University of Sopron

István Széchenyi Doctoral School
for Business Economics and Management

Efficiency Increase in Innovation Processes

Mixed Methods Research for the Development of a Reference Model

Theses of the PhD Dissertation

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1 Research Background and Objectives

Successful business management presents itself in a new kind of complexity context today. To meet this challenge, companies are focusing on the implementation and execution of innovation management, lean management and knowledge management. Each of these topics has been considered, formulated, structured, studied and evaluated many times as an individual research field. However, the direct combination of the three areas represents a research field that has been not been researched to a large extend until today. Various international studies show that companies depend on continuous innovation activity and the resulting innovation outcomes in order to maintain their competitiveness. Further studies show that managers place particular emphasis on increasing the effectiveness and efficiency of their companies' innovation processes. Based on these findings, this dissertation investigates how knowledge management can be integrated into innovation management and how lean management principles can be applied in innovation processes to improve the resulting process effectiveness, efficiency as well as competitiveness in companies. Consequently, the dissertation aims to develop a holistic approach towards a reference model for efficient innovation, whose contents result from the practical combination of the three mentioned topics. The verification of the practicability of the model is also the goal of the dissertation.

Based on these objectives, the following research questions are derived:

- Which content-related aspects characterize innovation processes, describe lean management principles and define the success factors of knowledge management?

- How can efficient innovation be described, and is it possible to bring the topics together into a comprehensive process model?

- Is this process model a promising method to increase the operational excellence and the capability for efficient innovation of companies and thus, to support the development of these companies?

- How can such a process model be applied in practice and enable companies to identify potentials for increasing efficiency in the innovation process and to initiate corresponding implementations?

2 Hypotheses

Since the objectives and research questions refer, among other things, to the theoretical model, which shall be created, and its practical implementation, hypotheses are derived in the following. These hypotheses serve as the basis for the operational examination of the object of investigation. The goal of the hypotheses is to come to a confirmation (verification) or refusal (falsification) and thus, to an understanding about the research object by means of a detailed discussion.

Hypothesis 1

It is possible to combine Lean Management principles and innovation success factors and, with the help of process-oriented knowledge management, to create a scalable process model for increasing the efficiency of and in innovation processes.

The first hypothesis results from a combination of the first two research questions. Based on the elaboration of the content-related aspects of innovation, lean and knowledge management, it shall be examined whether their combination into a holistic process model is possible. Basically, the direct application of lean management principles in innovation processes has not been investigated very much so far. It is also postulated that the principles of lean management, which are geared towards a consistent increase in efficiency, oppose the aspects inherent in innovation, such as freedom and creativity. Based on these findings, hypothesis 1 aims to examine whether an innovation process model can be developed taking into account lean management principles. Due to the resource "knowledge", which is used and created in both innovation and lean management, knowledge management should logically serve as a connecting element. The scaling refers to the ability of the model to be used in different stages of innovation and in different phases of company development.

Hypothesis 2

If such a model is practically applied on the basis of an existing will to innovate, then companies are in a position to record and evaluate their current innovation processes, to derive corresponding potentials for increasing process efficiency in a prioritized manner, and thus, to support the operational excellence of their organizational development.

Since the willingness and readiness to innovate is seen as a prerequisite for companies to be innovative, this is the starting point for the second hypothesis. Against the background of the explorative research approach, the second hypothesis intends to investigate whether a holistic process model can be used to increase innovation process efficiency in corporate practice in order to verify the case-related functionality of the model. The second hypothesis is therefore based on the third research question.

Hypothesis 3

If companies consider innovation as an essential success factor, then they strive to increase the efficiency of innovation processes.

Hypothesis 4

If companies know and apply lean management principles, then these companies also consider themselves to be innovative.

Hypothesis 5

If companies use process-oriented knowledge management, then they also recognize the success factors in innovation management and strive to implement them.

Hypotheses three to five are based on the fourth research question, which is also aimed at the practical applicability of the process model, which will be developed. Based on the detailed investigation of the applicability of the model, the aim is to investigate how the model can be used in broad corporate practice by involving further companies into the research. In this context, it is assumed that companies applying the model must be able to record, measure, evaluate and scale their own development status of innovation activity with regard to effectiveness and efficiency in a future-oriented manner.

