Szent István University

Management and Business Administration PhD School

Thesis of Doctoral (PhD) Dissertation

The role of information management in process development – an innovative approach to the Toyota-method

László Attila Csapó

Gödöllő

2017

Name of the PhD School: Management and Business Administration PhD
                            School

Course of the PhD School: management and business administration sciences

Head of the PhD School: **Prof. Dr. József Lehota D.Sc.**

                            Professor, Doctor of Science (MTA)

                            Szent István University,

                            Faculty of Economics and Social Sciences

                            Institute of Business Studies

Supervisor: **Dr. Árpád Endre Kovács PhD.**

                            associate professor

                            Szent István University,

                            Faculty of Economics and Social Sciences

                            Institute of Economics, Law and Methodology

....
  Approval of head of school   Approval of supervisor

TABLE OF CONTENTS

1. INTRODUCTION

1.1. Timeliness of the topic

„Infocommunication networks, tools, services and competences are increasingly contributing to improving the quality of life of citizens, the competitiveness of businesses and the efficiency of state operations. (...) However, in international comparison, the conscious use of info-communication tools among the domestic population and small and medium-sized enterprises is low. "(Ministry of National Development, 2013)

Since in our country the IT sector accounts for about 12 percent of the Hungarian GDP and the number of employees in the sector in Hungary is rather high, so I think it is necessary and urgent to consciously improve the utilization of the potential inherent in this factor not only in our country but also in other developing nation too.

In today's fierce competitive position, the Toyota-based management strategy that minimizes wastes, is one of the best strategic weapon to maintain competitiveness. In my research work, I became a dedicated devotee of this philosophy. Especially when I had the opportunity to undertake a course in the Toyota Engineer Training Center (TEC) where I had the chance to study from the professors who created the basics of the philosophy, and during the related factory visits, I also had managed to study the Japanese Toyota factory and its supplier operation. This has influenced me not only in my later research work, but in my personal development; in the organization of my everyday processes, and has placed it on a whole new basis.

On the basis of my personal experience, I have been given more motivation to continue to spread the Lean philosophy through my work, since the tools of the Toyota Production System (TPS) implemented by excellent specialists have been described and are now available to everyone, but it has not been a clear success among the introductory companies. That is why in my dissertation I write in detail what are the principles that must be observed in every circumstance.

And I also explain that during my research work I managed to develop processes using small causal actions, and show how we can achieve more development in a given time period.

1.2. Basic objectives and hypothesis of the research

As modern production systems have now gone beyond simple procedural-methodological basics and require philosophical, informational aspects that are now becoming the main driver of competitiveness, therefore, during my dissertation my main goal was to investigate the role of information management in process development using qualitative and quantitative methods, as well as the ever-increasing quantity of information available to us, and thus becoming more and more important, to be linked to the Toyota method philosophy in an innovative way, and to collect the success factors of Japanese management culture. I wanted to accomplish this main objective with the following objectives:

T1: The first objective of my dissertation linked to the success factors of the process development was to examine the success factors of innovation and competitiveness, and to analyze the methodologies that were used for this, the interrelationships between the subindices.

T2: Analysis of the results of the Enterprise Survey research in the corporate environment, especially in terms of Lean Principles. In my research, I wanted to examine the success factors - from the Lean perspective - and the interrelationships between minimizing wastes, respect of people and taking human resource as a value, and their presence in different countries and country groups.

T3: As an important task, I also consider improving the use and management of available information for some components of the Toyota method, in particular with respect to Value Stream Generation (VSM). That is why I have been aiming to develop a "helper" that provides positive help for the use of the Toyota House Toolbox and the higher level of development results available to them.

T4: Based on my fourth objective, I am trying to further develop the latest version of the Toyota House, due to the ever-changing market environment in my opinion justified it, as information and management of the information has become more important in process development than before.

Furthermore, I consider it important to clarify the differences and identities between the concept of Lean and the Toyota method.

In order to achieve my goals I set out my hypotheses, which I wanted to justify in my research. The hypotheses of the research are as follows:

H1.1: I assume that, despite the different calculation method, there is a positive, straight proportionality between the Global Competitiveness Index (GCI) and the Global Innovation Index (GII).

H1.2: I assume that the factors examined (Knowledge workers, Ecological Sustainability, Online Creativity, Knowledge linkages, Creative Goods and Services, Education, Research and Development, Credit, Knowledge Absorption, Knowledge Creation, Knowledge Absorption, Tertiary Education, Investment, Trade and Competition, Innovation Linkages, General Infrastructure, Intangible Assets, ICTs, Regulatory Environment, Political Environment, Business Environment), countries can be distinguished from distinct clusters that can design innovation directions from an innovative point of view.

H2.1: I assume that there is a positive, straightforward relationship between "Quality workforce" and "Productivity". During the present investigation, the following categories have the following characteristics:

- the quality of workforce: Number of permanent full-time workers; Number of permanent non-production workers; Number of permanent production workers; Number of permanent skilled production workers; Percent of firms choosing political instability as their biggest obstacle; Percent of firms with an internationally-recognized quality certification; Proportion of unskilled workers (out of all production workers) (%); Percent of firms offering formal training;
- Productivity: Capacity utilization (%).

H2.2: I assume that in the Enterprise Survey database there is a statistically verifiable correlation with the "Years of the top manager's experience working in the firm's sector " with Lean Principles.

The principles are identified in the following metrics:

Number of permanent unskilled production workers; Percent of firms choosing access to finance as their biggest obstacle; Percent of firms choosing inadequately educated workforce as their biggest obstacle; Percent of firms offering formal training; Percent of firms with an internationally-recognized quality certification; Proportion of workers offered formal training (%).

H3.1: I suppose that by analyzing the structured interviews with corporate middle managers and senior executives, it can be demonstrated that the im-

pact of information management on process development and the operation of corporate processes has been considerably appreciated today.

H3.2: I assume that case studies with the value stream mapping (VSM) can verify the fact that the role of information management has been significantly increased in process development. Furthermore, I assume that support for creating a value stream mapping with a custom-developed software helps understand and adopt the method used to increase corporate efficiency.

H4.1: In my opinion, case studies have shown that the importance of information management in process development has increased than ever before, since the principles and tools of Toyota's philosophy have been supplemented with information as a factor of productivity with which the T-TPS system has further developed.

H4.2: Based on the comprehensive literature analysis, the knowledge acquired in the Japanese course and the experiences of the case studies, I assume that the concepts used by the majority of experts and consultants as a synonym and the Lean philosophy can be separated.

Differences can be summarized and presented in a new, comprehensive concept with the help of information management.

The methodology and tool kit used to justify my hypotheses is presented in Chapter 3, while the research results from the research and the new and novel results of the dissertation are presented in Chapter 4.

2. MATERIAL AND METHOD

2.1. Secondary data as a basis of the analysis

Selected secondary data (Global Innovation Index - GII), Global Competitiveness Index (GCI) and Enterprise Survey, and methodology of analyzes (correlation and regression analysis, factor analysis, cluster analysis And case studies) are adapted to the hypotheses based on the objectives, the analysis of which is based on Eisenhardt (1989), Ghauri and Gronhaug (2011), Malhotra (2009), Péchy (2016), Poór et al. (2012), Sajtos and Mitev (2007) and Stake (1995).

