilities in common with their partners. Diversity between partners is pointed out to be required for stimulating innovation. Otherwise, firms find they have nothing to learn from their partners. The opposite argument suggests that when companies have similar knowledge base, then the CETK strengthen it without actually expanding it, thus diminishing the benefits from the collaboration. No matter if the companies are similar or more complement each other, it is important how much they manage to learn and the quality of the knowledge they have acquired.

The benefits from NC are widely researched and emphasized (e.g. Arbonies and Moso, 2002; Asheim, 2004; Aylward, 2004; Bell, 2005; Bröker et al., 2003; Cappellin, 2003; Cooke, 2003; Orstavik, 2004). Firstly, through the network tacit knowledge, which is believed to give the sustainable competitive advantage to companies, becomes mobile, materializing itself in goods and services that can be sold. Secondly, the structure of NC is both horizontal and vertical, and both have positive influence on growth. Thirdly, through the NC a common cognitive frame is created, which educates all participants while at the same time each actor preserves its identity. Last but not least, there is an emphasis on the innovative process requiring integration and combination of various kinds of knowledge. Besides, the differences between the individual actors are part of the evolution process since the various competences are not static but develop continuously on the basis of interaction and collaboration in the network.

The development of each actor's competences, together with the benefits from NC, depend heavily on the ability to find appropriate partners, to acquire the knowledge related to innovation, and to maintain the relations in the network. Moreover, Cappellin (2003) argues that the more individuals, industrial enterprises, organizations and institutions participate in a unified NC, the larger its economic value and its innovation capacity. Based on this, the NC are viewed as networks of constantly learning organizations using also non-market mechanisms for coordinating their activities with those of other companies and institutions generating knowledge within the frames of a specific industry. Moreover, a special emphasis is laid on mutual trust and social capital (De Wit and Meyer, 2005). NC help to maintain variety, and overcome the lack of flexibility and inertia, while the knowledge flows are much more intensive and turn into a ground for encouragement of innovation, exchange and development of new technologies. The organizations are not just gaining knowledge from the environment. Instead, they generate it as a result from the interaction. For the industrial enterprises participation in those networks is not an alternative but a first strategic choice.

The benefits of NC are significant for SMEs which often have a deficiency of knowledge. As a result, they are trying to obtain access to it through exchange and transfer with other actors. Then combining it with their existing knowledge base new cognitive content is created. This is an interesting aspect of the CETK in the light of innovations in SMEs, as well as the comparison of the latter to the innovations in large organizations. We argue that knowledge flows have an important role for any company, no matter how large it is and in which country it operates. Besides, knowledge is viewed as a process while emphasizing its creation, exchange and transfer through intensive flows. As a result of all this, new knowledge is created when the actors that acquire it, relate it to their own via understanding and interpretation, throughout its exchange and transfer. This is only possible when tacit knowledge is transformed into explicit.

For the purpose of this study the following hypotheses are formulated:

H1: *The industrial enterprises with ECSTFDP in Sweden and Bulgaria use intensive knowledge flows* (*CETK*);

H2: *The degree of interaction and collaboration between industrial enterprises with ECSTFDP and other economic subjects in Sweden and Bulgaria is a key factor for the formation of industrial networks;*

H3: *Innovations and R&D of the industrial enterprises with* ECSTFDP *in Sweden and Bulgaria are influenced in a positive way by CETK and the collaboration between various interested subjects;*

H4: *There are differences between the Swedish and the Bulgarian companies with ECSTFDP concerning CETK;*

H5: *The SMEs demonstrate a higher degree of interaction and collaboration through knowledge flows from the large companies.*

H6: *The size of the industrial enterprises with ECSTFDP, their age and the country of operation, do not have a significant impact on the variables, which have a positive influence on innovations and R&D.*

3. Method

The method used for collecting empirical data is a questionnaire since it has been widely used in the literature about investigating questions related to innovation, collaboration and networking (Manov, 2001). It was divided into five sections each of them marked with a letter – A, B, C, D, E. The first group of questions referred to general information about the company (A) and the second (B) to the market conditions and behaviour of the company. The third (C) asked about innovation activities, R&D and technological strategy of the company and the forth (D) asked about the collaboration and knowledge exchange that the company was involved in. The last section (E) required more information about the respondent who filled the questionnaire. The total number of questions included in the questionnaire was 181. Slightly over 33% of them were included in Section D and were about the collaboration and knowledge exchange that the company was involved in.

It has been sent to the whole aggregate (59 companies) in South Sweden[2] and to 210 companies in North Central and Northeastern regions in Bulgaria[3]. Besides, expert interviews have been used as a widely applied qualitative method in order to complete, compare and clarify the survey results, as well as to provide another point of view and in-depth analysis (Massa et al., 2003).

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[2] South Sweden includes the territories east, west and south of the two biggest lakes in the country – Vänern and Vättern.

[3] For greater clarity, the term Bulgaria will be used interchangeably with *North Central and Northeastern regions of Bulgaria, and South Sweden as Sweden*. See, Paskaleva (2008) for more detailed overview of the questionnaire methodology.

Table 1: Summary of survey data

Phase	Location	Period (month, 2007)	Population Size	Method
1	South Sweden	01-03	59	Survey
2	North Central and Northeastern regions in Bulgaria	05-10	210	Survey
3	South Sweden	02-10	10	Expert in-depth interviews

The main criterion used to form the sample was that the companies should have *ECSTFDP as part of their main activity, according to the Statistical classification of EU economic activities* (NACE), or the National classification of economic activities, respectively, or based on their own view. The response rate for Sweden was 54,24%, and for Bulgaria - 41,43%. For the whole survey the response rate is 44,24%. The data divided by *country* is a mirror reflection for each country with a predominant number of SMEs in the sample (Table 2).