3 Research Approach and Research Process

In order to answer the research questions and discuss the hypotheses, empirical methods are used in science. These can be divided into two basic approaches: the quantitative and the qualitative approaches. The fact that the strengths of one method can compensate for the weaknesses of the other, has led to the combination of the two methods when considering multidimensional fields of research. The combination of the two methods is referred to as Mixed Methods Design, which is used in the dissertation. The use of the Mixed Methods Design is considered particularly helpful when investigating unexplored topics. The consideration of the method sequence has become an accepted specification criterion in research. In the dissertation, according to the problem, an exploratory-sequential Mixed Methods Design is implemented.

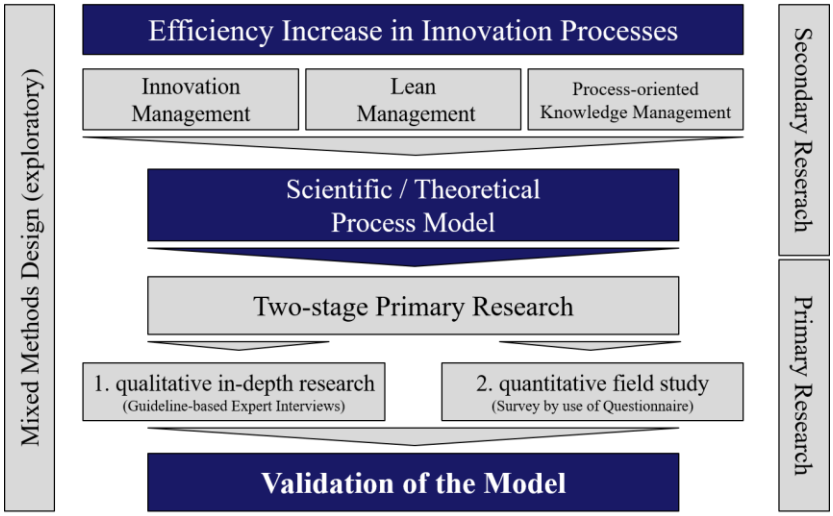
In order to collect the data and information necessary for the study, the research is divided into primary research and secondary research. The preparation of the primary research for independent data collection is done with the help of an extensive secondary research in order to work the current state of research out. The secondary research results in a theoretical process

model, which is tested and adapted in a two-stage primary research for its practical application and entrepreneurial added value generation.

The first stage of the primary research is a detailed practical in-depth examination in the cooperating company. In order to analyze and evaluate the current innovation process of the company, guideline-based expert interviews are conducted. Based on the results and experiences from the interviews, the validation of the created process model and the derivation of concrete recommendations for action towards the design of the scalable efficient innovation process can take place. The guideline-based expert interviews are conducted in the company with all employees, who have a direct or indirect relation to the company's innovation process. The theoretical foundation and derivation of the interview questions is based on the developed reference model. Within the primary research, detailed specifications are worked out with the previously defined group of employees in order to obtain a concrete overview of the use of the targeted process model for efficient innovation. This will lead to the practical validation of the model.

