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# 2. Impact of industrial knowledge base on knowledge sourcing: the case of printing industry

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*Latest researches that investigate the creation, diffusion and utilisation of economically useful knowledge go beyond questions like how much resources need to be invested to these processes by enterprises and what the result of these investments are. The objects of analysis have been shifted to issues like how knowledge creation, diffusion and utilisation actually take place at firm level, what kind of characteristics could be observed in this process and how much do the outputs contribute to the performance of firms, sectors and regions. Several theoretical frameworks have been developed to answer these questions from which the differentiated (analytical, synthetic, symbolic) knowledge bases theory seems a prevailing one. Hitherto the approach has been mostly used in developed countries yet it seems an appropriate framework to analyse the creation, diffusion and utilisation of industry specific knowledge and its spatial aspects at the same time in less developed countries like Hungary.*

*In the present paper we apply this framework to investigate the local printing industry in Kecskemét (Hungary) presumably characterised by synthetic knowledge base mainly. The aim is to unfold and analyse the characteristics of knowledge flows in the industry and to explore whether the revealed pattern is in line with the theory. Therefore the following questions are addressed: what is the main geographical scene of knowledge acquisition, what are the main sources of new knowledge and who are the main partners in the knowledge sourcing process. Evidence proof theory-led expectations, and reveal the relevance of direct knowledge sources, the importance of co-localization and the dominancy of engineering-based knowledge in the industry.*

*Keywords: knowledge flow, knowledge base, printing industry, Hungary*

## 1. Introduction

Alongside the growing knowledge-based economy and the increasing economic globalisation, there has been a higher interest in analysing industrial knowledge flows and exploring firms' competitive advantages on the one hand, and investigating industrial and regional interdependencies and their impacts on firms' knowledge acquisition activities on the other hand. Some notable conceptual frameworks addressing these issues are the theory of innovation milieu (Camagni 1991), the concept of learning regions (Florida 1995) and the approach of innovation systems (Lundvall 1992, Cooke et al. 1998).

These approaches no longer address questions like how much resources need to be invested to the creation, diffusion and utilisation of economically useful knowledge and what the result of these corporate investments are. The current issue is that how these activities

actually take place at firm level, what kind of characteristics could be observed and how much do the outputs contribute to the performance of firms, sectors and regions.

An increasing interest has been directed likewise towards the assumption that industrial knowledge and capabilities, i.e. industrial knowledge bases (Dosi 1988) describe the different knowledge acquisition patterns on firm and industrial level, and explain the spatial distribution of industrial players. Moreover, industrial knowledge base not only determines the industrial behaviour - how economically useful knowledge is generated, distributed and exploited - , but also the economic performance of regions, where the industrial actors are located.

Industrial knowledge bases, which dominate different industries, are classified by Asheim and his co-authors (Asheim – Gertler 2005, Asheim et al. 2007, Asheim et al. 2011) to three different ideal types: analytical, synthetic and symbolic knowledge base. The concept of differentiated knowledge bases takes both industrial knowledge and spatial aspects of knowledge flows into account. Nevertheless, the theory has been developed mainly on the bases of case study analysis from developed economies, and primary research approaches have been published only in the last few years. Owing to this their number is very small.

Therefore, the present paper aims at applying this framework to shed light on the patterns of knowledge flows in the local printing industry of Kecskemét in Hungary presumably characterised by mainly synthetic knowledge base. The objective is to unfold and analyse the characteristics of knowledge generation, diffusion and utilisation and to explore whether the revealed pattern is in line with the theory. Therefore, the study focuses on the following main questions: what is the main geographical scene of knowledge generation, diffusion and acquisition, what are the main sources of new knowledge and who are the main partners in the process of knowledge sourcing.

The paper is organized as follows. In the first part the conceptual framework of differentiated knowledge bases is presented. Then the second part aims at introducing the case and the methodology. The results, which origin from a primary, questionnaire based survey are shown in the third main part. The paper closes with the conclusions.

## 2. Theoretical framework

Due to the increasing complexity of knowledge creation, diffusion and utilisation the previously used twofold approach regarding the tacit and explicit nature of knowledge has become insufficient if it comes to the adequate investigation of these processes. Several

further features characterise knowledge creation, diffusion and utilisation yet disregarded, at least partially, by the tacit-explicit dichotomy. To overcome the drawbacks of the aforementioned notions other approaches like the differentiated knowledge bases theory has been introduced to the literature (Asheim – Gertler 2005, Asheim et al. 2007, Asheim et al. 2011, Martin 2012). It takes into consideration the characteristics and aims of knowledge creation and diffusion, the modes of knowledge utilisation, the actors in the process, the importance of geographical proximity and differentiates industries by dominant knowledge bases at the same time.

The proponents of the differentiated knowledge bases framework assume that the innovation performance of firms, industries and regions highly depends on the dominant knowledge base underlying their activities. The theory makes distinction between three ideal types of knowledge bases - analytical, synthetic and symbolic - (Table 1) as inputs to knowledge creation, diffusion and innovation.

