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EXAMINATION OF THE HUNGARIAN AGRICULTURAL MACHINERY MANUFACTURERS' PRODUCT PLANNING, QUALITY MANAGEMENT TECHNIQUES AND PRODUCTION COORDINATION

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Abstract

The present research was conducted in July 2017. We get information about what kind of software is used in the areas we are investigating. It was examined, whether IT systems are used for enterprise resource planning. It was reviewed how the failure mode and effect analysis (FMEA), the rapid prototype modelling and the quality function deployment (QFD) are extended among the agricultural machinery manufacturers. We compare the results with the International Manufacturing Strategy Survey and an earlier survey conducted by us in the Hungarian cob cracker industry. The comparison of the agricultural machinery manufacturers, Hungarian and international companies' average shows us the areas we should develop

Keywords

product planning, quality management techniques, Hungarian agricultural machinery manufacture.

1. Introduction

The research is based on the questionnaire of the International Manufacturing Strategy Survey (IMSS) [1]. The IMSS was set up in 1992. The goal of the participant researchers was to have an overview about international production strategies, their introduction and their results in production and related areas (eg supply chain management, new product development etc.) [2]. The data collection was carried out internationally in Europe, America and Asia. The international data include the results of the 2009 IMSS research (562 company data). After the international research it was realized a Hungarian survey with a participation of 71 companies [1] [3].

2. International and Hungarian surveys

The surveys about the manufacturing strategy play an increasing role in the research of manufacturing management. We collected these surveys and summarized in the table 1. An overview about the researches is very important to be able to make proposals to develop the IMSS.

3. Methods

Next to the international and Hungarian IMSS we made a new research among Hungarian agricultural machine manufacturers. Within the framework of this survey 57 companies have been asked. In the survey the whole cob cracker adapter manufacturing sector was represented, which made us possible to compare the performance of this sector with the results of the other surveys (international, Hungarian and agricultural machinery sector) [12].

It is important for Hungarian agricultural machinery sector to meet the needs of the domestic agriculture. Domestic-built machines include, machines for tillage (plows, disc harrows, seedbed makers, cultivators, rollers), sprayers, harvester and thresher adapters, stalk crushers, tractor-loading machines and trailers, animal husbandry tools, handling, storage and farm machinery. These machines and tools can be used by small and big farms. The domestic agricultural supply offers a choice for all kind of farmers [13].

The aim of our quantitative research was to compare the cob harvesting adapters industry and the agricultural manufacturers with the results of the domestic and international IMSS. The questionnaire uses a measurement scale in some cases. The scale has values from 1 to 5. 1 represents the worst value,

3 is neutral, and the higher values are positive [14] [15].

When reporting the results, the term "industry", "machine manufacturers", "Hungarian" and "international" are used in the table header. In this case, the industry means the Hungarian cob cracker industry, “machine manufacturers”, the Hungarian agricultural machinery manufacturers, “Hungarian” referring to companies operating in Hungary, and the “international” reflects the corporate data collected in other countries. It was presented in all figures the average value of the sectors.

Table 1. International surveys about manufacturing strategy [4] [5] [6] [7] [8] [9] [10] [11]

SURVEY	SECTOR	SUBJECT
International manufacturing research group	Small machine tools	Efficiency, sales, forecast, manufacturing planning
International manufacturing strategy	Machine manufacturers	Business, strategies, manufacturing programs, manufacturing efficiency, plans for the future
International research of the production’s future	America, Europe, Japan	Production strategy
World level manufacturing project	Electronics, vehicles, machines (America, Japan, Germany, Italy, UK)	Organisation factors, human resources, technology, infrastructure, quality management, partner relations, efficiency
Research of competitiveness	International	The whole process of the functioning (business, efficiency, relationships etc.)
Lean management	International	Introduction of the lean management
Other related research	International	Competitiveness of the countries