Table 2: Descriptive statistics according to company *size*

Industrial enterprises (no of employees)	Small (0-49)	Medium (50-249)	Large (over 250)	Missing	Total questionnaires
Total (pcs)	65	34	10	10	119
Total (%)	54,62%	28,57%	8,40%	8,40%	100,00%
Bulgaria (pcs.)	45	24	9	9	87
Bulgaria (%)	51,72%	27,59%	10,34%	10,34%	100,00%
Sweden (pcs.)	20	10	1	1	32
Sweden (%)	62,50%	31,25%	3,13%	3,13%	100,00%

Within this study several variables that positively influence R&D and innovation activities of the companies are formulated. However, this study did not attempt to include a comprehensive set of measurers/variables but rather, focused on what an extensive literature study found to be a number of important measures. Every question included in the questionnaire contained sub-questions that together represented a scale measuring a specific variable. The questionnaire contained both closed and opened questions. We used continuous five point Likert-scales for the sub-questions forming the investigated variables. The other questions were either open-ended or close-ended (categorical and with unordered response categories). They were included to provide additional information for each firm and were analyzed with the help of descriptive analysis. Below the main variables that were formulated are described.

Company environment and behaviour (CEBC) was measured by adapting questions from Zahra and Bogner (1999). Respondents were asked about their market approaches, target customers, production systems, nature and intensity of competition as well as different demands that the company had to respond to. This major question (variable) contained 15 sub-questions. It is expected that there will be a positive influence on companies' innovation and R&D activities. It could be explained with the fact that the faster the pace of competition is, the greater the pressure to the company to differentiate itself by introducing new products and processes with different level of newness. Additionally, the more technologically advanced the main customers and suppliers of the company are, the greater the incentive for the company is to be an equal partner in the relationship. This stimulates an intensive learning process for the company enhanced by its customers and suppliers.

Market situation (MSC) was measured by adapting questions by the Third Community Innovation Survey (Ribaille and Durvy, 2004). Respondents were asked about the type of changes in the company environment that occurred, during a three year period (2004-2006). This major question (variable) contained 17 sub-questions. The expected influence on companies' innovation and R&D is positive. If more disruptive changes in the industry occur, only the most flexible companies that innovate and adapt fast in line with the new developments would survive.

Company competences (CKC); innovations and R&D (IDC) measures were based on the work of Aylward (2004) and Zahra & Bogner (1999). Respondents were asked about the type of innovations they are involved in, to compare their competences and innovation activities with their strongest competitors, the ways to acquire technology as well as the availability and the quality of R&D resources. The CKC variable contained 5 sub-questions while IDC variable 18. The expected influence of CKC on companies' innovation and R&D is positive. Many researchers argue that it is actually the high level of company competences, including its employees' knowledge level that positively influences the innovative activity of the company.

Innovation factors (IFC), knowledge sources' frequency and importance (KSC), places for knowledge exchange (PKEC) were measured by adapting questions from the Third Community Innovation Survey (Ribaille & Durvy, 2004) as well as from Zahra (1996) and Wei, Zhu and Wang (2005). The questions presented lists with innovation factors (12 sub-questions), knowledge sources (26 sub-questions) and places for knowledge exchange (10 sub-questions) that the respondents had to rate on a five point Likert-scale. Recently, with the development of concepts such as open innovation and crowd sourcing, it is evident that sources and places for knowledge exchange have an important positive relationship to innovations activities.

Collaboration factors (CFC) and collaboration with competitors (CCC) were measured by adapting questions from the Third Community Innovation Survey (Ribaille and Durvy, 2004, and Karlsson et al., 2004). Respondents were asked about the nature of the collaboration with the competitors (5 sub-questions) as well as to rate different factors that stimulate the collaboration (9 sub-questions). The expected influence of CFC and CCC on companies' innovation and R&D is positive. Recent literature on innovation management preaches that knowledge has a fragmented character and it is impossible for one single company to develop a successful innovation without cooperating with different interested actors including competitors in order to manage the "knowledge puzzle".

The firm age was examined, because the younger the company is, it may be more open and willing to perform knowledge creation, exchange and transfer. Additionally, age is also associated with resource availability (Casillas and Acedo, 2005). Age was measured by the number of years that the firm had been in existence.

Table 3: Results from scales internal reliability analysis

Variable/Main question	Abbreviation	Cronbach's Alpha	No of sub-questions	Influence on dependent variable
Company competence (independent variable)	CKC	0,688	5	(+)
Company environment and behavior (independent variable)	CEBC	0,747	15	(+)
Market situation (independent variable)	MSC	0,75	17	(+)
Company innovations and R&D (dependent variable)	IDC	0,801	18	
Innovation factors (independent variable)	IFC	0,878	12	(+)
Knowledge sources - combined (independent variable)	KSC	0,893	26	(+)
Collaboration factors (independent variable)	CFC	0,876	9	(+)
Collaboration with competitors (independent variable)	CCC	0,551	5	(+)
Places for knowledge exchange (independent variable)	PKEC	0,835	10	(+)