2.2. Relationships of objectives, hypothesis and methods

The hypotheses of the dissertation, the tools and methods used to examine the hypotheses and the results thus obtained and the correlations of the conclusions drawn from these are illustrated in Table 1:

Table 1: The methodology used to justify the hypothesis

Data	Target	Research tools				Results		
Secondary data	- - -	**Hypothesis**	**Methods**		- - -			Conclusions→R5 (modeling)
Secondary data	T1	Literature review	H1.1	Correlation	→	R1	→	Conclusions→R5 (modeling)
Secondary data	T1	Literature review	H1.2	Cluster Analysis K-method	→	R1	→	Conclusions→R5 (modeling)
Secondary data	T2	Literature review	H2.1	Regression calculation and factor analysis	→	R2	→	Conclusions→R5 (modeling)
Secondary data	T2	Literature review	H2.2	Regression	→	R2	→	Conclusions→R5 (modeling)
Primer data	T3	Literature review	H3.1	Self-organized case studies and deep interviews	→	R3	→	Conclusions→R5 (modeling)
Primer data	T3	Literature review	H3.2	Self-organized case studies, market research, software development	→	R3	→	Conclusions→R5 (modeling)
Primer data	T4	Literature review	H4.1	Self-organized case studies, TPS, T-TPS, and modeling	→	R4	→	Conclusions→R5 (modeling)
Primer data	T4	Literature review	H4.2	Self-organized case studies, modeling	→	R4	→	Conclusions→R5 (modeling)

Source: own editing, 2017

The first aim of the dissertation, which was to explore the success factors of process development, was one of the focal points of the investigation with the analysis of secondary databases. To do this, I have put together two hypotheses for the verification of my statements, which have made correlation calculations and cluster analyzes. From the point of view of my research, the evaluation of the characteristics of the Innovation and Competitiveness Index and the relationship between them and one of the most important factors of the process development are the analysis of the environment of innovative thoughts and the examination of the respective countries in this respect.

My second objective is still related to secondary data sources, but I have already set out to evaluate the results of another database, Enterprise Survey (Enterprise Survey) for the dissertation. Regarding the data analyzed by regression calculation and factor analysis, my aim was to support the two factors of Lean philosophy with data.

Thus, I looked at the impact of minimizing wastes on productivity and capacity utilization as well as defining human resources as one of the visible signs of leadership being willing to invest in training or developing employees or listening to employee development suggestions, their views on the processes.

My third objective is to connect to Toyota's philosophy, where through my in-depth interview and my own case studies and developments I wanted to draw attention to the main success factors of the Japanese and especially the Toyota engineers, including the role and significance of information management in development processes, Something about how process development can serve to create a value stream map and how to help with the simplicity of the Toyota method, but more effectively, with the help of information technology.

Based on my fourth objective, I wanted to make an attempt to further develop the latest version of the Toyota House as the ever-changing market environment in my opinion justified it. As a set of literary and practical knowledge and through case studies, I wanted to demonstrate that information development and management was of greater importance in process development, and I consider it important to clarify the differences and identities between the concept of Lean and the Toyota method - Clarification of the common objectives of two methods - for the sake of clarity.

Last but not least, I wanted to make an experiment in the literature and then on the basis of the information gained from the practical experience, to create a model for successful leadership mentality and decision-making.

3. RESULTS

3.1. Analysis of secondary data

3.1.1. Global Innovation Index and Global Competitiveness Index

Based on the results of the analyzes carried out to verify the H1.1 hypothesis, it can be concluded that there is a very strong correlation between the two factors, which shows a straight proportionality. So it can be clearly stated that innovation contributes to the competitiveness of a country. The direction of the correlation and the trend line equation are illustrated in the following figure (Figure 1):
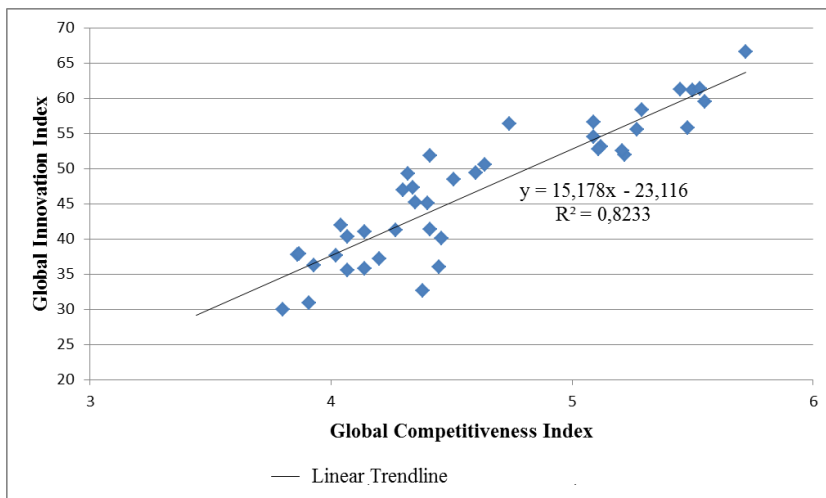

Figure 1: A linear trend line and its equation illustrating the relationship between competitiveness and innovation indices
Source: Own editing, 2017

Based on the above, between the Global Innovation Index and the Global Verifiability Index, despite the different calculation method, there is a mathematically demonstrable relationship, so the hypothesis that I have raised is thus justified.

Based on this, it can be concluded that innovation contributes to the competitiveness of a given country, which can be further compelled by the successful application of the Lean philosophy, so that competitiveness can be further increased.

As a summary, it can be said that the company does not innovate and does not try to make its processes as efficient as possible and without wastes, it can only

be a follow-up, but it does not have the competitive edge of market leaders anymore.

Following the discovery of the correlation, I made analyzes in relation to the H1.2 hypothesis in the available database, in which I developed the following four groups using the k-center method of cluster analysis:

1. "Development-friendly" states: this group includes countries where, inter alia, the business environment, general infrastructure, ICT, innovation and higher education play a prominent role, while knowledge dissemination and research and development are not too much. Thus, it can be said in general that there is high external environmental support, that is, capital strength means that external environmental conditions are at the disposal of innovation, but unfortunately this is not coupled with appropriate research and development factors, thus the possibilities can not be completely unfolded, and this will result in lower expected results as well.

2. "Non-potential" states: a group of the most difficult countries where no factor contributes to innovation sufficiently, either because neither R & D nor infrastructure or education is adequate to create an innovation environment, so that they have less growth than any other group Potential is expected from the indicators examined by me.

3. "Environmentally friendly" states: these countries are somewhat similar to those of the "Developing States", but are less capital-strong. Basic circumstances would be more appropriate, such as the use of education or knowledge, but infrastructure and investment will not allow innovation to be fulfilled. This group includes those countries where the internal environmental conditions and the knowledge to develop are given, but the external environment is inadequate, so, unfortunately, they can expect little developmental improvement. This group among others includes Hungary.

4. "Great Innovator" States: in this category, countries where both external environmental factors and research, development and innovation factors are outstanding compared to other countries. So, this group includes those countries with the biggest innovation and hence the potential for development and competitiveness. This includes, for example, Japan and the USA.

Based on the examined innovation indicators, the methodology of cluster analysis allows the countries to be divided into four distinct groups that give an explanation for innovation in the development potential of each group, so my research hypothesis is justified.