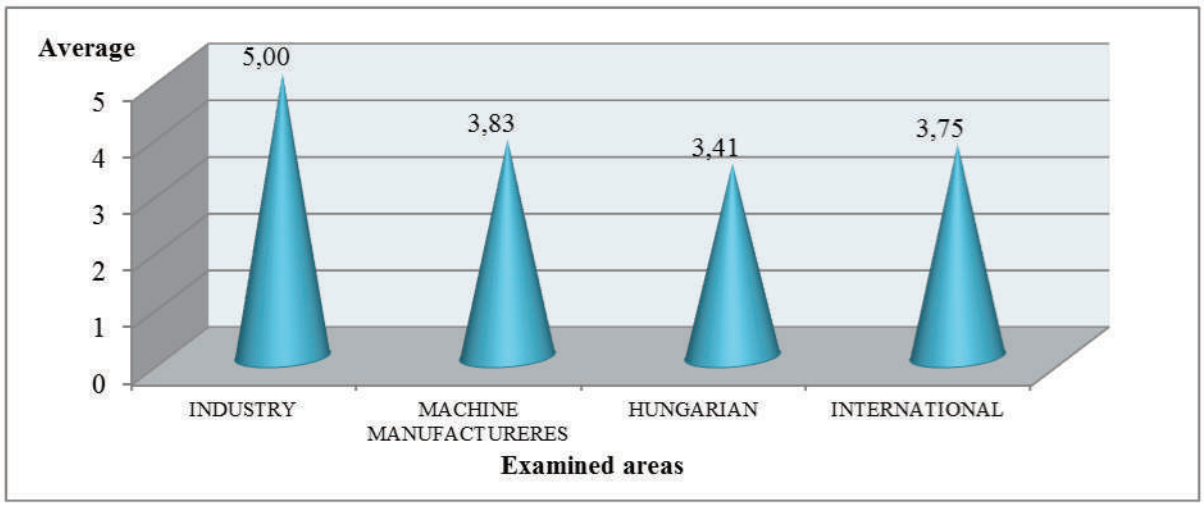

Figure 1. Usage of CAD/CAM software (scale 1-5, 1= not used, 5= frequently used)

4. Coordination of the product planning and manufacturing at the Hungarian agricultural machinery sector

The coordination of product planning and manufacturing was examined with seven questions. CAD / CAM software help engineers and other design specialists in the cob cracker industry in their planning activities. The values are higher than the Hungarian and international average. This may be due to the fact that CAD software is nowadays the most basic design tool for engineers (engineers, builders, architects). As in the case of Hungarian agricultural machinery manufacturers, like the international one,

the more modern design programs (Inventor, SolidWorks, ProE, CATIA) are widespread (Figure 1). It can be assumed that there are several manufacturers among the examined companies, which are multinational firms, where the parent company is a foreign owner and a larger amount is spent on upgrading software.

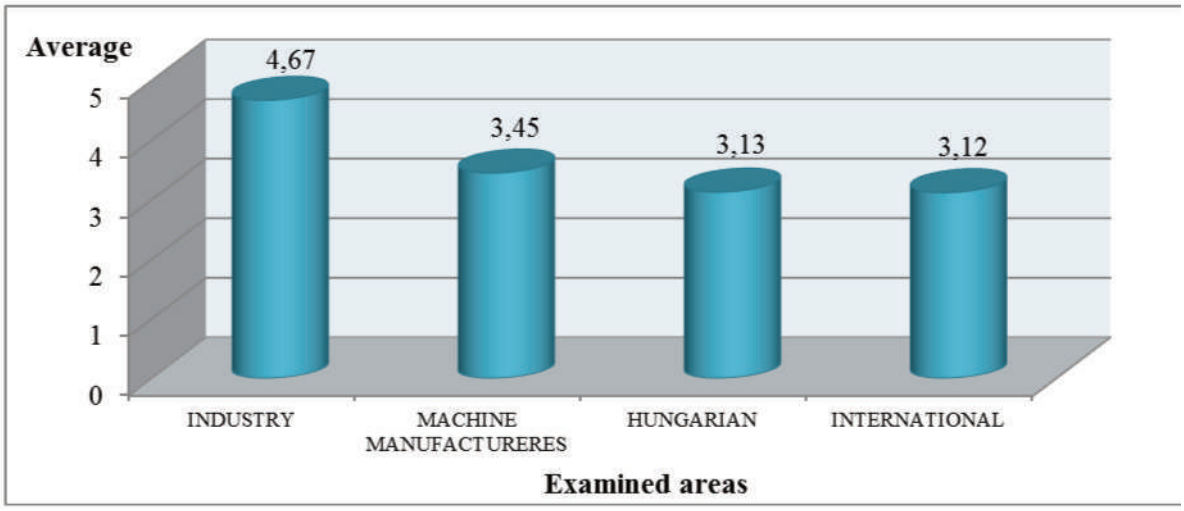

Figure 2. The role of planning (scale 1-5, 1= not used, 5= frequently used)

In the case of product planning and manufacturing coordination, we consider, it is important to study how the planning is being implemented. Machine manufacturers, with an average of 3.45, are on a similar level with the other investigated groups (manufacturers 3.45, Hungarian 3.13, international 3.12). The manufacturers of corn harvester adapters have the highest value of 4.67 (Figure 2). It can be deduced from the results of the other examined areas round the middle vale that they don't focus so highly on the planning of production and assembly. In spite of this, the planning plays an important role in engineering.