With the help of SPSS, a reliability test has been carried out, used to determine the scales internal consistency, i.e. how much free of errors every scale is (Manov, 2001). Following the recommendations of Nunnally (1978), a minimum level of 0,7 of Cronbach's quotient ά for each scale is needed to be able to define it as reliable and to include it in the subsequent analysis (in Pallant, 2005). This quotient shows the average correlation between all questions that form the scale, i.e. to what extent each one measures the variable set. In the present survey seven variables (main questions with respective sub-questions/scales) in total have a proven internal reliability and compatibility with values of Cronbach's quotient ά over 0,7. The sub-questions they consist of can be claimed as reliable scales with the sample surveyed. The results from the test for reliability of scales are shown in Table 3. Only two of the variables do not demonstrate internal compatibility of the scales according to the reliability test – *competences of the company* (CKC) and *collaboration with the competition* (CCC). Nevertheless, as Pallant (2005) points out, the values of Cronbach's quotient ά are influenced by the number of sub-questions included in the scale and demonstrate tendency to lower outcome when the questions are fewer than ten. Following the recommendations of Briggs and Cheek (1986), using SPSS the mean inter-item correlation values show that CCC and CKC have reliable scales (in Pallant, 2003).

After the above performed analysis, we computed the means of all sub-questions forming each main question, thus nine main variables (quality parameters) were constituted describing the knowledge flows of the companies with ECSTFDP – CKC, CEBC, MSC, IDC, IFC, KSC, CFC, CCC, PKEC (the abbreviations correspond with those included in Table 3). The variable KSC was formed by combining the scales of the sub-questions describing the importance and the frequent use of the knowledge sources exploited in the of ECSTFDP in order to reduce the number of variables in the analysis.

4. Results

4.1 Industry - ECSTFDP

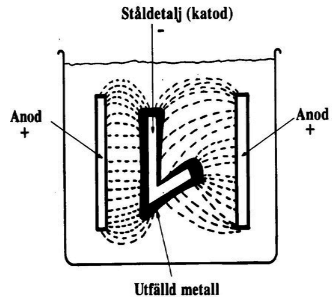
ECSTFDP's main production process is one of chemical and electrochemical conversion, electrolytic metal coating, and chemical coating, in which an electric current is fed through a solution containing dissolved metal ions and a metal object (Fig. 1). The latter serves as the cathode in an electrochemical cell, attracting ions from the solution (Regenstein, 1996). The anod can be inert or made of the coating material, e.g. zinc. It gradually dissolves in the solution.

Various parts are plated with a wide range of metals such as aluminum, brass, bronze, cadmium, copper, chromium, gold, iron, lead, nickel, platinum, silver, tin, and zinc. As Jan Skogsmo[4] explains (SYF Conference in Elmia, Jönköping, 16.11.2006), it needs a robust quality control throughout the whole process (voltage and amperage,

[4] Chairman of Svensk Ytbehandlings Förening (SYF)

temperature, residence times, concentration and purity of bath solutions, pH etc.). Additionally, competent knowledge (thickness of the layer needed, colour and brightness, alloys, hardness, friction etc.) is essential. Mutual collaboration between the producer (electroplater), the customer (exchange of information about the requirements for corrosion protection, appealing outlook, wearing out protection etc.) and the chemical suppliers (the right quality of the chemicals at the right time) also need to be in place.

Figure 1: The main production process in ECSTFDP



Source: Svensk Ytbehandlings Förening (SYF)

Parallel with the production process, strict environmental standards and requirements should be followed and kept. Moreover, the price is directly connected with the quality and determines the process to be used.

4.1.1 Main customers and target markets

Nowadays, the finishing offered by ECSTFDP is very common. The European Committee for Surface Treatment (CETS, 2006) has stated an approximate market structure of ECSTFDP consisting of automotive 22%, construction 9%, food and drink containers 8%, electrical industry 7%, electronics 7%, steel semis (components for other assemblies) 7%, industrial equipment 5%, aerospace 5%, others 30%. As Jan Skogsmo explains on a SYF Conference in Elmia, Jönköping (16.11.2006), this is mainly due to the fact that the surface of the metal products is altered, enhancing their corrosion resistance, electrical conductivity, reflectivity and appearance (e.g., brightness or colour), torque tolerance, solder ability, tarnish resistance, chemical resistance, ability to bond to rubber, hardness, wear resistance, etc. A product's life will be much shorter without the surface treatment that ECSTFDP provides. Moreover, as British Surface Treatment Suppliers Association (BSTSA) stated in 2007, the ECSTFDP is in the right direction of preserving raw materials and natural resources, protecting the environment and saving energy wherever possible, as it uses thin layers of just a few microns that are deposited onto base materials. The importance of ECSTFDP can be illustrated with the fact that each car contains over 4000 surface treated components, including body panels, while an Airbus aircraft contains over two million (CETS, 2006).

According to the "European Business. Facts and Figures" (2006) only a small part of the output of the metal products sector reaches the final customers directly (e.g. household tools, cutlery) and consequently, the biggest share of the output is delivered to other industries (business-to-business setting). The biggest competitors in ECSTFDP on the European market are German, Italian, French, English, Slovenian, Spanish and Swedish companies (Eurostat, 2006). As ECSTFDP serves several major manufacturing areas, there is a high concentration of customers in some areas (such as the automotive industry in Sweden) with highly competitive markets, and surface treatment overcapacity (CETS, 2006). A small number of companies are large enough to serve more than three or four industry types. Consequently, they specialize in certain surface treatment types. Moreover, the companies operating in the ECSTFDP are mostly comprised by SMEs (CETS, 2006).