The analytical knowledge base characterises industries where scientific knowledge is important thus the creation and utilisation of knowledge often take place in a highly formalised manner based on research and development results (Asheim – Gertler 2005, Asheim – Coenen 2005). Biotechnology and drug development are mentioned as typical industries that rely on analytical knowledge base. In these industries the type of innovation is mainly radical. Development of new products and/or processes is considered as the main aim of knowledge creation to which firms rely on basic and applied research. In-house research and development activities are significant, however often external collaborating partners, such as universities and research centres, are also involved to the process. The analytical knowledge base has strongly codified knowledge content, that is the inputs and results of innovation process could be easily documented and transmitted (Asheim – Gertler 2005). Such inputs and outputs include scientific publications, patent documents and research briefings. In this way highly abstract knowledge is produced with universal meaning which allows easier knowledge transmission between distant geographical places via global networks (Martin 2012). Naturally analytical knowledge base could also involve tacit component but it is negligible in terms of innovation compared to synthetic or symbolic knowledge bases.

*Table 1* Types of differentiated knowledge bases

| | **Analytical (science-based)** | **Synthetic (engineering-based)** | **Symbolic (arts-based)** |
|---|---|---|---|
| **Aim of knowledge creation** | Creating new knowledge about natural systems by applying scientific laws | Applying or combining existing knowledge in new ways in order to solve specific problems | Combining existing knowledge in new ways, creating meaning, desire, aesthetic qualities, immaterial goods, intangibles, symbols, images |
| **Mode of knowledge creation** | Scientific models, Deductive, Significant R&D: basic and applied research Know-why | Solving specific problems, custom production Inductive Moderate R&D: applied research and development Know-how | Creative process Negligible R&D Know-who |
| **Type of knowledge** | Strong codified knowledge content, highly abstract, universal | Partially codified knowledge, strong tacit component, more context specific | Builds mainly on tacit knowledge, importance of interpretation, creativity, cultural knowledge, highly context specific |
| **Type of innovation** | Radical innovation | Incremental innovation | Mostly recombination, occasionally radical innovation |
| **Actors involved** | Collaboration within and between research units (academic, industrial) | Interactive learning with customers, suppliers and other actors from the industry | Actors of short, project based co-operations |
| **Spatiality** | Global linkages | Few global linkages, moderate local embeddedness | Strongly embedded local networks |
| **Typical industries** | Drug development, biotechnology | Mechanical engineering | Film industry, publishing, music industry, fashion, advertising |

*Source:* own construction based on Asheim − Gertler (2005), Asheim et al. (2007) and Martin (2012)

Synthetic knowledge base is dominant in industries such as mechanical engineering or shipbuilding (Asheim – Gertler 2005, Asheim – Coenen 2005). It forms the foundation of engineering-based activities where knowledge creation and adaptation rest on the application and combination of existing knowledge. Innovation is considered incremental focusing on specific problems rather than radical which focuses on transformative product or process innovations. Accordingly, research and development activities are least important in the innovation process compared to the analytical knowledge base and if R&D activities take place applied researches and development tasks are the most common. Although co-operating with universities or other research centres is not unusual, customers, suppliers and other actors from the industry are more prevalent partners. Synthetic knowledge base includes more tacit, context-specific component than the analytical one. Experimenting, testing and learning-by-doing are more important forms of knowledge production than formal R&D. Diffusion of

knowledge is harder since it is not possible to transmit every knowledge element in a codified way. Regarding spatiality few global connections characterise such an industry with a relatively higher local embeddedness.

With the increasing economic significance of creative activities and industries the proponents of differentiated knowledge bases approach introduced a third knowledge base category which is related to the creation of meaning, aesthetic qualities, symbols and other cultural artefacts (Asheim et al. 2007, Asheim et al. 2011). Typical examples of this symbolic knowledge base are film industry, publishing, music industry, fashion and advertising. Innovation in symbolic industries is similar to synthetic ones: combining existing knowledge elements in new ways. However the aim of knowledge production is to create new symbols or aesthetic value and not to renew process of physical production. R&D activities are negligible in these industries. The symbolic knowledge base consists of nearly exclusively context-specific tacit knowledge elements which are strongly embedded locally. Therefore firms source external knowledge from other firms in the industry which reside in geographical proximity, follow similar culture, values, norms and interpret symbols in similar way. Thus, firms characterised by symbolic knowledge base are concentrated in specific locations with different social and economic background and creating dense local networks.

It has been revealed that the concept of differentiated knowledge bases describe the inter-industrial differences in knowledge creation, diffusion and utilisation, and explain the spatial distribution of industrial players, thus the economic performance of the regions. To understand this phenomenon, several researches have been conducted using both primary and secondary data (e.g. Martin – Moodysson 2011, Liu et al. 2013, Asheim – Hansen 2009, Eriksson – Forslund 2014). Secondary data collection and analysis is more accurate mode to explore and compare the differences among industries and regions, even over a longer period of time. But certainly more sufficient to conduct primary research if in-depth study of sectors is in target. Given the fact, this study aims at deeper understanding of a particular industry, we focus on reviewing existing studies, which build on primary data collection.

