Marcin Soniewicki

The use of external knowledge sources in manufacturing companies

The aim of the article is examining the use of selected from the literature, external knowledge sources by particular types of manufacturing companies. The meaning of this aspect for analyzed type of enterprises is the result of economic transformations that took place in the recent decades.

Global economies have undergone considerable changes at the end of twentieth century, especially in the last decade [Karlsson, Johansson, Sough, 2006]. Their main part was substantial increase of knowledge role in economic processes [Gaczek, 2009]. Knowledge has always been important but in the last decades it has become prevailing resource [Welfe, 2007]. Many terms have been used to describe these changes. Nevertheless, the most popular among them became Knowledge Based Economy which has been created and promoted by OECD report in 1996 [OECD, 1996].

Described economic changes affect enterprises forcing them to transform and adjust. To remain competitive and survive they need to change by developing certain dynamic competences in the area of knowledge resource [Soniewicki, 2014 a].

Many concepts have been created in order to help companies to organize their activities related to knowledge resource. Among the most popular should be named learning organization – LO, organizational learning – OL and knowledge management – KM [Evans 2005, Handzic, Zhou, 2005]. Currently, the most popular among them is the last one – knowledge management, due to its transparency, practical character and clarity [Vera, Crossan, 2003]. There are many approaches to KM, but this article concentrates on the process approach. The clear distinction of processes in this attitude is its important advantage [Soniewicki, 2014 a]. In the literature one may find number of knowledge management definitions [Ahmed, Lim, Loh, 2002, Geisler, Wickramasinghe, 2009].

In this publication knowledge management definition created by Cranfield Business School has been adopted. It describes the KM as: *collection of processes that enable the creation, dissemination and use of knowledge to achieve organizational objectives* [Perechuda, 2005, p. 74].

In the literature, there are also various concepts of distinguishing knowledge management processes. Some authors suggest more or less detailed approaches. This research adopts the attitude developed by G. Probst, S. Raub, K. Romhardt [2004] which consists of six elements: locating knowledge, knowledge acquisition, developing knowledge, sharing knowledge and knowledge dissemination, exploitation as well as protection.

Due to global increasing significance of services in the global economy, manufacturing industry, which is its very important part, is sometimes forgotten.

Especially, when it comes to knowledge management. This is because the role of knowledge is more apparent in case of service industry [Grönroos, 2005, Soniewicki, 2014 b]. Nevertheless, enterprises in the manufacturing industry to become and remain competitive need to constantly create new products. Such actions require effective knowledge management processes and their first element is constant knowledge acquisition from suitable sources. This area has not been thoroughly examined yet. For example Economist Intelligence Unit's report [2007] in the matter of knowledge management in the manufacturing industry underlined the importance KM activities, but did not concentrate on examining knowledge sources used by companies operating in this industry. This article tries to partly fill this gap.

As knowledge management in the adopted approach consists of series of complex processes, the examination of all of these elements in one article is not possible. That is why this publication concentrates just on one of them – knowledge acquisition, and more specifically – external knowledge acquisition. It analyzes the use of various knowledge sources by examined enterprises. Moreover, one may expect that companies from each industry rely on different knowledge sources, that is why author decided to concentrate only on one industry – manufacturing enterprises.

Locating and acquiring necessary knowledge by company is key element of all KM actions, no matter which division of KM processes we prefer [Soniewicki, Wawrowski, 2014]. The importance of external knowledge acquisition is also underlined in the literature and by business practitioners one of the most famous is Jack Welch [Kowalczyk, Nogalski, 2007]. This resource can be obtained by enterprises from many sources; the choice of them can affect the competitiveness of an entity [Darroch, 2003, Paliszkiewicz, 2007].

It must be emphasized that clear division between internal and external knowledge sources does not exist. Research and development (R&D) has been examined for comparison, but some authors underline that such departments often concentrate more on external knowledge acquisition than their own studies [Probst, Raub, Romhardt, 2004].

Methodology

In the research three groups of manufacturing companies have been distinguished (table 1). The implemented grouping has been based on OECD breakdown of manufacturing enterprises [Hatzichronoglou, 1997]. The only difference is combination of two groups: low and medium-low technology. A lot of research studies concentrate on high technology, but not so many examine equally interesting medium-high technology enterprises.

For additional detailed, statistical analyzes two other groups have been combined – high and medium-high technology (table 2). This gave two relatively similar in size groups of companies for comparison.

Table 1 **Composition of examined sample**

Type of manufacturing	**Number of companies in the sample**
low and medium-low technology	180
medium-high technology	115
high technology	39
Total	334

Source: own study, breakdown of manufacturing enterprises based on OECD [Hatzichronoglou, 1997].