In Sweden there is a decrease in the number of companies in ECSTFDP following the overall international trend for decrease of the number in favour of the size as opposed to the situation in Bulgaria where there is an increase (Askengren and Clarin, 1991). This is also supported by the fact that there has been a loss of engineering manufacturing in Europe, largely to Asia, which has caused a decrease in the industry by over 30 % in recent years (CETS, 2006). However, neither the Swedish nor the Bulgarian ECSTFDP companies have entirely followed this trend as the majority of the companies are SMEs (Jan Skogsmo, SYF Conference in Elmia, Jönköping, 16.11.2006). Compared with the European competitors in ECSTFDP which have more than 100 employees, the Swedish and Bulgarian companies are predominantly much smaller (Askengren and Clarin, 1991).

Both the questionnaire results and the expert interviews showed that companies with ECSTFDP generate their sales on national (average value 43% of the sales) and regional markets (average value 34% of the sales), while only 23% of the sales are realized on international markets. This trend is valid both for Sweden and Bulgaria. The main markets and their relative share in the sales are investigated as they are considered to be a key parameter of innovation activity (see, Beise-Zee and Rammer, 2006). The predominantly national markets for the companies are not considered to be an obstacle for their CETK and innovation activities since their production is concentrated in specific regions which are close to the biggest customers. For the companies with ECSTFDP in Sweden, for example, Volvo, Scania, etc., the concentration of automobile industry predetermines the low level of export activities which emerges from the survey results too. Besides, the industrial enterprises with ECSTFDP do not manufacture end products but supply plated components, which are assembled or fitted (for example in automobiles). After that they are exported. This explains the fact that the results regarding export of the companies are not high.

4.1.2 Innovations and R&D

The intensity of R&D and the expenses incurred are considered to be another reliable index for the intensive knowledge flows and innovation activities of the companies (see Wei et al, 2005). The expert interviews show that innovation plays an important role for ECSTFDP. The majority of experts argue that it is the new processes together with consistent quality levels that account for the security and long term relations with customers. The orders are not redirected to countries with lower production and labour costs like China. The experts point out that innovation is necessary to meet increased environmental regulations and the ensuing ban on some of the existing processes. The new process development is also seen as a mean boosting the growth of ECSTFDP.

In the sample, the majority of the companies (42,86%) invest between 1% and 5% annually, while just 4,20% of the respondents invest over 21% per year, all of them being from Bulgaria. An average of 51,48% from the top managers are involved in R&D and innovation. Additionally, the middle, functional and other management levels are involved in R&D considerably less – average for each level 20,85%, 6,80% and 7,94%, respectively. The results are a mirror reflection for both countries surveyed. The explanation for this is the prevailing SMEs in the sample which have deficiency of resources for R&D investment. In relation to the expenses for R&D and product differentiation for the period 2004-2006, experts argue that the sum allotted annually from the company budgets for this purpose has increased. They explain this mainly with the changes in industrial production and the increased regulatory requirements for environmental protection.

Collaboration with customers, followed by competitors and suppliers, is indicated as the main factor stimulating innovation and R&D activities. The experts point out that the size of the company affects this process considerably because the smaller the company is, the harder it proves to be for it to influence its customers. The tendency in the last 20 years has been for major manufacturing companies to gradually assign the surface treatment to affiliated suppliers as it was not part of their core competences and main business. This led to loss of knowledge and competence regarding surface treatment processes. Nevertheless, the common way of working is that customers provide specifications and technical requirements for the surface treatment. According to the experts, the customers possess neither the competences necessary for the active selection of an appropriate process, nor the knowledge to create viable assignments. That is why they usually copy old specifications. For this reason, the unification of companies and other interested actors in a singular organization like SYF is crucial. It will have the role of a "mediator" between all interested parties and facilitate their learning about ECSTFDP. The respondents also highlight additional factors favourable for innovation and R&D activities such as EU environmental requirements; government financing and support; favourable interest rates; reduced bureaucracy. Furthermore, vital are the collaboration with universities for the development of competences as well as the creation of technologies in the countries themselves (in this case Sweden and Bulgaria), instead of buying those from other countries (namely, from Germany, Italy, the USA).

For the time being, there is not a universal plating process, applicable to various parts and meeting all requirements, which can be a “quick fix” solution to production challenges of all kind. Therefore, another important aspect is the involvement of ECSTFDP companies in their customers’ new product development (NPD) from the very beginning of the process - idea screening. That is how they can contribute to the selection of the optimal shape for the surface treatment, which will guarantee the quality (i.e. integrated design of parts, technologies and production tools). According to the experts, this happens much later (testing and validation stage) when the development process is finalized by the customers’ R&D units. It poses potential quality problems during the full scale production as in most cases there is insufficient or even lacking knowledge about the available surface treatment types and requirements which can secure the quality.

The expert interviews show that there are four types of innovations in ECSTFDP. The first type is *new processes* developed on the due to increased environmental protection requirements. They also include improvement in the water treatment facilities. The second type is *organizational innovations* related to providing complete logistic solutions and quality customer service. They are evoked by the desire of the companies to add value to their products and provide complete service package to their customers. The third type is *other new processes* induced by the requirements of the large customers due to the change in their industrial production and the latest technological development. The fourth type is *changes in the equipment currently used* aimed at achieving better control and reducing the production costs. The experts emphasize all innovations are perceived as new in Sweden and Bulgaria, but are not new to the world developments.