Evidence from primary researches has been published only in the last few years, and owing to this their number is very small. The overview of existing articles allows us to draw a number of important conclusions. Generally, studies aim at providing a more accurate understanding on the differences in knowledge acquisition and utilisation, thus innovation performance. Most of the studies focus on presenting the impact of knowledge bases on industrial innovation performance, emergence of knowledge networks and industrial development trajectories (Martin – Moodysson 2011, Plum – Hassink 2012, Zukauskaite –

Moodysson 2013, Liu et al. 2013). The minority investigates the influence of regional economic environment on industrial knowledge flows and innovation performance (Chaminade 2011, Gülcan et al. 2011). Thus, authors use slightly different number and types of indicators to measure differentiated knowledge bases, and present several industrial examples with different knowledge bases (Table 2).

*Table 2* Qualitative research approaches measuring industrial knowledge bases and regional effects

| Authors (year) | Object of research | Data source | Measuring knowledge base | Methodology |
|---|---|---|---|---|
| **Martin – Moodysson (2011)** | Life science (analytical), food (synthetic) and moving media (symbolic) (Southern Sweden) | Structured and semi-structured interviews | Monitoring<br>Mobility<br>Collaboration | Descriptive statistical analysis, social networks analysis |
| **Chaminade (2011)** | automotive and software (Puna-India, Beijing China) | Survey, semi-structured interviews | Source of knowledge, interactions and spatiality | Descriptive statistical and comparative analysis |
| **Liu – Chaminade – Asheim (2013)** | Global innovation network of MNCs in telecommunication (analytical) and automotive industry (synthetic) | Interviews, questionnaires, websites, corporate internal reports, press news | Actors<br>Type of interactions<br>Intensity of interactions | Social networks analysis<br>(intra and inter-firm relations) |
| **Plum-Hassink (2011)** | Biotechnology and automotive industry (Germany) | Interviews | Characteristics of partners, relevance of interactions, content and spatiality of knowledge transfer | Social networks analysis |
| **Zukauskaite – Moodysson (2013)** | Food sector (Southern Sweden) | Text analysis, semi-structured interviews | Nature of innovation activity (radical or incremental) | Abduction |
| **Gülcan – Akgüngör – Kustepeli (2011)** | Fashion design (symbolic), household textile (synthetic) industry in Turkey (metropolitan and rural region) | Secondary data analysis, In-depth interviews | Source of workforce, education, source and spatiality of information and knowledge, output of innovation, policy initiatives | Descriptive statistical analysis |

*Source*: own construction

To collect the data structured or semi-structured, in-depth interviews, questionnaires and content analysis are conducted. However, in several cases these techniques are completed with others, like secondary data collection and overview of previous empirical studies, press news, corporate internal reports and websites. Most of the surveys cover the representatives of

firms (CEOs, executives, managers), but there are some, which address representatives from related industries and actors (e.g. policy makers), who have an impact on the innovation activity of firms. Results are mostly performed by social network analysis (Martin – Moodysson 2011, Plum – Hassink 2011, Liu et al. 2013), and there are only a few numbers of studies using descriptive statistical and comparative analysis (Chaminade 2011, Gülcan et al. 2011), and in one case the conclusions are drawn by abduction (Zukauskaite – Moodysson 2013).

Findings of the above-mentioned researches are in line with each other from lot of respects. All of the studies highlight the differentiating role of industrial knowledge bases and the heterogeneity of innovation patterns which vary from industry to industry, from region to region. Martin and Moodysson (2011) reveal that industries with analytical knowledge base use rather formalized knowledge sources, as well as workforce coming from universities and build science-based, global collaborations. In case of industries building on synthetic knowledge base, the knowledge sources are less formalized, the labour force rather comes from other firms and the collaborations are more regional and national. Finally, economic activities presenting symbolic knowledge base have less formalized knowledge sources, the sources of labour and the collaborations are local.

Results are slightly different if multinational companies (MNCs) are in target (Liu et al. 2013). Whether a MNC builds on analytical or synthetic knowledge base, its innovation network is global (or 'regionalized global' in case of MNC with synthetic knowledge base). However, the dynamics of the global innovation networks are different. Analytical MNC has no strong local embeddedness, and rather focuses on R&D activities. Synthetic MNC is embedded in the local environment. Similarly, Plum and Hassink (2011) reveals that knowledge networks depend on the dominant industrial knowledge base, and the knowledge base may change over the time. Additionally, Zukauskaite and Moodysson (2013) prove that those firms are more innovative, which build on more knowledge bases.

However, differentiated knowledge bases are not the only reasons for the differences in innovation activities and performance (Chaminade 2011, Gülcan et al. 2011). It has become clear that different regional innovation systems result different industrial innovation patterns. Moreover, bigger the difference between the same sectors in different regions than in case of two different sectors in the same region (Chaminade 2011). Beside these, the corporate strategy, the local market barriers, etc. also should be taken into account.

