DOI: 10.18515/dBEM.M2017.n02.ch17

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3.4. INNOVATION – THE IMPORTANCE OF KNOWLEDGE NETWORKS

Summary
The global social and economic changes that could be felt in the past decade forced the players of the public and private sector to base their decision making mechanisms on information of better quality while reacting to the challenges of the era. The actuality of our paper lies in the fact that the need to have punctual information disclosed about the single organisations, sectors of the national economy and the innovation activity as well as the features of the entire economy is more and more underpinned by recognising the economic role of innovation. In our paper we present the role of knowledge networks activity of the Hungarian agricultural machinery manufacturers in the innovation process efficiency. The conclusions of our paper are based on the examination results of questionnaires and in-depth interviews that were carried out at 58 Hungarian agricultural machinery manufacturing companies.

Keywords: innovation, marketing, knowledge networks, key factors of innovations

Introduction and objectives

The current production of the Hungarian agricultural machinery manufacturing sector, which used to see better days, lags behind the production of the previous years to a great extent. The general financial, organizational and structural poblems of the Hungarian agriculture can be detected in this sector as well (Borbély et al., 2011). The organisational structure of the Hungarian agricultural machinery production has been transformed, primarily regarding its ownership structure. The general problem of this sector is that they can only spend slight amounts on development an innovation relative to foreign-owned concerns. The extent of market loss and the general situation of the Hungarian agricultural machinery manufacturers justify that the present of this sector must be dealt with by searching the ways-out of the crisis and make steps to develop. Before the political and economic changes in the 1990s, only 27 agricultural machinery plants operated mostly "embedded" in the system of the Hungarian "agri-business". Due to this fact (among others), 60 percent of the requirements for agricultural machinery in the country were covered by these plants at a more advanced standard than the average of the former socialist countries. During the past 15-20 years the organisational structure of the Hungarian agricultural machinery production has totally been transformed (Losoncz, 2008; Fenyvesi, 2005). Generally, the machine manufacturers operating as small-or medium-sized enterprises appear on the market with "separate" products usually not developed by themselves. Consequently, they are not price-setters, rather price takers. The product line of the companies that are successful in the international competition primarily consists of mass-produced and highly automated products. The Hungarian agricultural machinery manufacturers-partly due to their size- are not able to mass-produce in such an extent that they could compete with the West-European, American and Asian companies of huge capital power either in productivity, price or product range. A drastic innovation wave could

mean a break out of this situation. Regarding innovation, the Hungarian agricultural machinery manufacturers also significantly lag behind as they can only spend slight amounts on development relative to foreign-owned concerns. As a consequence, loss of market is not surprising as a bit more than one-quarter (26-27%) of the current total domestic market turnover comes from domestic manufacturers. The success of the innovation is decided on the market, therefore it is important that the product development how it is prepared and followed by knowledge networks. It is possible that the earlier phases deficiency can be corrected by networking activity, but it can also happen that previous good results can be destroyed by a wrong market activity. Therefore, the harmonization of agro-technological innovation processes is essential (Magó, 2011). Innovation and R&D activities are supported by different tools, some of them are connected to the tax system. The relations between R&D&I activities and tax allowances are different in different sectors of the national economy. Illés et al. (2013a; 2013b) examined how different agricultural companies could utilize these allowances, while Hustiné et al. (2014) focused on car traders. Their findings underlined that the innovation activities are lather low, companies with profitability problems cannot utilize the available support tools, which will affect their R&D&I activities as well.

The technical advantage of the innovation can only be realized if adequate networking skills can support and complement the new products and technologies (Husti, 1990).

The innovation processes have been described by the first linear models that product ideas are born, based on these new product is planned, produced, and sold. However is more effective when the process starts out from the market needs, the new products are planned, manufactured based on these, and during the selling process the satisfaction of the needs is controlled. Nowadays it is essential, that the networking has to link all the processes, including the innovation too.