The results from the survey, confirmed also by the expert interviews, show that companies with ECSTFDP are relatively active in the market launch of new or improved products for the period under investigation. This is due mainly to the specific characteristics of ECSTFDP, for which a new type of plating with different properties or improved quality can be introduced into production only through the change of chemical substances and voltage, without any replacement of existing equipment. This is supported by the statement that at least one new process is introduced annually, mostly in collaboration with the suppliers of chemicals (interview with Mr. Schimanke[5], on 2007.03.25.). The high results found for the independent development of innovations are attributed to the organizational innovations for adding value to the products and providing better customer service, as well as using equipment for a comprehensive control over the production and reducing the costs.

In addition to the expert interviews, the innovations and R&D in the companies were investigated through the questionnaire looking at a period of three years (2004-2006). The majority of respondents (77,4%) have chosen *Agree* or *Strongly agree* for the statement that there is technological development in ECSTFDP. Around 58% declare that

[5] Owner of a family controlled company

improvements/modifications of existing products have taken place. 51,2% have offered new or improved products/services and processes, while 50,4% even estimate that all innovations in the company have been developed independently. Most of the surveyed companies (33,6%) are self-confident and declare that they have presented a greater number of new products faster than their biggest competitors. Only a small number of the respondents (6,7%) have waited for the competition to introduce a new product and then copy it. In accordance with the findings from the expert interviews, 35,3% of the companies use advanced technologies as the main strategy to defend their existing markets. It supports the finding that 50,4% have developed innovations mostly independently. This predicts the findings that the skills for creating new products, services and processes are assumed as excellent by 42,9%. On the other hand, a smaller percentage (31,10%) of the respondents have chosen *Agree* or *Strongly agree* for the statement that all innovations in their companies have been developed in collaboration with other companies. Followed by 33,60% of the respondents who have bought technologies; 12,60% have acquired other enterprises, and 22,70% who have used license agreements for access to new technologies.

4.1.3 Collaboration

The collaboration with the competition is an important factor for the intensive flows of knowledge, i.e. CETK. It is one of the strengths of the SMEs which are trying to overcome the shortage of resources through collaboration with other companies. In addition to this, Askengren and Clarin (1991) state that ECSTFDP is dependant on external knowledge. It means that all companies have to facilitate the knowledge flows and collaboration as a tool to compete with the European competitors. This would allow introduction to new methods and products as Jan Skogsmo stated. There are examples of companies that work tightly together and have an intensive CETK. The representatives of the ECSTFDP companies described them *as "friendly (close) companies"* (J. Skogsmo and B. Schimanke, SYF Conference in Elmia, Jönköping, 16.11.2006). However, the collaboration levels were not at the level as SYF believed should be. The expert interviews show that collaboration between competitive companies is extremely rare and depends to a large extent on the personal contacts and trust between the industrial enterprises. Some of them even define it as "mission impossible", but point out that the increased unity of action can turn into strength for ECSTFDP. The collaboration between companies with ECSTFDP and chemical suppliers is much more common due to the availability of resources for R&D.

The respondents perceive the achieved technological development level as the most important factor for collaboration (73,10% - *important* and *very important*). It is followed by reducing the costs for production; new products and new knowledge acquisition (71,50%) and trust and amicable relationship between top managers (69%). To a lower extent influence have larger benefit than the costs invested for collaboration (66,40%); the state of material and non-material infrastructure (63,90%); similar professional jargon

(63,8%) and opportunities for frequent personal meetings (56,30%). Technological superiority of the potential collaborating company (44,50%) and the physical distance between the partner organizations (30,30%) are seen as less important factors.

There is notable difference between the two countries regarding the factors influencing collaboration. In the Scandinavian country, managers prioritize the achieved technological development level, trust and friendship as well as the opportunities for frequent meetings. It illustrates the significance of social networking and personal relations. On the other hand, what matters most in the Balkan country is the opportunity to reduce the production costs, as well as the costs for new products and knowledge; the level of achieved technological development and a greater outcome from the resources invested.

4.2 Statistics

First, there is an effort to determine the relationship between the innovative activity in the industrial enterprises, the degree of interaction and collaboration through knowledge flows between various actors in the companies with ECSTFDP in Sweden and Bulgaria. Therefore, the relations between the variables are investigated using a linear correlation quotient – r. The investigation started with the calculation of these relationships for the entire sample (H1). After that, the sample was divided in two, based on a certain indication (1. the country where the company is operating, and 2. the size of the company), in order to determine the differences in the two cases (H4 and H5).

The results show a weak ($r = 0.10$ to 0.29), average ($r = 0.30$ to 0.49) and strong ($r = 0.50$ to 1.0) positive correlation between the variables under investigation. The only variables without statistically significant correlation between each other are the market situation (MSC) and the collaboration with the competition (CCC). This finding is somehow puzzling. From a theoretical point of view, the results were expected to show a correlation between MSC and CCC. The latest research indicates that the more dynamically changing the industry and the market situation are, the more intensive the collaboration between competing companies becomes. Therefore, an explanation for this finding might be that ECSTFDP is a mature industry where the market situation is not so dynamic. Another explanation might be that the questionnaire is a self reported form, i.e. the managers of the companies fill it in based on their own perceptions which might not be the most objective ones.