According to the existing evidence, we expect that an industry with synthetic knowledge base deals dominantly with tacit knowledge, possess rather regional knowledge

networks and collaborations with co-located partners. Use less formalized and largely industry-specific knowledge sources, and attract the skilled workforce from other firms, and finally focus not on R&D collaborations, but rather on solving customer-supplier problems. Due to the fact that the most comprehensive research to reveal the peculiarities of knowledge bases is done by Martin and Moodysson (2011), we build on their methodology. Our case and the methodology are presented in the following chapters.

## 3. Introduction to the case and methodology

In this study our aim is to unfold and analyse the characteristics of knowledge flows in the printing industry of Kecskemét as a synthetic industry in a transition economy in order to explore whether the revealed pattern is in line with the assumptions of differentiated knowledge bases theory. To do so we address the following questions: what is the main geographical scene of knowledge acquisition, what are the main sources of new knowledge and who are the main partners in the knowledge sourcing process.

As we presented in the previous chapter authors studying problems like these have come up with several different methods to measure knowledge flows and innovation patterns. For the purpose of our analysis we adapted the methodology used by Martin and Moodysson (2011). They examine industrial knowledge base and the knowledge acquisition activity of firms along three dimensions: monitoring, mobility and collaboration. Monitoring is an indirect way of knowledge acquisition. It refers to a situation when firms do not come into direct contact with knowledge sources (e.g. universities, competitors, agencies), but use intermediary carriers of knowledge, like: scientific journals, surveys, questionnaires, specialized magazines, fairs and exhibitions. Compared to this, mobility is a more direct way to access knowledge. It refers to the recruitment of new, skilled workforce from other organizations, like universities, technical colleges, firms in the same industry and firms in other industry. The third fundamental and direct mode of knowledge acquisition is collaboration. Collaboration provides knowledge exchange through direct interaction with other actors. Collaboration may focus on product development, exploitation of new market opportunities, technology procurement etc.

In our research a distinction is also made between regional, national and international level of knowledge acquisition in case of measuring mobility and collaboration. Furthermore, we are also interested in the differences between market and technological knowledge acquisition patterns of firms. Technological knowledge is defined as a type of knowledge

which is necessary for the development of new products or processes while market knowledge refers to knowledge about new trends or other market-related facts. With this distinction we could also examine which types of sources are important and what spatial level that really matters if it comes to one or to the other type.

To answer the proposed questions a survey has been conducted in January 2016. Data have been collected from 26 firms in Kecskemét. Firms with NACE code 17 and 18 were considered as printing industrial firms. Firms outside the city and its agglomeration and firms with less than 2 employees or considered inactive were excluded from the survey. In this way we were able to collect data from 70% of the potential firms from the local printing industry. Data collection was conducted in person. In most cases the firm's executive officer was asked to answer the questions. In cases when he/she was unavailable another representative of the firm, who has the appropriate knowledge, was interviewed.

Kecskemét, with its 115.000 inhabitants, is the 8th biggest city in Hungary. It lies about 85 km south from Budapest in the Southern Great Plain region, in the county Bács-Kiskun. The economy of the city is very diverse. From agriculture and food processing to mechanical engineering and car manufacturing several industries could be found in the city. Among them, according to Juhász and Lengyel (2016), the printing and paper industry has a significant concentration in the area. Based on their location quotient (LQ) analysis conducted in 2014 the former has a 1,048 while the latter a 3,777 value which means higher industrial concentration in the area (in terms of employment) compared to national level.

The history of printing and paper industry in the area goes back to 1840s when the first printing house, called Petőfi Press, was founded in the city and since then it has still operated (Juhász – Lengyel 2016). After the socialist era, in the 1990s, many private printing and paper companies are funded. Some of them originated from the Petőfi Press (e.g. Print2000, GoesslerKuverts) others funded by international companies (e.g. Axel-Springer). Besides the few bigger firms, currently the printing and paper industry in Kecskemét is dominated by small and medium sized companies which entails that the main focus is the creation of unique paper products in small series (e.g. specifically printed, folded, unique paper products, packaging materials, stickers and labels) mostly to satisfy regional demand. A higher education institution with and engineering faculty (Kecskemét College Faculty of Mechanical Engineering and Automation) and a specialised secondary school are also found in the city which could provide the necessary human resource for the industry. All in all the long tradition, the geographical concentration, the similar social and historical background of the

companies makes the printing industry in Kecskemét a suitable case to investigate the relevance of differentiated knowledge base approach in a transition economy.