The task of the innovation networking is not just selling the novelty, but to acquaint the expectations of the relevant stakeholders and with this to help for the management to increase the support of the strategy by satisfying the market demands on a reasonable and legitimate way, and on the other hand, to promote the acceptance (diffusion) of planned and implemented results of the innovations as well.

Strategy in the competitive market is such a guideline of corporate function that defines the long-term goals and the system of means and methods that are necessary to reach them. Strategic planning plays an important role at all types of companies especially in the case of the innovative ones as it is they who dare to enter an uncertain area in its technical and economic sense due to their special activities (Edquist, 1997). A thoroughly planned conscious strategy is the basis for creating innovations and operating an innovative organisation. Innovation strategy has to derive from and serve corporate strategy. The main point of innovation strategy is how the company can reach the market starting from research and development via product/service/ technology production in the easiest way. An effective innovation strategy is implemented in a simple, concentrated way to a small extent so at the beginning scarce resources (funds, labour) are used and, simultaneously, the way out is also considered (Bak, 2013).

Our research objectives are summarised in the following points:

1. Reviewing and evaluating the relevant national and international literature on the topic with special regards to the features of agricultural technological innovations.
2. Preparing and improving a questionnaire and a method of examination that can be used to collect primary data on the innovation activities of agricultural machinery manufacturers.
3. Preparing a thorough picture of the present situation and performance of agricultural machinery innovations as well as the direction of developments on the basis of the empiric research and methodology.
4. What are the main indicators, decisive trends and narrow cross sections of the innovation performance of the national agricultural machinery manufacturers?
5. How can the effects of the global economic climate be felt by the enterprises with special regards to their innovation activities?
6. What is the cooperation activity of enterprises like, what are the characteristics of their social network and how can they affect innovation activities?

Material and method

The basic objective of the research is to explore and analyse the innovation activity of the Hungarian agricultural machinery manufacturers, its results and influencing factors. Finally our objective is to have a picture of the innovation activity of the organisations involved, the special features of innovations, the partners taking part in the processes and the impact of innovation on the general situation of the companies through our examinations. Besides the brand-new or significantly developed products and technological procedure innovations, organisational features, marketing activity and the environment of the innovation are also considered. The questionnaire serving as the basis of primary research embraces three years, from 2007 to 2009. According to the estimations of experts the number of agricultural machinery manufacturing companies is between 160 and 170 in Hungary. (A great part of the enterprises are involved in more than one activity: a lot of predominantly small enterprises are also engaged in other activities besides machinery production so that is why it is difficult to define the actual number of 'agricultural machinery manufacturers' exactly). Most of the organisations that are subject to our analysis are small enterprises whose annual revenue does not reach one billion HUF. As there was not an available list on all the companies on the basis of which a pattern of probability could have been compiled, the companies that could be drawn into the research had to be defined in another way. To find the companies necessary for carrying out the questionnaire, the address list of MEGOSZ (National Association of Agricultural Machinery Manufacturers) served as a basis and the heads of this professional organisation were also consulted.

Basically our research is based on primary research within the framework of which a questionnaire was compiled. When drafting the questions the results of our secondary research data on this industry were considered and also the 2005 edition of 'Oslo Handbook' was consulted that formulates OECD guidelines for collecting and interpreting technological innovation data. According to the general methodological requirements some pilot interviews were made a first and afterwards the questionnaire was finalised on the basis of our experience.

In compliance with the general methodological requirements first of all some pilot questions were asked on the basis of which the questionnaire was finalised. Data recording took place between March 2010 and September 2010.
The duration of in-depth interviews was various, typically 90-100 minutes per interview. A positive feature of them was that data providers mainly come from the senior management (chief executive officer, head of production or technical manager). In this way first-hand information on the general situation, actual projects and strategic plans of the organisation involved was gained besides the reliability of data. The atmosphere of the interviews was typically of honesty and intimacy. Some of our interviewees have already expressed their enquiry in our results. The questionnaires compiled on the basis of the interviews and sent out by post were also accompanied by a guide to filling in. A kind of evaluation of our preliminary work is that all the responding organisations gave answers that could be assessed.
The statistical processing of data recorded by the questionnaires was carried out by using SPSS 13.0 programme.
The multi-channel approach was used when recording the data of the research whose main points are the following:

- 15 machine manufacturers were interviewed personally.
- Questionnaires were sent to 25 organisations by post asking them the send it back after filling in the questionnaire.
- The electronic version of our questionnaire was sent to organisations incorporated in the MEGOSZ database. Altogether 18 questionnaires were returned.