Table 2 **Overall composition of examined sample**

Type of manufacturing companies	Number of companies in the sample
low and medium-low technology	180
high and medium-high technology	154
Total	334

Source: own study.

Knowledge sources analyzed in this article have been divided in four categories listed in table 3. They have been gathered from various knowledge management literatures. As it was mentioned in the introduction, many R&D departments concentrate on knowledge acquisition [Probst, Raub, Romhardt, 2004]. That is why R&D has also been examined with other external knowledge sources.

The author's idea was to create as simple as possible questionnaire survey which would be clearly understood by all respondents. Such attitude increased the number of fully filled questionnaires in the research. The research goal was testing several elements of knowledge management and market orientation of examined companies. This article concentrates on the first part of the research which concerned knowledge acquisition. As mentioned earlier, all knowledge sources that have been examined in the research come from knowledge management literature – most common knowledge sources utilized by companies. In the implemented questionnaire survey their use has been tested by 5-grade Likert scale.

The sample of studied companies was selected from Kompass Poland database. The research was carried out among enterprises active in Poland in two stages. The first one has been conducted with the use of custom made Web-based surveying system. It has been created by author with help of computer scientist. The second stage has been performed with use of ordinary, paper-based questionnaire. Such division has been necessary because of restrictions included in license conditions by database provider. They allowed dispatch of questionnaires, in electronic form, to certain companies only. The results from electronic and paper-based questionnaires have been analyzed jointly.

Ultimately, almost 1300 questionnaires filled by respondents have been received in the research; however some were eliminated due to incompleteness. This

Table 3 **The list of examined knowledge sources and their categories**

No.	Knowledge source	Category of the source
1.	external trainings	knowledge purchase
2.	consulting companies	
3.	publications (scientific, industry)	
4.	external expertise / external expert advice	
5.	market research	market related knowledge sources
6.	customers	
7.	suppliers	
8.	competitors	
9.	networking groups or associations	governmental and non-governmental institutions
10.	scientific institutions (including universities)	
11.	governmental or local government institutions	
12.	own research and development	research and development

Source: own study on the basis: Soo, Midgley, Devinney, 2002, Darroch, 2003, Probst, Raub, Romhardt, 2004, Kowalczyk, Nogalski, 2007, Paliszkiewicz, 2007, Mazur, Rószkiewicz, Strzyżewska, 2008, Sparrow, 2010, Soniewicki, 2014 a.

research concentrates on manufacturing enterprises. Among completely filled surveys 334 came from businesses operating in manufacturing industry (table 1). The study has been performed in the second and third quarter of year 2012 and the beginning of year 2013.

Statistical differences in the usage intensity of particular knowledge sources by particular types of manufacturing companies have been examined using Student's t-Test. For this purpose R programming language with Integrated Development Environment – RStudio has been used.

Research results

Knowledge sources have been divided into four categories as presented above: knowledge purchase, market related knowledge sources, governmental and non-governmental institutions, research and development. Results in each category have been shown in two intakes – first one is more detailed, in the second companies have been divided into two main groups: high and medium-high technology as well as low and medium-low technology. This has been done to measure the difference between these groups and each time check the statistical significance of this difference.

Table 4 shows intensity of use of particular knowledge sources classified as knowledge purchase by three groups of manufacturing companies. In case of the first element – external trainings – it is practically equally used by all distinguished types of manufacturing companies. There are only tiny differences. The use of consulting companies is unpopular among examined companies; nevertheless this way of gaining knowledge is more prevalent among low and medium-low technology manufacturing companies. The most common way of purchasing knowledge by analyzed companies is buying publications, either scientific or industry. In case of this knowledge source – the more advanced type of manufacturing company, the more it exploits this knowledge source. The last aspect is also true for external expertise and external expert advice. Their use is considerably higher among higher technology companies. Nevertheless, the overall use of this knowledge sources is very low.

Knowledge purchase may seem very common way of gaining knowledge by companies. Nevertheless, results show that generally it is not too much popular way of obtaining knowledge by examined entities.

Table 5 shows the statistical differences between two main groups of entities – low and medium-low as well as high medium-high manufacturing enterprises. External trainings are the exemplar of knowledge source which is almost equally used by two groups of companies. In turn consulting companies are knowledge source which is the only example of external knowledge source that is more in-

Table 4 **Knowledge purchase – the use of selected knowledge sources by different types of manufacturing companies**

Knowledge source / **Type of manufacturing companies**	External trainings	Consulting companies	Publications (scientific, industry)	External expertise / external expert advice
low and medium-low technology	2.61	1.93	2.88	1.62
medium-high technology	2.65	1.78	3.07	1.83
high technology	2.64	1.87	3.08	1.95

Source: own study.