## 4. Results

Our sample consists of 26 firms from the printing industry of Kecskemét. Regarding their main activity 42.3% marked printing activities as their main field, while both pre-press and pre-media services and manufacture of paper and paper products as main activity reached 23.1%. The rest (11.5%) indicated other fields as main sources of their revenues such as binding or manufacture of tools for printing firms. The average age of the firms are 18,1 years so the printing industry of Kecskemét can be considered as a mature one. Considering the average number of employees in 2015 the firms in the industry employ 28,1 person on average. However if we exclude STI (former Petőfi Press) from the sample it decreases to 13,4 person. The industry is mostly dominated by microenterprises (69.2%), only almost one fourth (23.1%) of the industry consist of small and medium sized companies, while STI is the only large firm in the city. Out of 26 firms, 12 can be considered as spin off companies from which 5 has their roots in the former Petőfi Press. One fifth (19.2%) of the firms has foreign capital in their ownership and almost 40% of them export their products to the global market.

Although the printing industry is generally presumed to be characterised by synthetic knowledge base, we explore the actual composition of workforce to assess this assumption. The interviewees were asked to categorise their employees into 4 categories according to their main tasks. The pre-press category includes employees who deal with graphics and design. They are mostly responsible for planning the appearance of products, creating aesthetic value or meaning which activities are, in our understanding, mainly based upon symbolic knowledge. Pressmen, plant engineers and managers and other employees who deal with the actual production process are classified under the printing category and considered as synthetic knowledge-based workforce. Technical assistance, also classified as synthetic knowledge related occupation, refers to employees with less specific knowledge dealing with labelling, packaging or cutting and also classified as synthetic ones. Finally the administrative label stands for employees dealing with management, procurement, marketing and other operation tasks.

Examining the composition of full-time workforce (Table 3) it becomes clear that the industry is dominated by synthetic knowledge-based occupations compiled under the label ‘printing’ (52.7%). Even if the STI, the largest firm in the area, is excluded the proportion of

this group remains the highest (43.7%). 7.6% of the workforce dealing with symbolic type pre-press activities if STI taken into account, however their share is twice as many if STI is excluded. It is almost the same with the workforce in category 'other' including part-time workers. This is well in line with the fact that the local industry is dominated by smaller firms focusing on unique and small series products where unique design and creative solutions are more important. The bigger share of technical assistance in the second case (23.4%) entails that smaller firms tend to employ people with least specific skills. All in all the composition of workforce shows the dominance of synthetic knowledge in the industry.

*Table 3* Average composition of workforce (%)

| | **Pre-press** | **Printing** | **Technical assistance** | **Administrative** | **Other** |
|---|---|---|---|---|---|
| **With STI** | 7.6 | 52.7 | 16.5 | 20.9 | 2.4 |
| **Without STI** | 14.2 | 43.7 | 23.4 | 13.6 | 5.2 |

*Source:* own construction

Regarding mobility, knowledge acquisition through recruitment of highly skilled workers is a typical way to gather new knowledge. Knowledge creation in synthetic industry is driven by experimenting, testing and learning-by-doing so workforce with former experience seems more important than newcomers from professional, vocational schools or higher education institutions. Our results show a surprisingly low ratio in connection with the importance of different knowledge sources in terms of mobility (Table 4). Almost 40% of the firms do not mark any sources as important if it comes to recruitment of highly skilled workforce. Firms in the printing industry of Kecskemét hardly recruit highly skilled workers from higher education institutions or other vocational training schools. The latter is even more surprising knowing that a specialised vocational training school operates in the city.

However during the survey many interviewees complained about the quality of education. A little bit less than one third of the responders (30.8%) considered other firms from the same local industry as moderately or highly important source of skilled workers. Regarding importance, this group is followed by actors from the same industry on national level and actors from other industries from all spatial levels, all of them considered at least moderately important by 15.4% of the firms. For printing industrial firms local workforce is the most decisive.

*Table 4* Mobility: Relative importance of sources of skilled workforce and their spatiality (%)

| | Higher education institution | | | Vocational training school | | | Same industry | | | Other industry | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L | N | I | L | N | I | L | N | I | L | N | I |
| **Not at all** | 84.6 | 76.9 | 84.6 | 69.2 | 80.8 | 88.5 | 61.5 | 73.1 | 88.5 | 65.4 | 73.1 | 80.8 |
| **Low** | 3.9 | 7.7 | 0.0 | 11.5 | 7.7 | 3.9 | 3.9 | 7.7 | 3.9 | 15.4 | 7.7 | 11.5 |
| **Moderate** | 0.0 | 0.00 | 7.7 | 0.0 | 3.9 | 3.9 | 19.2 | 11.5 | 3.9 | 11.5 | 11.5 | 3.9 |
| **High** | 3.9 | 7.7 | 7.7 | 15.4 | 3.9 | 0.0 | 11.5 | 3.9 | 0.0 | 3.9 | 3.9 | 0.0 |
| **N/A** | 7.7 | 7.7 | 7.7 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 |
| **Total** | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

*Notes*: L – local (county), N – national (country without the county), I – international
*Source*: own construction

Based on the responses collected during the survey two reasonable explanations occur if we would like to explain the low ratio of knowledge sourcing through mobility. Firstly, the local industry includes few bigger companies with large-scale production who rather employ workers without specific skills and train them in-house, and several smaller firms who specialised in unique products, thus provide special on-the-job training to their employees. Secondly firms do not recruit directly from the abovementioned actors but use other channels (e.g. websites) to gather sufficient workforce.