3.1.2. Enterprise Survey

For the confirmation of H 2.1 hypothesis, I first performed a regression analysis with the selected indicators, which were:

- Number of permanent full-time workers
- Number of permanent non-production workers
- Number of permanent production workers
- Number of permanent skilled production workers
- Percent of firms choosing political instability as their biggest obstacle
- Percent of firms with an internationally-recognized quality certification
- Proportion of unskilled workers (out of all production workers) (%)
- Percent of firms offering formal training (%)

From the data in the database, I think these are the factors that are relevant to my research, that is, based on my previous literature processing and my experience, these factors may have an impact on performance. Based on the correlation between the values of the indicators and the productivity, I thought that I could reveal significant relationships from the point of view of the study.

In the database, the output and output figures were Capacity utilization, which adequately demonstrates which factors affect the actual capacity utilization of a given company compared to the maximum utilization available. The results of the regression calculations clearly demonstrated that capacity utilization showed a mathematically justified correlation with the capabilities and qualifications of the personnel available to the companies.

This also means that with steady workforce and training of employees, the availability, capacity utilization and thus the efficiency of the company can be increased. Therefore, managers of long-term competitive companies need to include ongoing, predictable, deliberately planned and planned training for employees of company employees.

The data of the component values obtained as well as the factors generated by these are shown in Table 2:

Table 2: The scoreboard of factor analysis

Name of indicator	Components				To which factor it belongs to?
	1	2	3	4	
Number of permanent production workers	,949	,024	-,060	,244	**Factor 1.**
Number of permanent skilled production workers	,935	,085	-,145	-,009	
Number of permanent full-time workers	,798	,122	,080	,374	
Number of permanent non-production workers	,741	,254	,365	,118	
Percent of firms with an internationally-recognized quality certification	,046	,706	-,180	,483	**Factor 2.**
Proportion of workers offered formal training (%)	,167	,645	-,053	-,155	
Years of the top manager's experience working in the firm's sector	,045	,559	,471	-,191	
Percent of firms offering formal training	,108	,537	,429	,453	
Percent of firms identifying an inadequately educated workforce as a major constraint	,026	,008	,902	,055	**Factor 3.**
Percent of firms identifying labor regulations as a major constraint	,000	,017	,867	,047	
Number of temporary workers	,333	-,084	,031	,787	**Factor 4.**
Number of permanent unskilled production workers	,599	-,107	,109	,629	

Rotated Component Matrix[a]

Source: own editing

As a result of the factor analysis performed on the basis of the parameters described above, the following factors can be created:

1. **HR factor:** factors that provide permanent, skilled, that is, stable workforce for companies. Certainly this is the most important group for every management, as it is only possible to start a serious development if there are behind them a workforce that can be "built on".

2. **Management factor:** indicators that depend on the management's preparedness, experience and decision-making. It is also important that leadership is properly committed and open to development-related innovations, as it is only possible to achieve really great results.

3. **Barrier factor:** Here are some of the factors that are a barrier or a completely restrain to achieve the highest possible level of capacity utilization and improving improvements. As the indicators listed here show, there is an external factor, such as labor regulation, which does not have effect at all, or it takes a very long time, and there is also an internal factor (the unskilled labor force), which we can, however, be able to exert in a short period of time by developing a well-structured and well-founded training thematic system and scheduling it.

4. **Negative HR factor:** As a negative inverse of the first factor, here, based on the data of the personnel, factors were grouped together that also have an effect on capacity utilization, but not as positively as for the first factor.

Based on the statistical analyzes made, there is a statistically significant relationship between high quality workforce and productivity (at one and five percent significance levels), so this point of my hypothesis is confirmed.

In order to verify my H2.2 hypothesis, I carried out a regression analysis with the selected indicators, the results of which clearly proved that the indicator of the first years of experience in the company sector was mathematically justified together with the skills of the employees available to the companies, namely their qualifications with the following indicators:

- A five percent significance level (i.e., stronger relationship) was shown with the following indicators:
    o Percent of firms choosing access to finance as their biggest obstacle
    o Percent of firms choosing inadequately educated workforce as their biggest obstacle
    o Percent of firms offering formal training
    o Percent of firms with an internationally-recognized quality certification

- One percent, so lower than the previous level, but showed statistically verifiable co-movement with capacity utilization with the following indicators:
    o Number of permanent unskilled production workers
    o Proportion of workers offered formal training (%)

Based on the statistical analysis carried out, it can be clearly stated that the number of years of experience of senior management in the sector of the company showed statistically significant correlation with the examined factors, with one or five percent significance level, so the second half of my hypothesis also proved to be true.

3.2. Empirical experiences of processes development case studies

3.2.1. The impact of information management on process development

3.2.1.1. *Self-organized case study I.*

Among the methods of the H3.1 hypothesis research, I applied the individual structured interview, based on which, among the experiences mentioned by the interviewees, I highlight the following factors when listing companies' information management losses:

1. The number of unnecessary data movements is high due to non-standardized processes.

2. Insufficient IT surfaces and / or inadequate IT skills.

3. Excess work due to manual data checking due to frequent errors of electronically entered data.

4. Due to the bad or missing reporting system, data entered and never unused are high and thus loads a lot of unnecessary data as part of the data asset.

5. Due to the lack of an integrated system, the re-entry of data also results in significant additional work.

6. Also due to the lack of integrated systems, the problem of converting to different formats.

7. Despite the hand-held data checks, hibernate data is common.

8. Securing data security for island systems is also a common problem.

9. Due to the frequent lack of expertise, systems are unclear, incorrect data and definitions.

10. Data requests are inaccurate, do not give a clear answer to the decision points.

11. Institutions are unaware of what information they possess.

12. The set of available information is fragmented, undisturbed, has no structure, and is not focused around goals.

13. People are "suffering" from the mass of information and the lack of knowledge at the same time.

14. Important information such as professional proficiency, professional knowledge, practical training, and valuable feedback and working relationships will become null and void as the holder leaves them.

15. The difficulty of sharing lessons leads to the need to redefine the once-solved task, which will waste much money and time.

Therefore, it can be said that the hypothesis assumed in my H3.1 hypothesis that today's considerably appreciated the impact of information management in process development and the operation of company processes is also justified.

3.2.2. Process improvements initiated by creating value stream mapping (VSM)

3.2.2.1. Self-organized case study II.

The H3.2 hypothesis is based on a very important tool on the Toyota method, the SMED methodology. The main result of the work presented as part of the case study was that, as a result of the highly volatile process, a standard was developed that required a fraction of the need for the previous operating time and all in a stable process.