The strongest positive correlation is between *knowledge sources* (KSC) and *innovation factors* (IFC). The latter are also strongly influenced by the collaboration factors (CFC), the environment and behaviour factors (CEBC) of the industrial enterprises with ECSTFDP. CEBC is strongly influenced by the innovations and R&D (IDC), as well as the collaboration factors (CFC).

Table 4: Linear correlation quotient, *general*

Variable	Pearson correlation								
	CKC	CEBC	MSC	IDC	IFC	KSC	CFC	CCC	PKEC
CKC		,464(**)	,202(*)	,350(**)	,273(**)	,459(**)	,240(**)	,225(*)	,268(**)
Sig. (2-tailed)		,000	,028	,000	,003	,000	,009	,015	,003
CEBC	,464(**)		,375(**)	,535(**)	,508(**)	,477(**)	,549(**)	,402(**)	,433(**)
Sig. (2-tailed)	,000		,000	,000	,000	,000	,000	,000	,000
MSC	,202(*)	,375(**)		,442(**)	,207(*)	,308(**)	,232(*)		,434(**)
Sig. (2-tailed)	,028	,000		,000	,025	,001	,012		,000
IDC	,350(**)	,535(**)	,442(**)		,351(**)	,443(**)	,445(**)	,393(**)	,493(**)
Sig. (2-tailed)	,000	,000	,000		,000	,000	,000	,000	,000
IFC	,273(**)	,508(**)	,207(*)	,351(**)		,593(**)	,586(**)	,281(**)	,357(**)
Sig. (2-tailed)	,003	,000	,025	,000		,000	,000	,002	,000
KSC	,459(**)	,477(**)	,308(**)	,443(**)	,593(**)		,527(**)	,458(**)	,542(**)
Sig. (2-tailed)	,000	,000	,001	,000	,000		,000	,000	,000
CFC	,240(**)	,549(**)	,232(*)	,445(**)	,586(**)	,527(**)		,362(**)	,238(**)
Sig. (2-tailed)	,009	,000	,012	,000	,000	,000		,000	,010
CCC	,225(*)	,402(**)		,393(**)	,281(**)	,458(**)	,362(**)		,435(**)
Sig. (2-tailed)	,015	,000		,000	,002	,000	,000		,000
PKEC	,268(**)	,433(**)	,434(**)	,493(**)	,357(**)	,542(**)	,238(**)	,435(**)	
Sig. (2-tailed)	,003	,000	,000	,000	,000	,000	,010	,000	

n = 119

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

A strong positive correlation has also been detected between KSC, *places for knowledge exchange* (PKEC) and *collaboration factors* (CFC). It is essential that the variables researched have a minimum of average positive correlation with the company innovations and R&D. All registered weak, average and strong correlations are interesting because they confirm the studied variables are part of a process, i.e. they are not necessarily independent of each other.

The correlation quotients have been re-calculated after the data have been divided by *company size* and *country* (H4 and H5). Concerning *company size,* the analysis has determined that the number and strength of correlations between the variables is greater for SMEs than for large companies. Most correlations determined for SMEs are positive average, followed by strong and weak positive correlations. These results are identical with the general case, where the average correlations are predominant. For the big companies the correlations calculated are only strongly positive. Their number is much smaller compared to that of SMEs, with the biggest impact of KSC and CKC, and the strongest positive correlation between KSC, IFC and CFC. For SMEs the most important variables are CEBC, MSC and IFC, and the strongest positive correlation is between CEBC and CFC. Concerning innovations and R&D (IDC), in SMEs they are strongly influenced by CEBC, MSC, and PKEC. On the other hand, CKC, KSC, CFC, and CCC have only average influence of R&D and innovations. The smallest influence is determined for IFC. For the large companies the companies' R&D and innovations do not show any correlation to the other variables. These results could be explained by the fact that SMEs have a simplified structure; they rely on mutual trust and have fewer resources available, which force them to search actively for ways to get access to missing information, knowledge and resources. The great number of positive correlations is an indication that SMEs exploit various mechanisms, when their R&D and innovation activities are concerned. This reveals the great extent to which SMEs rely on the knowledge flows, i.e. CETK (H5). This in itself suggests that there are conditions for collaboration and networking.

Notably, when calculating the correlations based on *country,* their number for Swedish companies is much smaller, compared to the number of Bulgarian ones (H4). Besides, they are only average and strong, with the average correlations prevailing. Concerning the Bulgarian enterprises, the correlations prevailing are average positive, followed by strong and weak. It is specifically noted that the innovations and R&D (IDC) in the Swedish ECSTFDP are strongly influenced by CKC, CEBC and less by CCC and PKEC. In Bulgaria, the variables influencing IDC are CEBC, CFC, CCC, and to a smaller extent, MSC, IFC, KSC. In both countries the *collaboration with the competition*, environment and company behaviour prove to be essential for ICD. The strongest positive correlation among the variables for the Swedish companies is between *sources* (KSC) and *places for exchange of knowledge* (PKEC), while for the Bulgarian companies it is between the *innovation factors* (IFC) and the *sources of knowledge* (KSC).

The above-mentioned results necessitate the investigation of the relation between CETK, company innovations and R&D, i.e. how well CKC, CEBC, MSC, IFC, KSC, CFC, CCC and PKEC stipulate IDC in the sample surveyed. It is important to define the variables which best predetermine IDC.