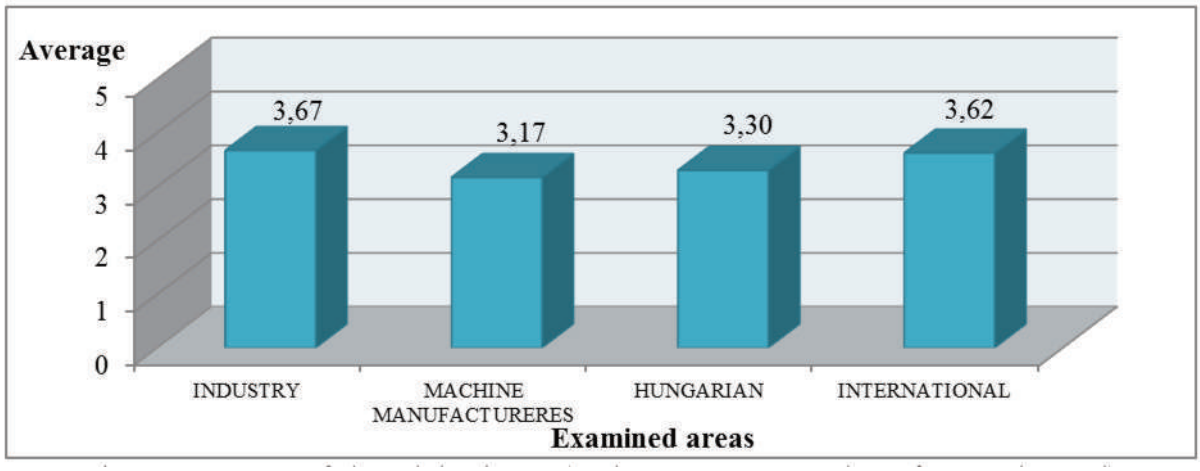

Figure 3. Usage of shared databases (scale 1-5, 1= not used, 5= frequently used)

When analysing the shared databases, it can be seen that the area of production of agricultural machinery (3,17) had the lowest value among the four areas. The Hungarian average did not differ significantly from the previously mentioned value (3,30). Figure 3 shows that the industry and international average are very close to each other. So, in all four areas, the average is higher than 3 that reflects the importance of reliable and long-term storage of data and the relatively quick retrieval of data.

We investigated the presence of corporate resource planning systems for agricultural machinery manufacturers. The results were compared to the averages of industry, Hungarian and international survey (Figure 4). In ERP systems, procurement, logistics, billing, shipping, financial, corporate governance, etc. processes can be integrated. All the operations can integrate that are part of a company's management, production and sales tasks. In the industry, 3.33; machine manufacturers 2.48; for Hungarian companies 2,68; international 3, 68 were the values. The background of the very low value of manufacturers, is that the questions were answered mainly by micro and forced enterprises.

In case of forced enterprises, the reason is often that they do not know the corporate governance system. In case of micro companies owner and the company manager coincide in almost every case. There are no different groups involved, the owners work with a small number of employees. However, information is also a competitive advantage for them, so from the low value it can be seen that micro company / computing companies employ a small number of enterprise resource planning systems.

The low value of Hungarian companies means that most of the respondents are small and medium-sized companies, so introducing the ERP system is a big challenge for them. Based on the industry average, it can be said that the introduction, the software and systems are not a local decision, but rather the needs of foreign owners determine the process of the investment.

The FMEA (Failure Mode and Effect Analysis, for error, cause, and impact analysis) method can be used for product design and manufacturing process in parallel. In our study it becomes clear that the four areas use this method to a lesser extent (Figure 5).