Figure 2 shows clearly how different workflows (A, B, C, D, E, F) of the three operators analyzed by independent groups during development were recorded with a rather different operating time and then succeeded in selecting best practices and developing them To develop a standard that was not at all volatile, and contained only minimal waste (muda) and the time requirement of the entire migration process was reduced to less than 8 minutes. In our case, by eliminating wastes, the ability of a company to produce more than 1 319 000 units a year, resulting in a total sales revenue of € 989,773 for a business year, by reducing or eliminating time-consuming new products and redundancies. An additional benefit of this SMED development is cost-saving beyond quality improvement and thus more satisfied customers.
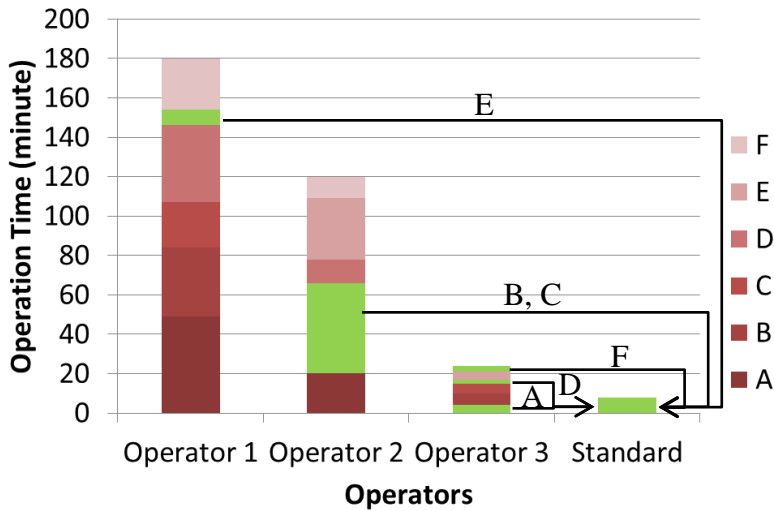
Figure 2: Role of information management in case of quick change-over
Source: own editing

The purpose of this case study was to justify the standardized methodology for the continuous development of VSM. Based on the results obtained, it can be clearly stated that the development process with the appropriate expertise led to the creation of a reliable result. By creating a value stream map, we received current information at the beginning of the process development cycle, which resulted in much more effective results than without it. In addition, it has been proven that the methodology and the expertise are correct, as the leader with three competing but still independent teams has achieved the same result. Thus, the present case study presented the first stage of the assumed hypothesis in my H3.2 hypothesis.

3.2.2.2. *Self-developed VSM software*

Thanks to the visualization prepared by the colors and the pictograms, the software flow chart shows good value added, wastes, or the location of inter-production kits, which indicates the potential development points.

The process steps visualized with colors require additional data input, so the following data are continuously generated during the VSM generation:

- The cycle time of a given process by type of process (for example, the time required to move stocks, allowing you to see how much time can be saved to make the state of the future).

- The number of people needed at a particular moment in the given workflow, from which bottlenecks can be seen later.

- The size of the area required for a particular workflow (which also makes it easy to detect the size of a space that can be released by eliminating a given waste (e.g. inventory)).

- The rate of movement / movement and transportation wastes suffered during the process, from which you can immediately see what can be eliminated or at least minimized when planning a future state.

- The level of inventory levels is also recorded in the state of the current state, so in addition to seeing the size of the inter-production kits, the bottlenecks can also be estimated, which should be offset during the load balancing (heijunka).

Figure 3 illustrates in detail the process steps that the VSM solution I have developed can be visualized. After the insertion, the data recorded in this file will automatically be aggregated by Excel, so at the end of the process we can see immediately the current operator overrun times, inventory levels, decision points, and also very important information flow.

Thanks to good visualization, it is relatively easy to see the wastes and also the locations of inter-production kits that are indicative of potential development points.

	Total	VA						
Name of process								
Value added (sec)	0							
Motion (meter)	0							
Process (sec)	0							
Inventory (piece)	0							
Transportation (sec)	0							
Control (sec)	0							
Information (sec)	0							
Production area (m2)	0							
Operator (person)	0							

Figure 3: Types of process steps of VSM software
Source: own editing based on self-developed software, 2017

Therefore, the software developed has all of the following properties:

- Easy to use, no specialized knowledge required;
- does not require special software or high performance computers (can run on any laptop capable of performing office tasks) and can be used to analyze or improve production or service processes;
- visualize the process well;
- visualize the results well;
- visualize the wastes well;
- visualize the potential development points (for example, by clearly identifying the location and quantity of inventory levels);
- cost-effective, as it does not require special resources;
- work-efficient, as with the help of macros, a significant part of the recording process is automated;
- it is capable of producing accurate and quick feedback and reports from the moment following the commencement date of the survey.

In the previous chapter, I succeeded in verifying my H3.2 hypothesis that value-based crawl-driven process improvements are more efficient than non-performing kaizen actions, due to the conscious use of information management that has become increasingly important today. The software supporting the process development described in this section clearly serves the efficiency of development processes and makes the operation of the company more competitive by the results thus obtained, so the second stage of the H3.2 hypothesis can be considered as justified, so the full content of the H3.2 hypothesis can be considered justified, I consider it as proven.

3.2.3. Innovative approach of the Toyota method

I wanted to substantiate H4.1 hypothesis in three case studies, in connection with which my dissertation described in detail the results, experiences and the development suggestions for eliminating them.

3.2.3.1. *The circuit T-TPS model with VSM*

Based on the experiences of self-organized case studies, the VSM tool should be given a prominent role in the whole system, because in my experience, I believe that all the more comprehensive development processes need to start with a VSM action that explores the whole process. That is why I developed a VSM-based circular T-TPS model with a special emphasis on visualization and

flexibility, and to provide a flexible production line that is essential to meet customer needs to the fullest extent possible, to provide the main structural element of the system (Toyota) can be illustrated by the VSM tool.

As a result of the literature review, my experiences in Japan and the experiences of domestic case studies, I would like to illustrate the complex T-TPS system, which is indispensable elements of a competitive production system in today's world, as shown in Figure 4:
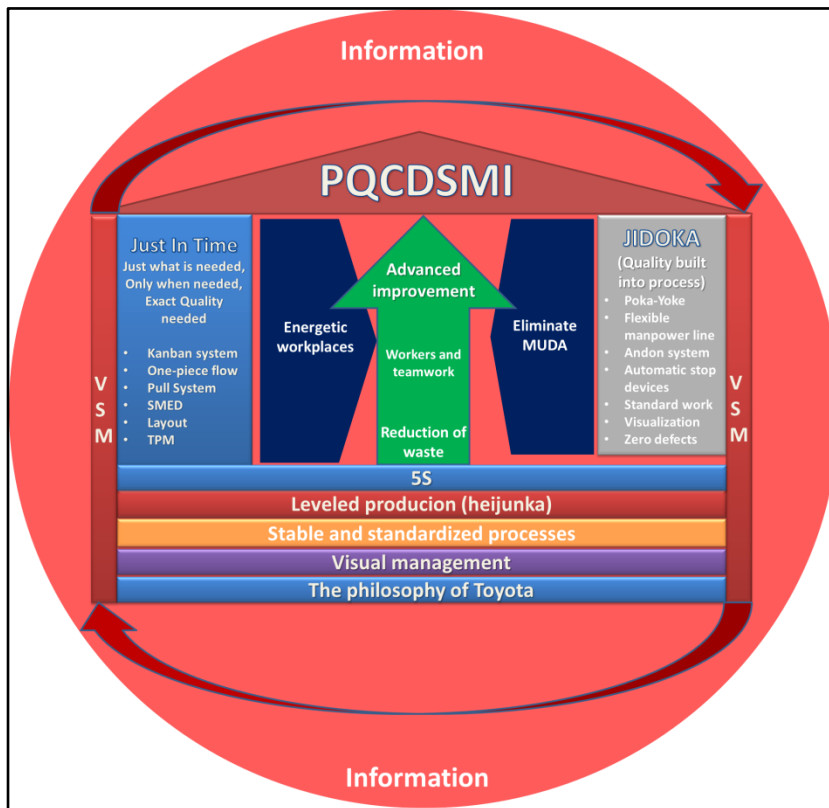

Figure 4: The self-developed VSM T-TPS model
Source: own editing, 2017

In the presented model, therefore, the information has become the productivity factor and the whole system has become a pervasive factor. In order to provide the necessary information in our processes (both production and administrative), it is essential to prepare the VSM (Value Stream Map) according to the specificity of the process at predetermined intervals. Compared to the previous ones, I appreciated the layout of the Toyota model, the role of highly trained operators, the continuous flow, the role of the system-led information on peo-

ple, the respect and resource management of people, the importance of standard work and the visual management and visual control (Andon).