A *standard multiple regression* has been carried out for the whole sample (both countries) among *company innovations* (IDC) as a dependent variable and *company competences* (CKC), *environment* and *company behaviour* (CEBC), *market situation* (MSC), *innovation factors* (IFC), *knowledge sources* (KSC), *collaboration factors* (CFC), *collaboration with competition* (CCC) and *places for exchange of knowledge* (PKEC), all of them like independent variables (H3).

The analysis shows that 40,7% of the variations of IDC (Adjusted R square) = 0.407, significance (sig) = 0,000) is determined by CKC, CEBC, MSC, IFC, KSC, CFC, CCC and PKEC (Table 6 and Table 7). In the present survey the recommendations of Tabachnick and Fidell (2006) have been followed and the adjusted determination quotient (adjusted R Square) is reported instead of the determination quotient (R square), since it provides a more realistic idea of the relevance between the regression model used and the sample surveyed. The values of the determination quotient (R-square) in most cases are too optimistic about the relevance of the regression model used (Pallant, 2005).

Table 6: Model summary (b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,670(a)	,449	,407	,43978

a Predictors: (Constant), PKEC, CFC, CKC, MSC, CCC, IFC, CEBC, KSC

b Dependent Variable: IDC

Table 7: Model summary (b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16,697	8	2,087	10,792	,000(a)
	Residual	20,501	106	,193		
	Total	37,198	114			

a Predictors: (Constant), PKEC, CFC, CKC, MSC, CCC, IFC, CEBC, KSC

b Dependent Variable: IDC

Table 8: Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,119	,406		-,293	,770
	CKC	,099	,081	,107	1,232	,221
	CEBC	,213	,123	,180	1,726	,087
	MSC	,250	,104	,199	2,402	,018
	IFC	-,029	,078	-,038	-,379	,706
	KSC	-,011	,113	-,011	-,098	,922
	CFC	,170	,081	,211	2,088	,039
	CCC	,045	,038	,103	1,188	,237
	PKEC	,190	,082	,224	2,311	,023

a Dependent Variable: IDC

The greatest contribution to predicting IDC (the dependent variable) is made by PKEC (standardized coefficient β = 0,224). A smaller contribution is made by CFC, MSC, CEBC, CKC, CCC. Regardless of this, only PKEC, CFC and MSC have a unique statistically significant contribution (sig. < 0,05) for predicting the company innovations in the companies with ECSTFDP (Table 8). It is important to note that the values of standardized coefficient β show the average standardized unit change of the dependent variable as a result of the one standardized unit change of the respective independent variable (Manov, 2001).

The next step of the regression analysis is to test whether the selected set of independent variables will foresee the variation of IDC to a great extent if the possible effects of the company's age and its size in the country of its operation are controlled (H6). This is executed through the so-called hierarchical multiple regression analysis. The results show that after the variables for *company age, size and country of operation* are controlled for, the model accounts for 2,3% (Adjusted R Square = 0,023) of the variation (0,023x100). After introducing the remaining factor variables (CKC, CEBC, MSC, IFC, KSC, CFC, CCC and PKEC), the model as a whole accounts for 39,8% of the IDC variation (Adjusted R square) = 0.398, significance (sig) = 0,000). All independent variables account for 39,8% (0,398x100) different from the variation of IDC (change of determination quotient (R Square changed) = 0,398, significance (sig) = 0,000), even when the effects of *company age, their size and the country of their operation* are controlled statistically. This is a statistically significant contribution as the value change for sig. F (0,000) shows (Table 9). As a whole, the model including all independent variables (*company age, size and country of operation*, CKC, CEBC, MSC, IFC, KSC, CFC, CCC and PKEC) is significant [F(11,90)=7,066, sig. 0,000].

Table 9: Model summary (c)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	,227(a)	,052	,023	,56473	,052	1,778	3	98	,156
2	,681(b)	,464	,398	,44321	,412	8,638	8	90	,000

a Predictors: (Constant), Number of employees today working 35 hours or more per week, Country, Company age

b Predictors: (Constant), Number of employees today working 35 hours or more per week, Country, Company age, CFC, PKEC, CKC, CCC, IFC, MSC, CEBC, KSC

c Dependent Variable: IDC

The uniquely statistically significant contributions of the independent variables repeat the results of the standard multiple regression even when the effects of *company age,* are controlled, with the exception of the PKEC factor. The latter has no statistically significant contribution to foreseeing IDC, if *size and company age,* as well as *country of operation* are taken into account. This shows that the market situation (MSC, standardized coefficient β = 0,251) and the collaboration factors (CFC, standardized coefficient β = 0,237) have a statistically significant effect on innovations and R&D of industrial enterprises irrespective of the country of operation, their size and age.

Table 10: Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2,753	,273		10,087	,000
	Company age	-,003	,002	-,130	-1,178	,241
	Country	,111	,140	,087	,798	,427
	Number of employees today working 35 hours or more per week	,000	,000	,152	1,491	,139
2	(Constant)	,040	,469		,084	,933
	Company age	-,001	,002	-,074	-,820	,414
	Country	-,153	,137	-,119	-1,121	,265
	Number of employees today working 35 hours or more per week	,000	,000	,105	1,254	,213
	CKC	,107	,089	,115	1,207	,231
	CEBC	,153	,140	,130	1,093	,277
	MSC	,316	,137	,251	2,297	,024
	IFC	-,029	,084	-,038	-,349	,728
	KSC	,017	,123	,017	,136	,892
	CFC	,191	,089	,237	2,136	,035
	CCC	,047	,042	,108	1,132	,260
	PKEC	,163	,092	,192	1,761	,082

a Dependent Variable: IDC

5. Conclusion

Contemporary environment makes the traditional way of viewing an organization obsolete. Instead, it is seen as constituted of knowledge bundles, constantly in motion, in an attempt to address knowledge asymmetry and get access to parts it doesn't possess. Consequently, companies are impregnated with intensive knowledge flows (CETK) and actively network. Our research showed that, this alternative view is not dominantly valid only for knowledge-intensive, high-tech organizations, but also for companies from a rather mature industry – ECSTFDP.