Table 5 **Knowledge purchase – statistical difference between uses of selected knowledge sources by two primary types of manufacturing companies**

Knowledge source / Type of manufacturing companies	External trainings	Consulting companies	Publications (scientific, industry)	External expertise / external expert advice
low and medium-low technology	2.61	1.93	2.88	1.62
high and medium-high technology	2.65	1.81	3.07	1.86
difference (high-low)	0.04	-0.13	0.19*	0.25**

Note: *p < 0.1, **p < 0.05.
Source: own study.

tensively used by low and medium-low than high and medium-high technology manufacturing enterprises. One needs to note that this difference is not statistically significant. Nevertheless, in all other cases of knowledge sources in this research they are more intensively used by the latter group of companies. The following knowledge source – scientific or industry publication are quite significant knowledge source especially for the second group companies. External expertise and expert advice are rather marginal way of gaining knowledge for examined companies. Nevertheless, it is a little more appreciated knowledge source for higher technology enterprises.

Table 6 presents the intensity of use of market related knowledge sources. It can be clearly seen that, on average, the higher the technology of examined manufacturing companies the more intensive use of all sort of market knowledge sources. One should especially note that there are larger differences between two last groups of companies. It means that high technology manufacturing companies differ considerably from the other manufacturing companies. They are much more active in gaining market knowledge. It is especially interesting when it comes to obtaining knowledge from competitors. It indicates that this sort of companies may hold close ties or closely observe each other.

For all types of examined manufacturing companies most important market sources are customers and suppliers. These are elements of value chain which are crucial for every manufacturing company as it has been underlined by other scientific publications for example M. Ratajczak-Mrozek [2013]. It must be emphasized that one of those – customers – are in general the most important knowledge source for every type of examined manufacturing company. Among analyzed market knowledge source the least popular is market research. This is probably because it is relatively expensive way of gaining knowledge. In this matter

Table 6 **Market knowledge – the use of selected knowledge sources by different types of manufacturing companies**

Knowledge source / Type of manufacturing companies	Market research	Customers	Suppliers	Competitors
low and medium-low technology	2.18	3.33	3.11	2.83
medium-high technology	2.54	3.55	3.27	2.87
high technology	2.85	3.97	3.59	3.23

Source: own study.

Table 7 **Market knowledge – statistical difference between use of selected knowledge sources by two primary types of manufacturing companies**

Knowledge source / Type of manufacturing companies	Market research	Customers	Suppliers	Competitors
low and medium-low technology	2.18	3.33	3.11	2.83
high and medium-high technology	2.62	3.66	3.35	2.96
difference (high-low)	0.43***	0.33***	0.25**	0.13

Note: **p < 0.05, ***p < 0.01.

Source: own study.

there is especially substantial difference between high technology manufacturing companies and other businesses in this industry. It may mean that for many types of enterprises it is an unexploited opportunity and a chance for many companies to improve their competitive position.

Table 7 shows differences and their statistical significance in case of market related knowledge sources between two aggregated groups of companies low and medium-low as well as high and medium-high manufacturing companies. As we found out from previous table, there are considerably large differences between high technology analyzed companies and medium-high technology business. That is why in case of these knowledge sources this aggregation to some extent reduces existing differences as the second group is heterogeneous. Nevertheless, there are many statistically significant differences – in case of market research, customers and suppliers. The lack of statistical significance in case of competitors is likely to be an effect of heterogeneity of the latter group. Table 6 shows that the use of this source is much more intensive among high than medium-high technology manufacturing companies. One should note that difference in case of knowledge sources such as market research and customers is especially statistically significant $p<0.01$. Especially large difference is seen in case of knowledge source which is market research – but the use of this source by analyzed enterprises is not as intensive as utilization of customers and suppliers.

Table 8 shows that the knowledge sources from the group of governmental and non-governmental organizations are relatively little appreciated by all types of examined enterprises. To some extent, the exception is the use of scientific institutions (including universities) by medium-high (2.23) and high (2.64) technology manufacturing companies. In the latter case the use of this source cannot be considered low but rather medium. Moreover, in case of this knowledge source the larg-

Table 8 **Governmental and non-governmental organizations – the use of selected knowledge sources by different types of manufacturing companies**

Knowledge source / Type of manufacturing companies	Networking groups or associations	Scientific institutions (including universities)	Governmental or local government institutions
low and medium-low technology	1.63	1.94	1.59
medium-high technology	1.79	2.23	1.57
high technology	1.87	2.64	1.69

Source: own study.