By setting this model, my hypothesis H4.1 proved to me that the importance of information management in the process development was much more valuable than ever before, so the principles and tools of Toyota's philosophy have been supplemented with information as a whole philosophical element, Can be indicated as a productivity factor. Furthermore, the production of the value stream map (VSM) has also gained more importance as a result of the increased information management, resulting in the eligibility of the VSM circuit cycle T-TPS model.

3.2.4. The conceptual differences between Lean and Toyota philosophy

Based on self-organized case studies and literature review, my H4.2 hypothesis was justified, that is, there is a conceptual difference between the Toyota method and the Lean philosophy, which is used synonymously almost without exception, but the two concepts only differs in the device system, so the target is the same in both cases, so I have shown the two device systems in a common graph. The relationship is illustrated in Figure 5.
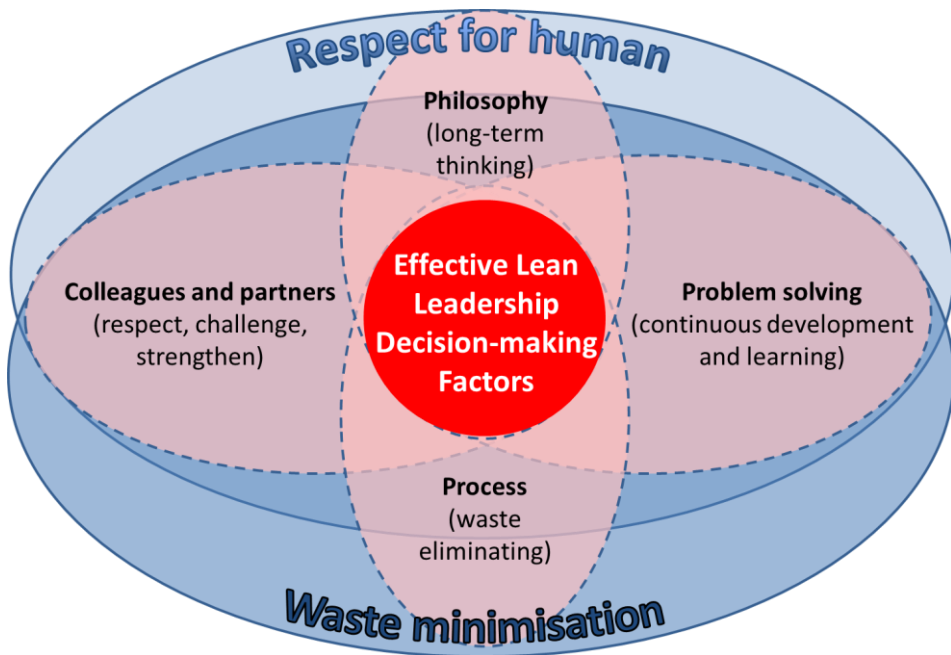

Figure 5: Fundamental connections of Lean and Toyota philosophy
Source: own editing, 2017

21

3.2.5. The right decision of a competitive company is based on the 5i model from the information management perspective

Based on the literature analyzes I concluded that the models published so far are not fully current in the rapidly changing economic environment and are therefore not sufficiently effective. It has become necessary for me to use the whole set of research experiences to create the right decision-maker of the competitive company, the most basic model for information management, as illustrated in Figure 6:
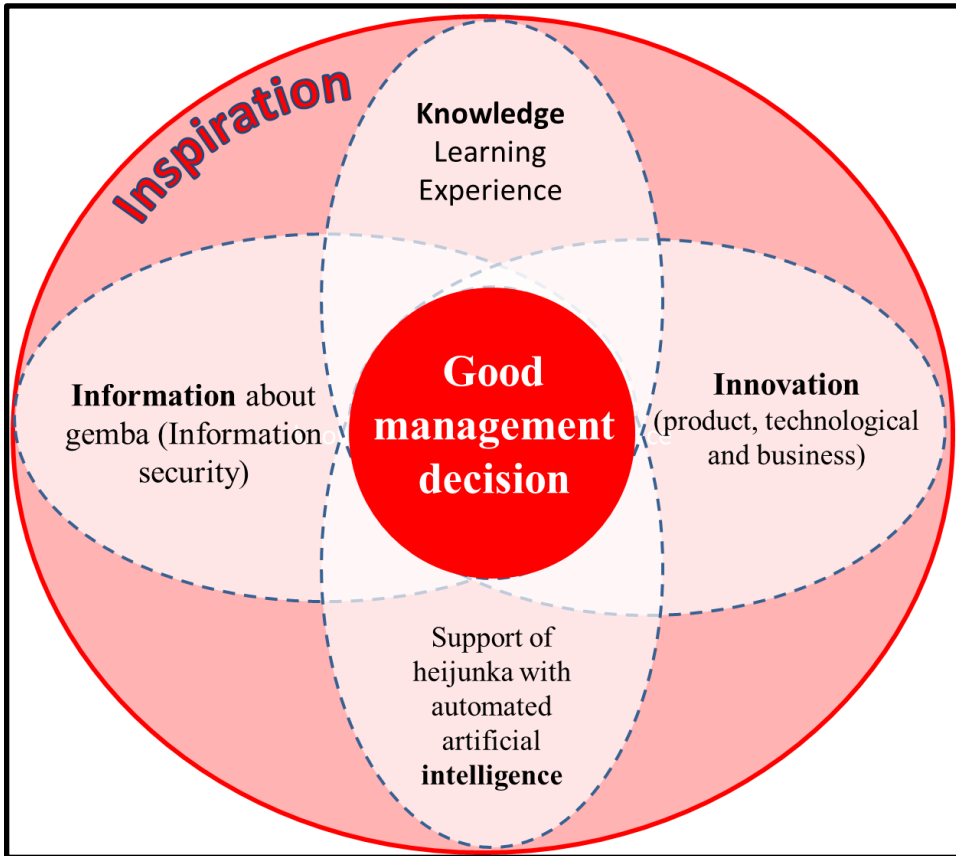

Figure 6: The right decision of a competitive company is based on the 5i model from the information management perspective
Source: own editing

Using my research experience, a current 5i model, which is the most well-grounded in information management, is described by the right driver of a competitive company, with the support of automated and artificial intelligence (information security), knowledge, production and load balancing (heijunka), inspiration of innovation and the staff of the learning organization.

3.3. New and novel scientific results

The hypotheses that emerged before writing the dissertation and the new and novel scientific results formulated in their examination are as follows:

R₁: Based on the Global Competitiveness Index and the Global Innovation Index data, based on correlation and regression calculations, I found that innovation contributes to the competitiveness of a country, which means that a country is enjoying the potential of its innovation potential and the better opportunities to increase its competitiveness. Until now, it seems to be a trivial statement that it is of the utmost significance that a straightforward correlation has been demonstrated in the case of a derivative derived from the two different methodologies.