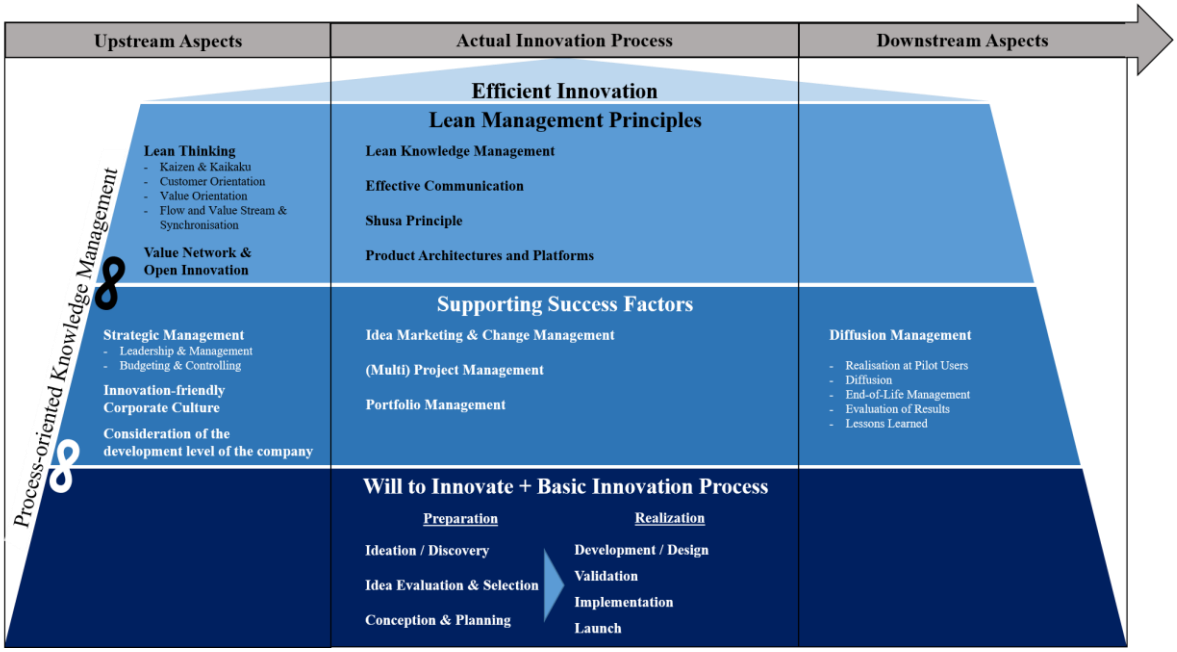
The second stage of the primary research is based on the results of the first stage. In the second stage, a quantitative field research is carried out, in which additional companies from innovation-driven industrial sectors are included in the research process. The aim of the field research is to obtain comprehensive findings on the transferability of the research results of the first stage of the primary research. The field research will be implemented as a standardized survey in which a questionnaire for companies will be made available online. The questionnaire is used to test the theoretical process model for its attractiveness and practicability. The aim of the survey is to find out whether the developed theoretical process model can be applied holistically in corporate practice. The evaluation of the results obtained by the survey is carried out by using methods of descriptive statistics. The verification and discussion of hypotheses three, four and five is based on inferential statistical methods.

This approach validates the general practicability of the model related to the research field. According to the objectives of explorative research (i.e. basic research) and inductive research (i.e. theory building), the research process is thus, build by the Mixed Methods Design. The following figure summarizes this research approach.



4 Results and Discussion of the Hypotheses

In the following, the reference model for efficient innovation is described. It serves as a content-related guideline and basis for investigation within the framework of the two-stage primary research of the dissertation. The model is divided into three process components: the aspects and activities upstream of the actual innovation process, the topics relating to the actual innovation process and the measures downstream of the actual innovation process. In addition to this horizontal structure, the model extends vertically to three levels, which are connected by use of process-oriented knowledge management. The lowest/first level describes the basic innovation process and therefore focuses exclusively on the area of the actual innovation process. In the second level of the model, the described innovation success factors, all three horizontal structure areas are focused. The upstream aspects can be described as the general management framework and the orientation of the company. The downstream aspects include topics related to the successful implementation of the product after its market launch. The third model level describes the possible competitive advantages through the increase in process efficiency. Here, the upstream aspects can be shown as the topics of the fundamental orientation of the company towards increasing efficiency. Topics downstream of the actual innovation process cannot be implemented, since it is impossible to apply lean principles to phases that occur after products have been launched on the market. The methods and tools of process-oriented knowledge management are applied as a connecting element between the three vertical model levels. Only by use of topics inherent in knowledge management, such as the creation, use and sharing of knowledge, process design and implementation can be enabled, as existing knowledge is used and new knowledge is generated in each model component. The reference model is shown in the following figure.



The suggested scalable, efficient innovation process in the reference model can be used to classify and evaluate the innovation processes used in companies and identify areas for improvement.

After the reference model was created, it was examined for its practical feasibility in the cooperating company. As part of this in-depth, qualitative investigation, it was possible to validate the model to the extent that it allows the current innovation activities of the company to be captured in the process structure of the model. Based on these results, the model was also able to prove its scalability, allowing the derivation of direct optimization potentials that would enable the company to further develop its informal innovation process into a holistic, efficiency-oriented one. This first stage of the two-stage primary research, which is limited to the cooperating company, thus, makes a significant contribution to the creation of new scientific insights. The first stage of the primary research provides contributions for testing the first two hypotheses.