Issues of sampling, reliability and precision level of infinitive population from equation:

$$\Delta = z \cdot \sqrt{\frac{p(1-p)}{\tilde{n}}}$$

where: z = quantile of the standard normal distribution,
p = reliability,
Δ = level of accuracy,
$\tilde{n}$ = size of population.

The next equation corrects an infinite population size ($\tilde{n}$) to the finite population size (n):

$$n = \frac{\tilde{n}}{1 + \frac{\tilde{n}}{N}}$$

where: $\tilde{n}$ = size of population (for the infinite)
n = size of population (for the finite)
N = the number of elements in the population.

The same questionnaire was used in all three approaches so figures can be compared. Fifty eight organisations supplied data in the examination. An approach based on proportion estimate was selected to ensure the reliability and accuracy of the research. The accuracy level of the entire sample is ±7,7 per cent points with fixed 95 per cent reliability on the basis of the statistical calculations that were carried out.

Results

Table 1 shows the aggregated revenue of the enterprises concerned. Seventy five percent of the revenue derives from agricultural machinery manufacturing.

Table 1: Correlations of revenue data (n=58)

Revenue (million HUF/year)	2007	2008	2009	Enterprise size by revenue (%)	2007	2008	2009
Total revenue	5370	5920	5500	Small (<700)	51,7	48,3	44,8
Average	1094,9	1285,7	1140,1	Medium (700-4000)	41,4	44,8	48,3
Median	692,5	708,6	665,2	Large (4000<)	6,9	6,9	6,9
Maximum	8273	9752	6101				
Minimum	28	25	20				

Seventy two percent of the examined organisations sell on the Hungarian market and in the past three years there was no significant change in this respect. The average revenue was approximately 1 billion Ft. Median helps formulate a clearer picture about the situation as a revenue of 700 million Ft is typical of the SME sector in Hungary.
Within the examined period 34,5 percent of enterprises had a separate R&D division, which can be regarded as favourable when compared to surveys in other industries.
Regarding organisational form, an interesting finding is that 48,2 percent of the enterprises operate in a linear while 37,9 percent of them in a simple organisational form, i.e. they do not have functionally separate organisational units while 13,8 percent have functional organisational forms.

Inputs of innovations

According to the results the examined enterprises realised the necessity of development and the figures show an increasing tendency in this respect. Enterprises tend to have spent more on innovation as of revenue (Table 2).

Table 2: Innovation, R&D and marketing expenditure as of percentage of revenue (n=58)

Average (%)	2007	2008	2009	Median (%)	2007	2008	2009
R&D expenditure	2,6	3,38	4,1	R&D expenditure	0,9	1,7	2,1
Innovation expenditure	3,0	4,3	5,3	Innovation expenditure	1,3	2,7	3,9
Marketing expenditure	1,3	1,6	1,8	Marketing expenditure	0,7	0,9	1,4

When examining the median, again a clearer picture can be obtained. 1-2% of the revenue is spent on research and development while 3-4% is used for innovation.

Outputs of innovations

According to my examinations 65,6 percent of enterprises during the period of examination launched a new product to the market or modified some and 68.9 percent carried out technological innovation. Fifty nine percent started to be implementing an innovation project at the time of the survey. The development of a new product of global standard is, unfortunately, very limited (5,3 %). 34,2 percent of the implemented product developments by the enterprises can be regarded as a novelty under Hungarian circumstances. At the same time a significant part, namely 60,5 percent are only about innovations of modifying-developing nature. With respect to modernity, manufacturers seem to concentrate on rather technological development as 48,7 percent of the examined sample developed/introduced new technologies not applied so far in Hungary.