In addition, based on the examined innovation indicators, with the help of the K-mid methodology of cluster analysis, the countries were organized into four clusters, the "Developmental States", the "Potential" States, the "Environment Friendly States, and the" Great Innovator "states. Based on the results of this study, the countries can be divided into distinct clusters that give an explanation for innovation in the possible directions of development of each group.

R₂: With Enterprise Survey data, I was able to demonstrate the relationship between the success factors of the Lean philosophy that minimizing wastes and respecting people as human resource value contributes to more efficient operation. Based on the statistical analysis carried out on the database, it can be stated that the qualitative labor force (Number of permanent full-time workers; Number of permanent non-production workers; Number of permanent production workers; Number of permanent skilled production workers; Percent of firms choosing political instability as their biggest obstacle; Percent of firms with an internationally-recognized quality certification; Proportion of unskilled workers (out of all production workers) (%); Percent of firms offering formal training (%)) is a statistically significant relationship with productivity (Capacity utilization (%)) (at one or five percent significance levels).

Furthermore, based on the analyzes it can be clearly stated that the Years of the top manager's experience working in the firm's sector showed a statistically significant correlation with one or five percent significance level with

the following factors: Number of permanent unskilled production workers; Percent of firms choosing access to finance as their biggest obstacle; Percent of firms choosing inadequately educated workforce as their biggest obstacle; Percent of firms offering formal training; Percent of firms with an internationally-recognized quality certification; Proportion of workers offered formal training (%).

R₃: Based on the in-depth interviews and case studies, it has been demonstrated that the impact of information management on process development and the operation of corporate processes has also been considerably appreciated today. In addition, the justification for the use of a standardized methodology of continuous development with VSM has been verified. Based on the results obtained, it can be stated that the development process with the appropriate expertise led to the creation of a reliable result. By producing a value stream map, we received current information at the beginning of the process development cycle, which resulted in much more effective results than we could get without having a stable startup state.

In addition, it has been proven that the methodology and the expertise are correct, as three executives with appropriate expertise but with a completely independent team in the course of development have achieved the same result.

A software development process development has also been developed that clearly serves the efficiency of development processes and makes the company's business more competitive by the results achieved. This software is easy to handle and does not require any special knowledge, but it does well visualize the process and the results that are cost-effective and work-efficient, and can guarantee accurate and quick feedback and reporting through the quality built into the process.

R₄: On the basis of the case studies, I have found that the processes needed to satisfy customer needs as much as possible, to maximize profitability and to employee satisfaction and safety require the development of the previously created TPS, and T-TPS, in which the full Visualization of the production area, layout of the layout, flow of flow, Kanban system, Jidoka (quality built into the process), standard work, visual management and visual control (andon).

Additionally, as a new element, information is fed into Toyota's productivity factors as a special factor affecting the whole system, and the VSM (Value Stream Map) is included in the toolkit, which must be included as the first step in any larger volume development process. This is how the circular T-TPS model with VSM is built up. I have found that the concepts used by the majority of experts and consultants as synonyms and the Lean philosophy can be separated. Although the objectives of the two methods are the same, but the tools are fundamentally different. In my dissertation, I have shown these identities and differences in a common graph according to my objective.

R_5: Using the present research experience of my dissertation, a current 5i model, which is the most important foundation for the information management, is described by the right decision of the competitive company, which is an automated and artificial information (and information security), knowledge, production and load balancing (heijunka) With intelligence, inspiration for innovation and the staff of the learning organization.

4. CONCLUSIONS, SUGGESTIONS

When writing the dissertation, my main goal was to examine the role of information management in process development using qualitative and quantitative methods, as well as the ever-increasing quantity of information available and thus of increasing importance in the innovative way I connect to Toyota, Methodology and gather the success factors of Japanese management culture and process development.

Based on the analysis of secondary data, it can be concluded that there is a direct relationship between innovation and competitiveness, so it is worth investing in innovation and dealing with it, as it will help to increase competitiveness on a long-term basis. This is especially true of our country, which, according to my analysis, came under the category of "environmentally friendly" states. Here, investment in infrastructure development could be achieved very soon.

Further conclusions and subsequent research work are also induced by the findings that there is a statistically demonstrable relationship between quality workforce and capacity utilization. It would be worth examining, for example, how the expenditure invested in the training of employees is compensated by the utilization of the knowledge gained during the training.

As a result of the inquiries, it has been proved that the goals of managers of a long-term competitive business should include the continuous planning of the company's employees in the form of continuous, deliberately planned training to achieve company goals. It is therefore recommended that the Lean Advisory System be transformed in a way that is not solely intended to solve this problem but to enable workers in the process to train employees through self-problem solving and developing their own development projects after understanding the principles of the Toyota method. However, the advisor can not be separated completely from the company. His task is to coordinate and supervise development processes that help achieve the company's goals, that is, a permanent coach activity.

Among the findings of the analysis of the primary data, I mentioned first that the successful introduction of 5S and the operation of the fifth S according to the original methodology is one of the most important tasks and is also one of the biggest challenges for companies. This includes maintaining the previous

four S with emphasis on the required training, training and reward, which encourages staff to properly maintain the machines, tools and tools involved in their processes, and continuously develop processes that determine their daily work and the work environment. To achieve this, leadership is required, training of appropriate level, quality and content, and a corporate culture in which the behavior that is commonplace within the company from the first machine to the office of the director is to maintain the achieved results and to constantly improve the processes.

One of the key issues for companies investigated in the research is that they do not respond appropriately to the dynamic development of the information society and therefore do not sufficiently use the technologies, tools and solutions that will increase their economic role and competitiveness. The barrier of catching up and progress can also be attributed to factors such as leadership, corporate culture, motivation, funding, qualifications, lack of information or even the fact that the company is not aware of its own processes, so it can also decide on a positive attitude towards modern technology procedures.

In many cases it is felt that there is at least some ambition to promote the use of information and communication technologies (ICT) in the enterprise, yet, despite the enormous potential, there is still a lag in many areas in Hungary.

Today's globalization, the ever-increasing global market, growing and worldwide trade leads to a tough market competition, as more and more competitors are emerging. In the fight, only companies can remain competitive that combine their resources to meet their goals and bring the business strategy into line with the human resources required for implementation, the efficient workflows and the information system

For this reason, human resources and the knowledge they possess have become the most valuable and competitive factors, because in the age of information technology, new knowledge appears in an unprecedented scale, steadily overcoming the old. It is therefore important for companies to exploit and develop their knowledge and competences at the maximum level. Where managers within a company are not educated there is no chance of long-term survival.

My development proposal in this area is the use of mobile devices in the field of services and the promotion of the flexible workforce on the strategic level of manufacturing processes, which is becoming increasingly popular today. My

specific suggestion is that this opportunity should be encouraged through the involvement of tender resources in order to promote a competitive domestic economy.

All in all, therefore, it is necessary to open up to companies that use the Toyota method in the direction of technological innovations and the management of information. While other companies should implement the method as soon as possible if they are to remain profitable in a rapidly developing and fierce competitive environment.

It is important that, after the introduction, these technologies support basic principles, that is, continuous flow and that staffing is still needed in everyday processes, since continuous development can only be achieved on their initiative because they are able with the help of kaizen to achieve continuous reduction of wastes. The modern technical tools and the results mentioned in this dissertation can be used to create the Smart Lean philosophy that utilizes technical possibilities, which does not involve waste or that only minimizes processes, to help create the Smart Enterprise concept.