Hypothesis 1

It is possible to combine Lean Management principles and innovation success factors and, with the help of process-oriented knowledge management, to create a scalable process model for increasing the efficiency of and in innovation processes.

The first hypothesis is verified/confirmed on the basis of the developed reference model. The first level of the model describes the will to innovate as a basic prerequisite for innovation activities in companies. This level also describes a basic innovation process consisting of seven sub-process steps. The second model level represents supporting innovation success factors

which, when applied in the company, result in an increase in the effectiveness of the innovation processes. These factors originate from different management areas and were assigned to the concrete application in the context of innovation management. In the third model level, six lean management principles are integrated, which enable a company to implement an increase in efficiency in a process-oriented manner. Process-oriented knowledge management flanks and links the three model levels. The scalability required in the hypothesis is achieved on the one hand by the instruments named in the model in the different levels and on the other hand clarified by the three process sequence phases.

Hypothesis 2

If such a model is practically applied on the basis of an existing will to innovate, then companies are in a position to record and evaluate their current innovation processes, to derive corresponding potentials for increasing process efficiency in a prioritized manner, and thus, to support the operational excellence of their organizational development.

The second hypothesis is verified/confirmed on the basis of the results of the qualitative practical research conducted. The extensive expert interviews made it possible to conduct an analysis of the existing innovation process in the company. Furthermore, concrete optimization potentials for increasing the efficiency of the innovation process could be worked out for the company. The mapping approach used in the interviews made it possible to objectively record the existing innovation process. Based on these results, a comparison with the reference model became possible. Based on this, optimization potentials for the company are determined specifically, which were also prioritized for implementation with the help of the model. Since all employees of the company involved in the innovation process were included in the expert interviews, it is ensured that the results of the study are implementable and beneficial for the company. This enables the company to develop holistically as an organization.

In order to conduct a further examination of the model with regard to its transferability and holistic practical applicability on the basis of the confirmed findings for the first two hypotheses, a quantitative field study in further companies follows within the dissertation. The goal of this second stage of the primary research is to verify to which extent the findings of the qualitative practical research are also confirmed by further companies, thus, proving the universal application of the model. The underlying assumption of the quantitative field study regarding the already practically validated reference model is described as follows: The scalability and thus, the applicability in companies whose innovation activities and processes vary depending on their degree of development, represents the core benefit of the model for business management practice. In the second stage of the primary research, therefore, the

respective development status as well as the knowledge and use of the model components in the companies participating in the survey is recorded directly. Depending on the results obtained in the survey, it can be shown that the reference model can help any company in the further development of its innovation activities towards the design of an efficient innovation process.

Hypotheses three to five are tested with the second stage of the primary research. These hypotheses result from the combination of the individual model components and are formulated as causal hypotheses. Because the hypotheses each consist of both, an if and then parameter and these parameters are assigned to specific questions or question items of the quantitative survey, the hypotheses, or rather their statistical verification, allow further validation of the reference model. The hypotheses are tested in two parts, respectively in a staggered manner. First, the descriptive statistical presentation of the assumed relationships between the hypothesis parameters is carried out by means of cross-tables and frequency distributions. Here, the hypotheses are evaluated with a limited scope only with regard to the surveyed companies (n = 51). However, as this evaluation relates exclusively to the sample of companies surveyed, it is not possible to transfer the results of the analysis to the overall population or to make a generalized assessment of the hypotheses. In order to test the hypotheses further, Pearson's bivariate correlation analysis is used. This procedure uses the correlation coefficient and significance values to determine whether correlations can be found between the values of the hypothesis parameters for the population.

Hypothesis 3

If companies consider innovation as an essential success factor, then they strive to increase the efficiency of innovation processes.