Another aspect of research-development and innovation activities consists of publications and patents. In this aspect the performance of Hungarian agricultural machinery manufacturers is rather weak. During the examined period regardless of one or two examples patents and publications were not typical of the enterprises in the industry.

The characterisation of the market environment

Technological and market uncertainties have a profound impact on the operation of the company and makes a decisive influence on innovation processes-that is why their analysis is of high importance. In the following part we publish the results of our questionnaire in connection with the market environment. An answer was intended to find what changes the management think were made in the sector regarding market and technological uncertainties in the past three years. Also, the main reasons for this were also searched.

Figure 1: Changes in the sectoral environment (n=58)

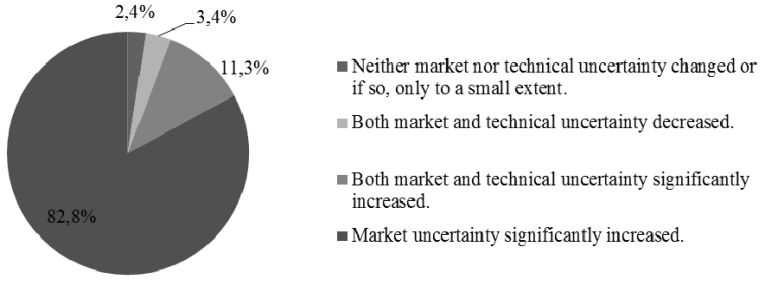
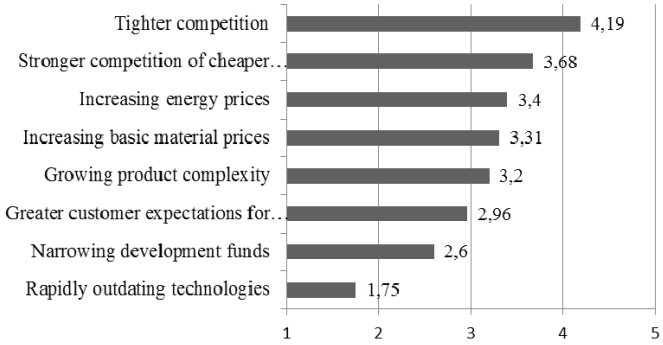


Figure 1 shows that nearly 83% of the companies think that market uncertainties can strongly increase during the examined period. It is not surprising as due to the global financial crisis all the sectors of the Hungarian economy have had to tackle serious issues and pessimism has also become general. Almost all respondents expressed their pessimistic opinions even during the small talk after the interviews had taken place.
Technical uncertainties have had a significantly slighter impact. One of the reasons for this can be that the sector does not change in a quick and predictable way when taking the basic technical considerations into account. Also, our results reflect that the main direction of innovations is developing the existing products so enterprises do not really dare to enter areas of uncertainties from technological point of view (except one). Some respondents made a complaint about spare parts of bad quality purchased from Chinese sources as a technical uncertainty.
If we examine the reasons for environmental uncertainties (Figure 2) the fact that organisations are aware of market and technical risks to a different extent is justified. The strongest environmental uncertainty is increasing competition (4.19) while the rapidly outdating nature of technologies (1.75) has the slightest impact. As mentioned earlier, the national producers are not price setters, rather price followers. So the stronger competition from the cheaper producers (3.68) as well as the rising energy (3.4) and base material prices (3.31) result in limited opportunities for the national

agricultural machinery producers. Its direct impact on innovation activity is that producers cannot make funds /savings for development and very frequently they even lack the capital necessary for the project application. The complexity of the products and the needs of the customers for development can be characterised by medium values regarding the other factors of uncertainty. However, it can be seen that the expectations of the clients for development have been growing in the past few years.

Figure 2: Reasons for uncertainties in the sectoral environment (n=58)



1-Did not play a role at all, 5-Had a significant role.