It is also important to ensure the sustainability of the industry by enhancing, supporting and supporting the development of a consultancy service to ensure continuous improvement as "problems with the same approach that can not be solved".

Nowadays, companies with very good results and efficiency use more tools of the Toyota method that is already a value, so it ensures in the long run that only companies can stay competitive, who can continuously develop and evolve. It can be achieved by becoming a learning organization and by taking constant kaizen actions, they always improve their processes, thus increasing their competitiveness. In addition, it is recommended for these companies to use the circular T-TPS model with the VSM developed by me, as this will also ensure the success of the process development.

In this topic I have to suggest to every reader how to use the XXI. Century achievements, try to master the minimum knowledge required to use them.

In addition, it would also be advisable to promote the Lean promotion policy, since, as the secondary analyzes have proved, Hungary is also highly capable and has a wealth of human resources that could be useful elements of the devel-

opment process, And because of the limited investment attractiveness, these opportunities can not be unfolded.

It would also be necessary and useful to encourage and improve the opportunities for promoting travels to Japan, and to develop an active relationship between the two countries so that professionals in addition to domestic multinationals can also meet other good practices.

Starting from my own experience, I know that during this kind of journey you can see positive experiences and good practices that, when you return home, you can significantly improve the productivity of the companies in Hungary and thus increase their competitiveness on the global market.

Since there are many failures in the world's to introduce the Toyota toolkit due to discrepancies or misunderstanding of the principles, and their non-consistent use; therefore, my recommendation is the development of an audit system in which the company, like the ISO quality assurance system, is certified by an external party that the principles of the Toyota method are well understood and applied in practice in their manufacturing or administrative processes.

The development of this audit system and the design of its practical feasibility are one of the greatest potential for my research to be pursued, since this should be a complex and objective-based tooling system that can be implemented in part or in whole for all companies.

In Hungary the knowledge of the Toyota methodology and the Lean profession have gained popularity and recognition in recent years. The increasing demand is well documented in the last few years - after a long time after their original appearance - in foreign languages.

All in all, it can also be said that the Japanese leadership approach coming from Western countries has reached Hungary and its application or learning is increasing. However, it can be concluded that this trend will surely continue in the future, and the methodology complemented by Western experiences will continue to expand here, and hopefully as soon as possible, the larger the number of small and medium-sized enterprises will be introduced.

In my opinion, my dissertation is just a snapshot of the current state of my research, as there are many ideas in my research continuation, but I would like to emphasize that the first and most important factor in each process is to reveal the information available to us through a VSM. My plan is to build an IT sys-

tem that uses artificial intelligence as a further development of the current software, based on the data collected during the past, to produce various reports for middle and top executives, and to help design alternatives for the future state and to make a choice decision based on factual information preparation.

5. LITERATURE

1. Eisenhardt, K. M. (1989): Agency Theory: An Assessment and Review. *Academy of Management Review,* 14(1), pp. 57-74.

2. Ghauri, P. – Gronhaug, K. (2011): *Kutatásmódszertan az üzleti tudományokban.* Budapest: Akadémiai Kiadó.

3. Malhotra, N. K. (2009): *Marketing Research: An Applied Orientation.* Harlow, England: Pearson Education LTD.

4. Nemzeti Fejlesztési Minisztérium, Kommunikációs Főosztály (2013): *Augusztus végéig véleményezhető a Nemzeti Infokommunikációs Stratégia.* Megjelenés: 2013.07.26. Letöltés dátuma: 2015.04.24. Forrás: http://2010-2014.kormany.hu/hu/nemzeti-fejlesztesi-miniszterium/info-kommunikacioert-felelos-allamtitkarsag/hirek/augusztus-vegeig-veleme-nyezheto-a-nemzeti-infokommunikacios-strategia

5. Péchy, B. (2016): *Rétegzett mintavétel.* Letöltés dátuma: 2016.11.13. Forrás: http://www.kislexikon.hu/retegzett_mintavetel.htm

6. Poór, J. – Karoliny, M., Berde, C. – Takács, S. (2012): *Átalakuló emberi erőforrás menedzsment.* Budapest: CompLex Kiadó Kft.

7. Sajtos, L. – Mitev, A. (2007): *SPSS kutatási és adatelemzési kézikönyv.* Budapest: Alinea Kiadó.

8. Stake, R. E. (1995): *The Art of Case Study Research.* London: SAGE Publications.

6. PUBLICATIONS ABOUT THE SUBJECT OF THE THESIS

Scientific articles in English:

Kisari, K. – Zörög, Z. – Csapó, L. A. – Takács, I. (2012): The Context of Introducing ERP Systems. *International Journal Of Business And Management Studies,* 4(2), pp. 53-62.

Kisari, K. – Csapó, L. A. – Csernák, J. – Takács, I. (2012): On the Way or in the Way of Development. *International Journal Of Business And Management Studies ,* 4(1), pp. 101-110.

Dúl, N. – Kovács, Á. E. – Csapó, L. A. – Kisari, K. (2012): Human Side of The Creating a Knowledge Based Agricultural Public Education Institute. *Annals Of The Polish Association Of Agricultural And Agribusiness Economists ,* 14(6), pp. 61-66.

Kisari, K. – Zörög, Z. – Csapó, L. A. – Takács, I. (2012): The Development Opportunities of Corporate Information Management Systems. *Annals Of The Polish Association Of Agricultural And Agribusiness Economists ,* 14(6), pp. 109-113.

Csernák, J. – Csapó, L. A. – Kisari, K. – Takács, I. (2013): Efficiency of Information Management Based on Longitudinal Examination of Hungarian Agriculture Enterprises. *International Journal of Business and Management Studies ,* 5(1), pp. 230-240.

Kisari, K. – Csapó, L. A. – Csernák, J. – Kovács, Á. E. (2013): Possibilities Provided by the Cloud Technology Based on Some Specific Examples. *International Journal Of Business And Management Studies,* 5(1), pp. 251-260.

Csapó, L. A. – Tasi, P. – Zsigmond, Sz. (2013): The role of the coach in the introduction process of a learning by doing based educational method in Hungary – an experience based study. *International Journal of Business and Management Studies,* 5(1), pp. 273-283.

Scientific articles in Hungarian:

Pitlik, L. – Pető, I. – Csapó, L. A. – Kovács, L. – Sápi, A. – Vrabély, B. (2011): Oktatási tapasztalatok szemléletformáló szabványok megértetése kapcsán. *Magyar Internetes Agrárinformatikai Újság ,* 2011(153), p. 10.