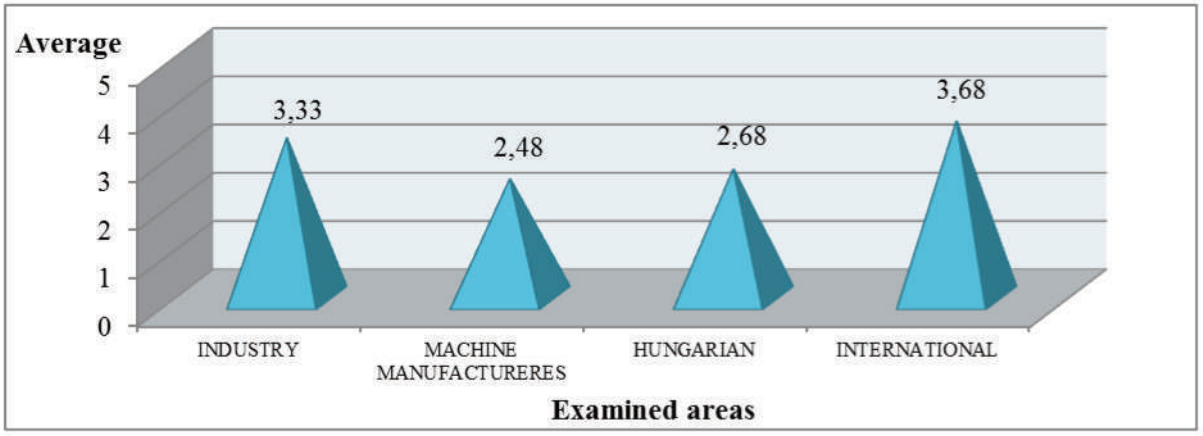

Figure 4. Enterprise resource planning (ERP) (scale 1-5, 1= not used, 5= frequently used)

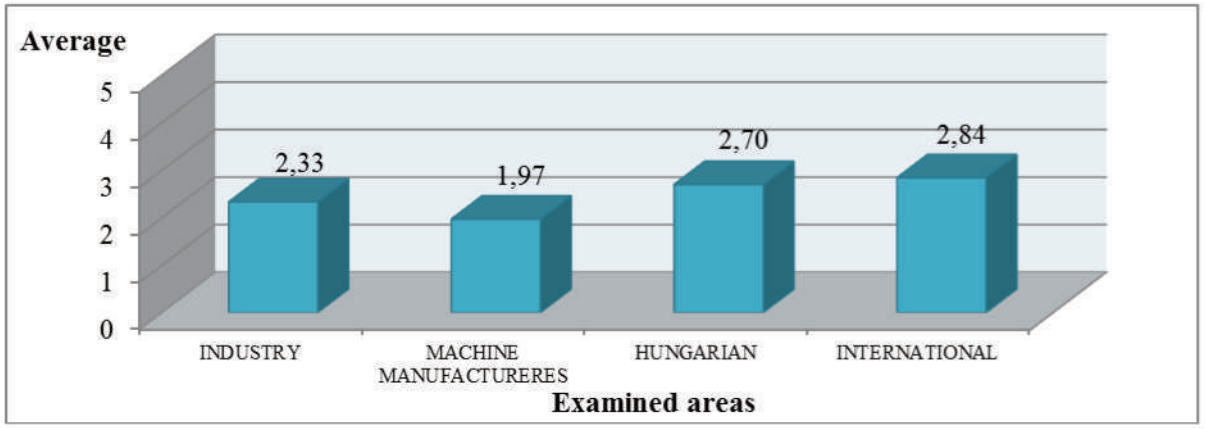

Figure 5. Failure Mode and Effect Analysis (FMEA) (scale 1-5, 1= not used, 5= frequently used)

It can be explained that FMEA has been slightly expanded due to its time requirement and that subjectivity is present in the risk assessment, therefore we cannot get sufficiently objective results in many times.

The benefits provided by the method would be advantageous, regardless of industry and size of the company, for example, ranking mistakes based on estimated risks, dealing with future defects in a product, process, or system, this can be prevented so you can save costs.