An interesting result is that of the reasons for uncertainty *narrowing development sources* (2.6) play a minor role. According to the producers financing innovations typically takes place mainly from own capital by channelling back the profit without the inclusion of an external source (credit). That is why it is felt to a smaller extent that the risk taking role of the banks has significantly been decreasing and consequently made the financing of less predictable innovations more expensive. The rate of changing technologies can differ in the market of certain products. In line with the results above, the *rapidly outdating technologies* (1.75) in the case of agricultural machinery are not the factor of technical uncertainty.

The innovation knowledge networks of agricultural machinery manufacturers

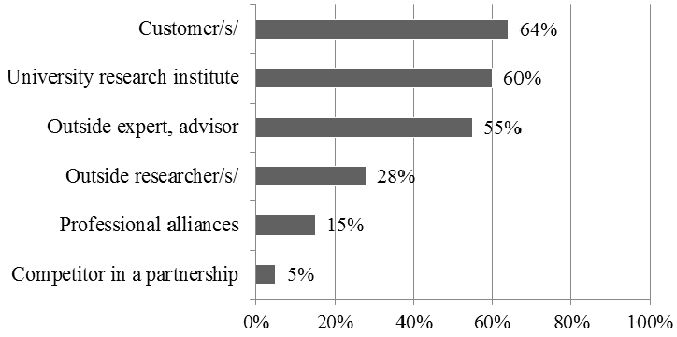
According to our survey almost 87 percent of the companies concerned in research-development cooperation have already taken part in a form, which can be regarded a fairly good proportion.

Table 3: Correlations between R&D cooperations and product- and process innovations

The proportion of R&D cooperation (%)	Product inn.(%)		Total %	Procedure inn. (%)		Total %
	No	*Yes*		*No*	*Yes*	
Never	75,0	25,0	13,8	100,0	0,0	13,8
Sometimes	34,8	65,2	79,3	30,4	69,6	79,3
Always	12,5	87,5	6,9	0,0	100,0	6,9
Total (%)	34,5	65,5	100,0	31,0	69,0	100,0
n (item)			58			58
Significance			0,016			0,008
Cramer V			0,377			0,406

Results show that for those who have never taken part in cooperation (although their proportion is slight, 6,9 %) the number of successful innovations is low. In this aspect the most active ones are who have always incorporated a partner in their innovation processes. A decisive part of the sample, i.e.79 percent occasionally participate in cooperations. In this case a significant difference can also be noticed as the ratio of the active ones is approximately 70 percent. There is a significant correlation between product, process innovation and R&D cooperation and the strength is the correlation is close to satisfactory.
The extent of R&D activity (Figure 3) reflects the most decisive directions of knowledge flow. These results illustrate the demand-driven nature of innovations in the agricultural machinery sector. Companies are trying to cooperate closely with their customers in order to know their needs. Sixty percent of the sample examined has already taken part in a common research-development project with a university research institute.

Figure 3: Proportion of R&D cooperation agreements of agricultural machinery manufacturing companies (Relative frequency, more than one answer could be given) (n=58)