Regarding monitoring, the secondary, indirect knowledge sources, in line with Martin and Moodysson (2011) four categories are distinguished: fairs and exhibitions with specific focus on latest industrial news, trends and technologies; professional magazines (including on-line papers) specialised in related fields; surveys conducted by support organisations (professional associations, chambers, statistical office) or businesses (market research firms) and scientific journals concerned with latest research results. Based on the theory-led expectations, we think that knowledge sourcing through indirect channels is less important for the firms in the printing industry, due to the fact that competitive advantages come from the applied and specialised nature of knowledge and innovation activities.

The results (Table 5) show that professional magazines can be considered as the most important secondary knowledge sources in terms of both market and technological knowledge. More than 60% of the respondents consider magazines moderately or highly important if technological knowledge is needed. If it comes to market knowledge still more than half of the firms rely on this source at least moderately. The next most important knowledge sources are fairs and exhibitions. These types are also more significant in case of technological (42.3%) than of market knowledge sourcing (34.6%). Only surveys can be considered as more important source of market knowledge compared to technological. Little

bit more than one fourth (26.9%) of the firms rely at least moderately on surveys as sources for market knowledge while the proportion is only one fifth (19.2%) in the other case. In line with the literature and our expectations scientific journals are hardly used by printing industrial firms.

According to the theory-led considerations (Martin − Moodysson 2011), it would be expected that monitoring other firms through fairs, exhibitions and magazines are the most important knowledge sources for activities relying on symbolic knowledge base due to the fact that their innovations are widespread and usually not kept in secret. It seems - given the nature of the printing activity - this assumption can be applied for the dominantly synthetic printing industry as well. These sources seem more important because specific technological and market knowledge could be obtained via them; furthermore the latter provide opportunity for face-to-face communication, especially with customers and suppliers, who have leading role in the innovation activities in case of synthetic related activities. Surveys and scientific journals are more important for analytical industries.

*Table 5* Monitoring: Relative importance of indirect sources for gathering knowledge (%)

| | **Fairs, exhibitions** | | **Magazines** | | **Surveys** | | **Scientific journals** | |
|---|---|---|---|---|---|---|---|---|
| | T | M | T | M | T | M | T | M |
| **Not at all** | 19.2 | 42.3 | 15.4 | 23.1 | 73.1 | 61.5 | 73.1 | 80.8 |
| **Low** | 34.6 | 23.1 | 15.4 | 19.2 | 3.9 | 11.5 | 3.9 | 7.7 |
| **Moderate** | 30.8 | 15.4 | 23.1 | 30.8 | 7.7 | 11.5 | 0.0 | 3.9 |
| **High** | 11.5 | 19.2 | 38.5 | 23.1 | 11.5 | 15.4 | 19.2 | 7.7 |
| **N/A** | 3.9 | 0.0 | 7.7 | 3.9 | 3.9 | 0.0 | 3.9 | 0.0 |
| **Total** | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

*Notes:* T – technological knowledge, M – market knowledge
*Source:* own construction

Investigating further the combination of secondary sources about one tenth (11.5%) of the firms do not use any secondary source to obtain either market or technological knowledge and they did not mark any other means in the questionnaire. On the other hand same proportion of the firms draws on all the four types during market or technological knowledge acquisition. However, most commonly, firms use two sources at the same time to acquire market (34.6%) or technological knowledge (38.5%). So firms in the printing industry of Kecskemét usually draw on two secondary sources (mostly magazines and fairs, exhibitions) to acquire knowledge. But it can be observed only in case of about one third of the companies. The proportion may be higher in symbolic related industries.

Since the partly tacit nature of synthetic knowledge relatively more importance to personal contacts and collaborations is expected in terms of technological or market knowledge acquisition. Therefore, we asked the firms to indicate how much they rely on different actors if they seek to acquire market or technological knowledge. Furthermore we were also interested in the spatiality of cooperation partners to decide whether local, national or international level that really matters for knowledge sourcing. In line with the theory we expect relatively high importance of customers and suppliers as main channels of knowledge and lower importance of competitors because of the strong competition in the local industry. Higher education institutions as knowledge providers are expected to be of low importance bearing in mind that applied researches considered being important in an industry characterised by synthetic knowledge. Regarding spatiality, because of the higher tacit component of synthetic knowledge base compared to analytical one, local and national levels are expected to be decisive.

Results show that the most important direct knowledge sources are the customers followed by the suppliers (Appendix 1). Competitors have slight significance only, while firms barely rely on higher educational institutions. Only a few respondents (7.7%) do not rely on any group to access external technological knowledge while about one tenth (11.5%) of the firms neglect other actors if they require market knowledge (Table 6). Investigating the combination of different sources only 7.7% of the firms rely on one particular actor to acquire technological or market knowledge. More commonly firms in the printing industry of Kecskemét gather knowledge from several actors at the same time.