Csapó, L. A. – Györpál, T. – Holló, E. (2013): Az információgazdálkodás kihívásai a KKV szektorban. *Acta Carolus Robertus* , 3(2), pp. 35-48., (ISSN 2062-8269)

Csapó, L. A. – Borbély, A. (2015): A javaslati rendszerek jó gyakorlata a folyamatfejlesztésben. *Acta Carolus Robertus* , 5(2), pp. 57-68., (ISSN 2062-8269)

Csapó, L. A. (2016): Az innováció szerepe a folyamatfejlesztésben. *Acta Carolus Robertus* , 6(2), pp. 78-93., (ISSN 2062-8269)

Scientific conferences in English:

Csapó, L. A. – Kisari, K. (2011): Development of The Information Management of Agricultural Firms. In: Monika Bumbalová, Eva Lázárová, szerk. *The International Conference of PhD. Students „YR NET": Social, Economics and Legal Aspects in Regional Development.* Konferencia helye, ideje: Nyitra, Szlovákia:, 2011.04.06-2011.04.08., Slovak University of Agriculture, Fakulty of European Studies and Regional Development, pp. 27-33., (ISBN:978-80-552-0614-1)

Csapó, L. A. (2011): The specificities of installing ERP systems. In: Tov Assogbavi, Vasa László, Nagy Henriette, szerk. *Global Management Conference, Proceeding.* Konferencia helye, ideje: Gödöllő, Magyarország, 2011.05.04-2011.05.07., Szent István University, pp. 99-101., (ISBN:978-963-269-233-3)

Vajna, I. – Kisari, K. – Csapó, L. A. – Csernák, J. (2012): The Productivity and Quality Improvement with Lean and TQC Seven Step Problem Solving Tools on one Automated Robot Development., In: Solti László, szerk., *7th International Conference for Young Researchers: "Breakthrough Points of World Economy in the 21st Century".* Konferencia helye, ideje: Gödöllő, Magyarország, 2012.09.12-2012.09.14., Szent István Egyetemi Kiadó Gazdaság- és Társadalomtudományi Kar - Gazdálkodás és Szervezéstudományok Doktori Iskola, pp. 262-271., (ISBN:978-963-269-319-4)

Vajna, I. – Csapó, L. A. – Kisari, K. (2012): The Economic Effect of the Practical Introduction of the TPM and SMED Methods on Industrial Productivity and Quality Improvement. In: Solti László, szerk. *7th International Conference for Young Researchers: "Breakthrough Points of World Economy in the 21st Century".* Konferencia helye: ideje: Gödöllő, Magyarország, 2012.09.12-2012.09.14., Szent István Egyetemi Kiadó Gazdaság- és Társadalomtudományi Kar - Gazdálkodás és Szervezéstudományok Doktori Iskola, pp. 254-261., (ISBN:978-963-269-319-4)

Scientific conferences in Hungarian:

Csapó, L. A. – Sinka, A. (2011): Precíziós növénytermesztéssel a fenntartható fejlődés irányába? – avagy az információgazdálkodás szerepe a mezőgazdaságban. In: Ferencz Árpád, szerk. *"Válságkezelés a tudomány eszközeivel" Erdei Ferenc 6. Tudományos Konferencia. 1-2-3. kötet.* Konferencia helye, ideje: Kecskemét, Magyarország, 2011.08.25-2011.08.26., Kecskeméti Főiskola Kertészeti Főiskolai Kar, pp. 82-86. (ISBN:978-963-7294-98-3)

Kisari, K. – Csapó, L. A. – Zörög, Z. (2011): Vállalatirányítási információs rendszerek nyújtotta lehetőségek és kihasználtságuk Magyarországon. In: Ferencz Árpád, szerk. *"Válságkezelés a tudomány eszközeivel" Erdei Ferenc 6. Tudományos Konferencia. 1-2-3. kötet.* Konferencia helye, ideje: Kecskemét, Magyarország, 2011.08.25-2011.08.26., Kecskeméti Főiskola Kertészeti Főiskolai Kar, pp. 339-344., (ISBN:978-963-7294-98-3)

Kisari, K. – Csapó, L. A. – Hugyi, M. – Takács, I. (2012): A vállalatok átállási hajlandósága a felhő technológián alapú szolgáltatásokra. In: Fejér-Király Gergely, Lázár Ede, szerk. *"Vállalkozói és gazdasági trendek a Kárpát-medencében " Konferencia. Konferencia helye, ideje:* Csíkszereda, Románia, 2012.04.20-2012.04.22., Státus Kiadó, pp. 89-102., (ISBN:978-606-8052-76-2)

Zörög, Z. – Kisari, K. – Csapó, L. A. – Csernák, J. (2012): A vállalati információs rendszerek alkalmazásának területei a vállalkozásokban. In: Herdon Miklós, Szilágyi Róbert, szerk. *Agrárinformatika 2012 Konferencia - Innovatív információtechnológiák az agrárgazdaságban: Konferencia kiadvány.* Konferencia helye, ideje: Debrecen, Magyarország, 2012.09.21-2012.09.22., Magyar Agrárinformatikai Szövetség (MAGISZ) , pp. 192-200., (ISBN:978-615-5094-08-8 (E-version (WWW)), ISBN 978-615-5094-07-1 (CD-ROM version))

Szabó, A. K. – Csapó, L. A. – Csernák, J. (2012): A háztartások zöldségfogyasztási szokásainak elemzése és a nemnövekedés paradigmája egy konkrét felmérés alapján a Dél-alföldi régióban. In: Balázs Judit, Székely Csaba, szerk. *A gazdasági fejlődés fő hajtóerői (Munkahelyteremtés - Hatékonyság - Innováció): Programfüzet és előadás kivonatok.* Konferencia helye, ideje: Sopron, Magyarország, 2012.11.12., Nyugat-magyarországi Egyetem Közgazdaságtudományi Kar, pp. 389-397., (ISBN:978-963-9883-99-4)

Csapó, L. A. – Csernák, J. – Szabó, A. K. – Kovács, Á. E. (2012): Az információgazdálkodás fontossága egy konkrét példán keresztül. In: Balázs Judit, Székely Csaba, szerk. *A gazdasági fejlődés fő hajtóerői (Munkahelyteremtés - Hatékonyság - Innováció): Programfüzet és előadáskivonatok.* Konferencia helye, ideje: Sopron, Magyarország, 2012.11.12., Nyugat-magyarországi Egyetem Közgazdaságtudományi Kar, pp. 1091-1103., (ISBN:978-963-9883-99-4)

Vajna, I. – Vajna Istvánné Tangl, A. – Csapó, L. A. (2013): A termelékenység fejlesztési módszertan innovációja – előnyök és haszon. In: Ferencz Árpád, szerk. *"Környezettudatos gazdálkodás és menedzsment"* Gazdálkodás és Menedzsment Tudományos Konferencia. *1-2. kötet.* Konferencia helye, ideje: Kecskemét, Magyarország, 2013. szeptember 5., Kecskeméti Főiskola Kertészeti Főiskolai Kar, pp. 1075-1079, (978-615-5192-19-7)

Csapó, L. A. (2016): A folyamatfejlesztési tevékenység eredményességének vizsgálata makrogazdasági szinten. In: Keresztes Gábor, szerk. *Tavaszi Szél, 2016: Spring wind, 2016.,* Konferencia helye, ideje: Budapest Magyarország, 2016.04.15-2016.04.17., Doktoranduszok Országos Szövetsége, pp. 230-238., II. kötet. (ISBN:978-615-5586-09-5)

Csapó, L. A. (2017): Az információ szerepe az üzleti tájékoztatás folyamatában. In: Keresztes Gábor, szerk. *Tavaszi Szél, 2017: Spring wind, 2017.* Konferencia helye, ideje: Miskolc, Magyarország, 2017.03.31-2017.04.02., Doktoranduszok Országos Szövetésge, (In progress)

Scientific books, partial books:

Ruff, T. – Domokos, T. – Kovács, Á. E. – Dúl, Nándor - Opauszky, Á – Szalay, Zs. G. – Szarka, K. - Csapó, L. A. (2012): *Felsőoktatási intézmények alkalmazkodó képességének javítása munkaerő-piaci információk alkalmazásával.* Gödöllő: Szent István Egyetem. p. 248, (ISBN:978-963-269-320-0)