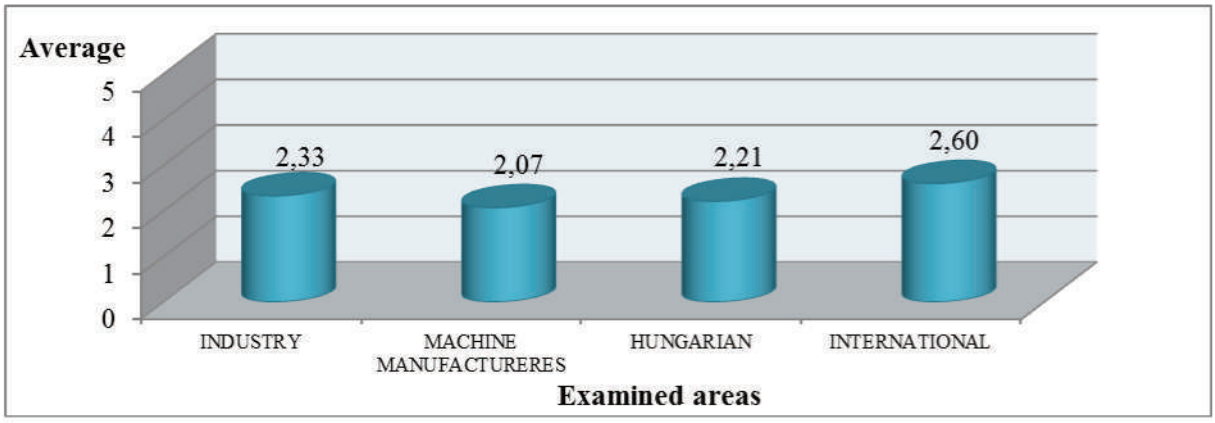

Figure 6. Rapid Prototyping (scale 1-5, 1= not used, 5= frequently used)

Fast prototype modelling was below middle value in all four areas. This is because maximum efficiency, high cost, too much work-saving and control cannot be solved for small-scale models of rapid prototype (RP) technologies (Figure 6). We would be desirable to put more emphasis on quick prototyping, because the insertion time of the pieces would decrease, design errors could be discovered, repaired and tested more easily.

The QFD model (Quality function deployment - "Quality House") is a tool for quality systematic development that can be used for product design, construction and technology. Used to a small extent in the four areas under investigation (industry - 1.67, machine manufacturers - 1.66, Hungarian - 2.03, international - 2.65) (Figure 7). The reason for this is that the team needed to produce the QFD model is missing (due to lack of expertise). A leader needs for the team who leads a QFD project, motivates and educates the team members.

A QFD expert is needed in the team also. He is the one of them who develops his knowledge from conferences and literature, passes on it, controls the method and highlights the main issues. The members of the group must implement the QFD project, using their own experiences. By team-building and using the QFD method, customer requirements can be fulfilled and can reduce the loss costs that could hinder work.

5. Conclusion

We examined and compared four areas (Hungarian corn harvester adapting industry, Hungarian agricultural machinery manufacturers, other small and medium enterprises in Hungary together, and international companies with different production activities) in our qualitative research, bearing in mind the production technology.

Our research has resulted that the product design and production coordination (from a technological point of view) structured as follows by regions:

- –corn harvester adaptation industry: 3.29
- –Hungarian agricultural machinery manufacturers: 2.66
- –other small and medium enterprises in Hungary together: 2.03
- –companies carrying out different production activities in other countries: 2.65

In summary, in the field of agricultural machinery manufacturing, product design and production iare mainly based on CAD / CAM software and shared databases, its values are higher better than middle value.

The enterprise resource planning systems, FMEA, QFD and rapid prototyping have reached a weaker value. Therefore, in the future, more emphasis should be placed on these areas in order to improve quality and cost-efficiency. Calculating an average value of

all these areas we receive 2,66 in the field of the agricultural machinery manufacturers.

As a conclusion, it can be deduced that the manufacturers mainly spend for technological development if they are able to implement them with support. These tenders are available in limited numbers in this area. The agricultural manufacturers would have opportunity for technological development if they could save costs. For reducing costs we would like to propose some fields to develop.

We propose to use more frequently the prevention technics like FMEA or QFD.

The benefits of the FMEA model would be useful, regardless of the size of the company. The ranking of the errors based on the estimated risks, and dealing with errors which have not yet occurred makes possible the prevention and thus can save costs.

In the examined sector we see a great potential for applying the QFD model. With introduction of QFD model, the time and cost of development could be reduced by 30-50% and less technical changes would be needed during the manufacturing process. The savings originate from the decline of technical changes, the improved production quality and the decrease of losses.

Additionally, it would be expedient to place greater emphasis on rapid prototyping because the time of product's introduction into the manufacturing would decrease, the errors of planning could be discovered and repaired earlier, and the structure of the product could be tested. With these results, working time and cost-effectiveness would change in a positive direction.

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