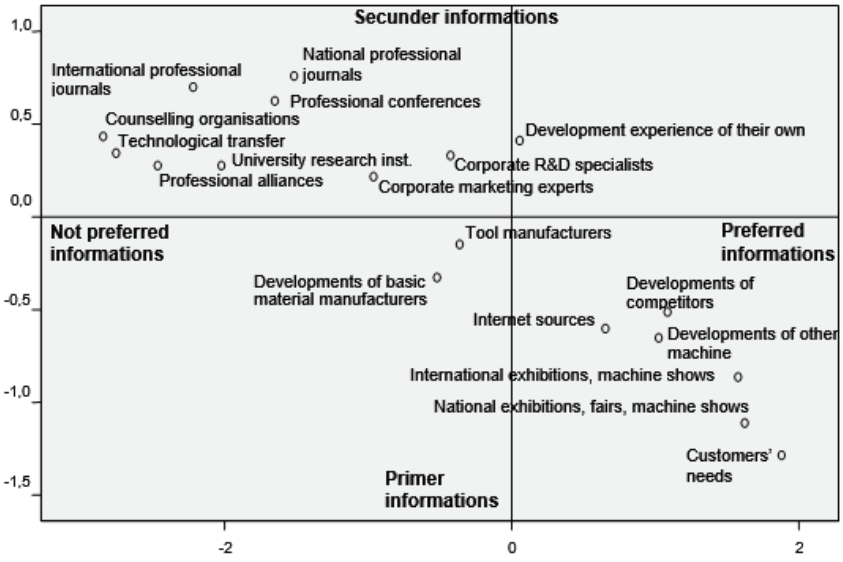


In order to get to know the typical groups and alliances the information managing habits of enterprises were also considered in the multidimensional scaling. The fitting of the model is good (RSQ = 0,95413) and the quality of solution can also be regarded good (Stress = 0,09959). When analysing the MDS map of information managing habits (Figure 4) we can find the typical groups that were described alongside two dimensions. The first dimension is the preferred-not preferred information on the horizontal axis while information (primary/secondary) is included on the vertical axis.
Typical groups:

- *Preferred primary information:* customers' needs, national and international machine exhibitions, and a further preferred source is the information of competitors and other machine manufacturers.
- *Slightly preferred information:* development experience of tool manufacturers, basic material manufacturers and of their own, information deriving from corporate R&D specialists and marketing experts.
- *Less preferred secondary information:* The use of national and international professional literature can be described as a less preferred secondary source.

Another less preferred group is the one of counselling, technological transfer organisations and professional alliances.

Figure 4: MDS map showing the information managing habits of enterprises



On the basis of the cross table and Chi-square analyses a positive connection can be observed between the two variables, i.e. different cooperations promote the innovation activities of agricultural machinery manufacturers in Hungary. According to the examination on the use of information sources we can state that of the information for their innovation activities enterprises prefer market like information sources most such as their customers and different professional exhibitions.

Conclusions and suggestions

The characteristics of the Hungarian agricultural machinery manufacturers drawn in the examination illustrate the situation of the sector in the country. A decisive part of the organisations (about 90 %) are small-and medium-sized enterprises. All in all, only about 26-27% of the national need for machinery derives from national manufacturers. Their attitude in development is reflected by the fact that more than 70 percent of their products are sold on the domestic market. Among the examined indicators of innovation performance the following ones must be highlighted:

- Organisations were spending more and more on R&D in the examined years, in 2009 it comprised 4.1 % of their average revenue. This value means a nominal increase of 154% relative to the one in 2007.
- More than 80% of the companies concerned have already been taking part in R&D cooperation. In these forms of cooperation, the proportion of the relationship with the customers is the highest, which indicates the priority of demand-driven innovations. It is also important to note that 60% is the proportion of partnerships with university research institutes.

- We stated that of the innovation used for innovation activity the national agricultural machinery manufacturers mostly prefer primary like sources. With the help of a multidimensional map information managing habits connected to innovation activities were divided into three groups along two dimensions: preferred primary like, slightly preferred and less preferred secondary information.
- We proved that for the Hungarian agricultural machinery manufacturers there is a positive significant (Sig_1=0,016; Sig_2=0,008) correlation of medium strength between innovation activity and cooperation ($CramerV_1$=0,377; $CramerV_2$=0,406). Our further examinations explored that in innovation cooperation it is typically the customers (64 percent) and university research institutes (60 percent) who are the preferred partners.

Manufacturers must show a greater interest in exploring and applying the new knowledge accumulated outside their organisational boundaries. In order to keep pace with market and technological changes as well as integrate new scientific results cooperation with professional alliances and specialist universities must be prioritised in their innovation processes. I would also highlight the role of strategic behaviour in the success of innovation processes. The management has to make decisions on investment and development on the basis of a strategic approach in line with systematic innovation objectives.

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