Table 9 **Governmental and non-governmental organizations – statistical difference between use of selected knowledge sources by two primary types of manufacturing companies**

Knowledge source / Type of manufacturing companies	Networking groups or associations	Scientific institutions (including universities)	Governmental or local government institutions
low and medium-low technology	1.63	1.94	1.59
high and medium-high technology	1.81	2.33	1.60
difference (high-low)	0.18*	0.39***	0.02

Note: *p < 0.1, ***p < 0.01.

Source: own study.

est differences between examined companies can be observed. The least utilized by analyzed companies knowledge source in this group, and generally in the research, are governmental or local government institutions. Surprising is the fact that analyzed manufacturing companies also practically do not use networking groups or associations.

Table 9 presents the differences between two aggregated groups of examined companies. Despite overall little importance of knowledge sources in this group very significant statistical differences between their use among analyzed enterprises have been observed. Particularly significant difference (p<0.01) has been noted for knowledge source of scientific institutions (including universities). In case of "networking groups or associations" statistical difference has been discovered but it is less statistically significant than in previous instance (p<0.1). In case of "governmental or local government institutions" the use of this source by both aggregated groups is practically equal.

Table 10 clearly shows that the more advanced type of technology of goods produced by company the use of research and development activities as knowledge source is more intensive. Especially high is the difference between first and last group of companies. One should note how large is the difference between low and medium-low technology and high technology manufacturing companies. For the former entities own research and development activities are the second most important knowledge source (3.67) – after customers (3.97). For medium-high technology manufacturing enterprises – third (3.23) after customers (3.55) and suppliers (3.27).

Table 11 shows that the difference between two distinguished, aggregated groups of companies is very large and

Table 10 **R&D – the use of selected knowledge source by different types of manufacturing companies**

Knowledge source / Type of manufacturing companies	Own R&D
low and medium-low technology	2.74
medium-high technology	3.23
high technology	3.67

Source: own study.

Table 11 **R&D – statistical difference between use of selected knowledge sources by two primary types of manufacturing companies**

Knowledge source / Type of manufacturing companies	Own R&D
low and medium-low technology	2.74
high and medium-high technology	3.34
difference (high-low)	0.59***

Note: ***p < 0.01.

Source: own study.

very statistically significant. It is the largest difference observed among examined knowledge sources in this article. If we would compare just low and high technology manufacturing companies we would probably receive much larger difference. Unfortunately, the number of examined high technology companies is too low to get reliable results in such comparison.

Summary

Results show that research and development is crucial knowledge source for high and medium-high technology manufacturing companies. Nevertheless, it is much less important for low and medium-low technology companies.

In general, with few exceptions, the research shows that high technology manufacturing companies use more intensively practically all examined knowledge sources. They look for valuable knowledge in many various external sources of their environment what is understandable due to competitive market. The use of analyzed knowledge sources varies a lot. The most popular are market knowledge sources, especially customers, suppliers and among high technology companies – competitors. Customers are the most important knowledge source for each type of analyzed manufacturing company. Among very important knowledge sources, but only for high and medium-high technology manufacturing companies, are own research and development. Knowledge sources that have been used the least belong to the groups of governmental and non-governmental organizations and knowledge purchase. These are networking groups or associations, governmental or local government institutions, external expertise/external expert advice.

The largest differences in use of particular knowledge sources among aggregated groups of companies – low with medium-low and high with medium-high have been observed in case of research and development (0.59), market research (0.43) and scientific institutions (0.39).

The research has certain limitations that are related to the questionnaire survey used as well as implemented methods of analyzes. The author's main goal, while designing the survey, was simplicity. The research tool was supposed to be well understood by every person that was taking part in the research. This attitude increased the number of received and fully filled surveys but caused that the results were not so detailed, including those concerning knowledge acquisition sources.

In case of knowledge sources analyzed in the research, they were based on the knowledge management literature – but this area needs to be examined more thoroughly, in more detailed manner, with taking into account industries in which analyzed companies operate.

The limitation is small number of examined high technology manufacturing companies examined in the research. Grouping of companies used in this research is not perfect. As the research has shown high technology companies in many aspects differ from medium-high technology enterprises. Unfortunately, in this particular research there was no other possibility of grouping due to relatively small number of examined high technology companies. One may expect that similar situation is among low and medium-low technology enterprises. In the future research it would be better to examine all four groups distinguished by OECD separately.

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Dr **Marcin Soniewicki**, Uniwersytet Ekonomiczny w Poznaniu.