*Table 6* Collaboration: Direct sources and their combination for gathering knowledge (%)

| | **Technological knowledge** | **Market knowledge** |
|---|---|---|
| None | 7.7 | 11.5 |
| CUST | 0.0 | 3.8 |
| SUPP | 3.8 | 3.8 |
| COMP | 3.8 | 0.0 |
| CUST+SUPP | 15.4 | 19.2 |
| CUST+COMP | 7.7 | 7.7 |
| SUPP+COMP | 3.8 | 3.8 |
| CUST+SUPP+COMP | 30.8 | 26.9 |
| CUST+SUPP+HEI | 3.8 | 0.0 |
| CUST+COMP+HEI | 3.8 | 3.8 |
| CUST+SUPP+COMP+HEI | 19.2 | 19.2 |

*Notes:* rows with 0 are excluded, CUST – customers, SUPP – suppliers, COMP – competitors, HEI – higher education institutions

*Source:* own construction

About one third of the respondents typically collect external knowledge from customers, suppliers and competitors in parallel. Interestingly higher education institutions are mentioned as potential external knowledge sources only in combination with the other three groups. Nearly 20% of the firms draw on all four groups during their knowledge sourcing activity. Firms who combine only two sources to acquire technological or market knowledge mostly rely on their customers and suppliers: 15.4% and 19.2% respectively. In this sense knowledge acquired from competitors can only be considered important if it is supplemented with knowledge from customers and suppliers.

The spatial dimension of knowledge sourcing through direct channels slightly different than it is expected (Table 7). Significant differences could not be observed between the two knowledge types. Firms acquire technological and market knowledge from nearly same spatial levels. The importance of local level on its own is very low. Only 11.5% of the firms gather knowledge exclusively from their proximity. Commonly firms source knowledge from at least two different spatial levels at the same time. 23.1% of the respondents contact local and national actors to acquire technological or market knowledge and 42.3% of them rely on actors from all - local, national and international - spatial levels. In our sample firms barely source knowledge solely from national level (7.7%). Firms who build on international sources usually complement that knowledge (either market or technological) with local or national source presumably to acquire context-specific knowledge.

*Table 7* Collaboration: Spatiality of direct sources for gathering knowledge (%)

| **Knowledge** | **None** | **L** | **N** | **I** | **L + N** | **L + I** | **N + I** | **L + N + I** |
|---|---|---|---|---|---|---|---|---|
| Technological | 7.7 | 11.5 | 7.7 | 0.0 | 23.1 | 0.0 | 7.7 | 42.3 |
| Market | 11.5 | 11.5 | 7.7 | 0.0 | 23.1 | 0.0 | 3.9 | 42.3 |

*Notes*: L – local (county), N – national (country without the county), I – international
*Source*: own construction

If we consider the relative importance of direct sources the most important one is local customers (Appendix 1). More than 40% of the respondents considered them as at least moderately important in both cases. National customers are also major sources of technological (38.5%) and market (34.6%) knowledge. A slight difference could only be observed in case of international customers because they are considered more important in case of market than technological knowledge. The same stands for local suppliers: only 15.38% of the firms attributed at least moderate significance to them in the technological

knowledge sourcing process, while little more than one fourth in case of market knowledge. Regarding suppliers, national ones are the most important sources (34.6%). In terms of technological knowledge, 30.8% of the firms in the printing industry rely, at least moderately, on local competitors as main partners. Regarding market knowledge they have lesser significance (23.1%) which might originate from the stronger local competition and the bigger impact of market knowledge on short term. Firms more willingly share technological knowledge with each other than market knowledge.

All in all printing industrial firms in Kecskemét rely on several actors, mostly customers (almost two third of the firms), suppliers (between 54–57% of firms, depending on need for market and technological knowledge) and competitors (around one third of the firms), from different, at least two spatial levels at the same time. Most frequently knowledge acquired from local and national customers are supplemented with knowledge from national and international suppliers.

## 5. Conclusion

In this paper we investigated the printing industry of Kecskemét in Hungary presumably characterised by mainly synthetic knowledge base in order to shed light on patterns of knowledge flow. Our theoretical considerations and expectations were built upon the differentiated knowledge bases approach. Hitherto, empirical evidence supporting the differentiated knowledge base approach is mainly based on results from developed countries, so studying if the argument holds for regions and industries in transition economies like Hungary seemed a promising line of research. Therefore, our aim was to unfold and analyse the characteristics of knowledge generation, diffusion and utilisation and to explore whether the revealed pattern is in line with the theory. Three main questions were addressed during our research: what is the main geographical scene of knowledge generation, diffusion and acquisition, what are the main sources of new knowledge and who are the main partners in the process of knowledge sourcing.