The present study is provoked by the identified gap in the field of knowledge flows for collaboration and innovation, i.e. neglecting the low-tech industries as object of empirical research. We believe that our main contribution is addressing this gap. Additionally, we perform an international comparison between two European countries: Sweden and Bulgaria. The first one has an extensive R&D spending as a percent of Gross Domestic Product (GDP) as opposed to Bulgaria. Furthermore, to our knowledge, there is no empirically grounded article within this field which investigates Bulgarian companies, their competitive behaviour, perception of and participation in networks for collaboration and innovation. This is also seen as one of our main contributions. What is more, this research is perceived as beneficial and needed by industry representatives which further enhances its value. The industry experts have already identified collaboration and networking as vital but something that they need further understanding about. As Jan Skogsmo says "the industry needs appropriate competence and a long lasting mutual collaboration". All this makes our study both theoretically and practically relevant.

In the business-to-business context in which ECSTFDP operates a high interdependence between all actors was revealed. The SMEs dominate in the industry. They actively try to compensate their knowledge deficiency by building on their strengths in order to facilitate all knowledge flows and networking for innovation. Compared with large companies, SMEs display a higher tendency for interaction and collaboration through knowledge flows, especially with respect to R&D and innovations, which is a prerequisite for networking. Our findings also revealed that managers have realized the importance of collaborating but still predominantly follow their usual practices to handle problems and challenges on their own.

In this study nine variables were identified in order to get a better understanding of the companies' knowledge flows for collaboration and innovation. Innovation and R&D activities turned to be correlated with different variables for each of the studied countries. The Scandinavian companies put priority to company competences and the environment in regards to their CETK for innovation. On the other hand, the Bulgarian companies are influenced foremost from the environment and claim to collaborate with their competitors. For them, the collaboration factors also have significant role for CETK. All other identified variables turned to have much weaker influence in relation to innovation and R&D activities.

Companies with ECSTFDP undertake mostly process innovations in collaboration with their suppliers. They also introduce organizational innovations in an attempt to increase the value added for their customers. Our regression analysis showed that innovation and R&D in both countries (i.e. for the whole sample) can be predicted by the set of eight variables even when the size and age of the enterprises, as well as the country of operation, are controlled. Namely, company competences (CKC), environment and company behavior (CEBC), market situation (MSC), innovation factors (IFC), knowledge sources (KSC), collaboration factors (CFC), collaboration with competition (CCC) and places for exchange of knowledge (PKEC).

Innovation and R&D are positively, statistically significant, affected by places for knowledge exchange followed by collaboration factors and market situation. Furthermore, our study showed that the key variables influencing innovation and R&D activities do not change (except places for knowledge exchange) when the size and age of the enterprises, as well as the country of operation, are controlled. However, the factors for collaboration and interaction (CFC) between various interested actors are the most important for increasing the innovation activity for companies with ECSTFDP, irrespective of size, age and country of operation. It shows presence of conditions for establishment of a network for collaboration and innovation. It also reveals the vital role of the social element in the CETK, which is also emphasized in the knowledge management literature. Moreover, it illustrates that companies are influenced by the number of factors in this collaboration and actively evaluate the trade-offs from it. Additionally, the dynamics of the market are setting the pace and degree of newness of innovation and R&D activities, so the above mentioned results do not come as a surprise.

In summary, in the studied context intensive knowledge flows are effectual for all companies no matter the size, country and the type of industry they operate in. Furthermore, SMEs have strong advantages that facilitate the knowledge, creation, exchange and transfer. Thus, a better understanding of their knowledge flows can help them organize their knowledge base in a sustainable way, enhancing their knowledge activities in order to survive in a highly competitive environment.

The above findings provide new insights and new avenues for research of knowledge creation, exchange and transfer, related to innovation and collaboration, in a mature, low-tech industry. It could be used as the first step to understand if, how and why networks emerge within this specific context. Future research could examine the transformation and the change processes of networks, i.e. how they develop over time and support growth. Moving beyond this study's single point of time results, future research can longitudinally explore these processes and existing trends in different contexts, similarly to Hagedoorn (2002). Additionally, specific aspects such as technological diversity and organizational forms of the collaboration could be investigated, providing data for comparisons with the results from already existing studies in other empirical contexts such as, for example, Sampson (2007). Furthermore, data from other mature, low-tech industries can add to the generalizability of the findings.

As for the limitations of this study, the major one is that self-reported data from CEOs or senior company managers was used as they sometimes tend to report too positive or overestimated information (Biazzo and Bernardi 2003). Another limitation was that we did not investigate any variables that were connected with the companies' intangible resources (e.g. corporate culture) and their relationship to CETK. These can intensify or hamper the knowledge creation, exchange and transfer, thereby influencing the companies' innovation activities and competitive advantage. We limited ourselves on purpose as our questionnaire was already too long and we wanted to keep the feasibility of its completion. However, investigating these aspects may provide new avenues of future research and contribute to the better understanding of CETK in a mature industry.

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