To collect evidence a questionnaire based survey has been conducted which was build on three dimensions - mobility, monitoring and collaboration - to capture industrial knowledge base and the knowledge acquisition activity of firms. The first, mobility, captures the recruitment of skilled workforce as holders of new, external knowledge. Monitoring stands for the indirect way of knowledge sourcing when firms use intermediary carriers of

knowledge. Lastly, collaboration refers to knowledge exchange through direct interaction with other actors.

The results are basically in line with our theoretical-led expectations. The composition of workforce confirms the dominance of synthetic knowledge base in the industry. However, if the biggest company is excluded from the sample the proportion of employees with symbolic knowledge base is increased which could be explained by their specific focus on unique design and creative solutions. Considering knowledge acquisition through mobility surprisingly low importance is dedicated to different sources. A bit more than third of the respondents do not mark any sources as important if it comes to recruitment of highly skilled workforce. Vocational schools and higher education institutions are mostly neglected, while other printing industrial firms or firms from other industries have only slight importance, only about one third of the firms consider them as important sources of potential workforce. Possible explanation of the low importance could be that firms employ less skilled workers and perform in-house trainings.

Regarding secondary and indirect knowledge sources professional magazines can be considered as the most important ones while fairs and exhibitions also have a moderate significance. Nevertheless the low significance of scientific journals and surveys is expected. Although the relatively higher importance of the former two sources is unanticipated. The monitoring of other firms via magazines or fairs is typical for symbolic industries, where innovations are widespread and usually not kept in secret. However the results could be explained by the fact that firms in the printing industry of Kecskemét mainly dealing with unique production and design which entails such knowledge acquisition activities. Moreover, greater importance is expected in a symbolic-related industry.

Investigating collaboration, the direct knowledge sources it could be said that firms rely on several sources at the same time. Most commonly they draw on knowledge gathered from customers and suppliers. Knowledge stemming from competitors is considered important only if supplemented with knowledge from the other two actors. Higher education institutions are the least important sources of external knowledge and only used by firms who acquire knowledge from the other actors too. In terms of different knowledge types firms more willingly share technological knowledge with each other than market knowledge.

About the spatial dimension of knowledge sourcing all the spatial level seem important for the printing industrial firms of Kecskemét. In connection with recruitment local level is the most decisive, while studying collaborations with other actors local, national and international levels can all be considered important. However firms who build on

international sources usually complement that knowledge with local or national source presumably to acquire context-specific knowledge.

To sum, recent analyses has proved that printing industry is dominated by synthetic knowledge base. The impacts of the transitional economy in Hungary have not been proved, but further in-depth analysis is needed to reveal the potential effects. Investigation of the development path in the industry could lead to several other interesting conclusions.

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## Appendix

*Appendix 1* Relative importance of direct sources and their spatiality for gathering knowledge (%)

| | **Customer** | | | | | | **Supplier** | | | | | | **Competitor** | | | | | | **Higher education institution** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Local | | National | | International | | Local | | National | | International | | Local | | National | | International | | Local | | National | | International | |
| | T | M | T | M | T | M | T | M | T | M | T | M | T | M | T | M | T | M | T | M | T | M | T | M |
| **Not at all** | 38.5 | 34.6 | 46.2 | 46.2 | 61.5 | 57.7 | 57.7 | 42.3 | 38.5 | 34.6 | 50.0 | 50.0 | 34.6 | 38.5 | 57.7 | 57.7 | 65.4 | 65.4 | 84.6 | 80.8 | 76.9 | 76.9 | 96.2 | 92.3 |
| **Low** | 19.2 | 19.2 | 15.38 | 15.4 | 11.5 | 3.9 | 26.9 | 26.9 | 23.1 | 23.1 | 11.5 | 11.5 | 30.8 | 30.8 | 26.9 | 15.4 | 7.7 | 3.9 | 11.5 | 11.5 | 11.5 | 11.5 | 3.9 | 3.9 |
| **Moderate** | 30.8 | 30.8 | 19.2 | 11.5 | 0.0 | 0.0 | 11.5 | 15.4 | 15.4 | 19.2 | 19.2 | 19.2 | 15.4 | 11.5 | 3.9 | 15.4 | 15.4 | 7.7 | 0.0 | 0.0 | 3.9 | 0.0 | 0.0 | 0.0 |
| **High** | 11.5 | 11.5 | 19.2 | 23.1 | 23.1 | 30.8 | 3.9 | 11.5 | 19.2 | 15.4 | 15.4 | 11.5 | 15.4 | 11.5 | 7.7 | 3.9 | 0.0 | 7.7 | 3.9 | 3.9 | 7.9 | 7.9 | 0.0 | 0.0 |
| **N/A** | 0.0 | 3.9 | 0. 0 | 3.9 | 3.9 | 7.7 | 0.0 | 3.9 | 3.9 | 7.7 | 3.9 | 7.7 | 3.9 | 7.7 | 3.9 | 7.7 | 11.5 | 15.4 | 0.0 | 3.9 | 0.0 | 3.9 | 0.0 | 3.9 |
| **Total** | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

*Note:* T – technological knowledge, M – market knowledge
*Source:* own construction