As a causal hypothesis, hypothesis 3 assumes that companies, which regard innovations as a significant part of their success, will then also strive to increase the efficiency of their innovation processes in order to enable a greater contribution to success. From the descriptive analysis, by means of, among other things, a cross-tabulation of the mean values of the hypothesis parameters, it emerges that a total of nine companies surveyed agree with hypothesis 3. It is interesting to mention that 30 companies are interested in both a general increase in efficiency and specifically in an increase in the efficiency of their innovation processes, but do not necessarily regard innovation as an essential success factor according to hypothesis 3. The inferential statistical test using correlation analysis yields a correlation coefficient of r = 0.629 for hypothesis 3, which expresses a strong correlation of the hypothesis parameters. Consequently, it can be concluded that companies that rate one of the two hypothesis

parameters with a high mean value also rate the other hypothesis parameter with a high mean value. The two-sided significance test results in a significance value of $p < 0.001$. Since the result of the significance test is clearly below the targeted significance level of $p < 0.05$, hypothesis 3 can be confirmed consequently.

Hypothesis 4

If companies know and apply lean management principles, then these companies also consider themselves to be innovative.

As a causal hypothesis, Hypothesis 4 assumes that companies that are familiar with and use lean management principles, also consider themselves to be innovative. The procedure for testing hypothesis 4 is analogous to the analysis procedure for hypothesis 3. Based on the descriptive analysis it becomes clear that overall, only two of the companies surveyed agree with hypothesis 4. The correlation coefficient between the variables of hypothesis 4 is $r = 0.601$. Likewise to considering the third hypothesis, this value also describes a strongly pronounced correlation between the two hypothesis parameters. The significance value of the correlation is $p < 0.001$. Consequently, the causal statement of hypothesis 4 can also be confirmed.

Hypothesis 5

If companies use process-oriented knowledge management, then they also recognize the success factors in innovation management and strive to implement them.

Hypothesis 5 is also a causal hypothesis. It assumes that companies that use process-oriented knowledge management also recognize the success factors in innovation management and strive to implement them. The procedure for testing hypothesis 5 is analogous to the analysis procedure for hypotheses 3 and 4. The descriptive analysis shows that five of the surveyed companies agree with hypothesis 5. The correlation coefficient for the parameters of hypothesis 5 is $r = 0.554$. This value again represents a strongly pronounced correlation between the hypothesis parameters. The significance value of the correlation is $p < 0.001$. Consequently, the fifth hypothesis of the dissertation can also be confirmed.

In summary, the descriptive examination of the hypotheses shows that all three hypotheses are only confirmed by small proportions of the surveyed companies on the basis of the threshold values for hypothesis parameter agreement. Based on this, it can be concluded that the hypotheses tend not to apply to the surveyed companies. However, the practicability of the reference model for structured use in corporate practice can be confirmed. Since the questionnaire asks for all components of the reference model, all participating companies were able to apply the model directly to their specific company situation. The inferential statistical

analysis leads to a confirmation of the three hypotheses, which fully underlines the findings on the practicability of the reference model.

5 New Scientific Insights

Both, business practice and science benefit from the results of the dissertation equally. The developed reference model for efficient innovation enables companies to plan, formulate and improve their innovation processes, which still represents a gap in the current state of research. The closing of this research gap has been achieved in the context of the dissertation. The scientific novelty created within the dissertation can be highlighted as follows:

- In order to achieve the objective of developing a practice-oriented solution to the challenges of merging different management topics and areas into a holistic reference model, the challenges were identified, structured and analyzed in a framework. **The development and implementation of a scalable model for efficient innovation processes is new.**

- In a cross-functional approach, business processes are analyzed, knowledge is identified and processes are described. In this way, **the derivation of potentials for increasing efficiency within the entire innovation process of a company becomes obvious.**

- Furthermore, **the model allows to support the transformation of an existing innovation approach into an efficient innovation process in a structured way as an implementation guide**.

In particular, the execution of the research as a mixed methods approach has contributed to these novel findings. Both stages of the primary research show cumulatively that the developed reference model is applicable in business practice. Because the surveys in both stages were developed concretely and consistently from the reference model, **the questionnaire in particular can be used directly as a measuring instrument for future use in companies**. Thus, in addition to the reference model itself, the necessary instrument for the targeted application of the model in corporate practice is developed.

In addition to these findings, which relate to the specific applicability of the developed reference model, the second-stage primary research itself can also clearly contribute to new findings:

- The primary research examined the collaborative application of the model components or the direct combination of the management areas for the first time. Based on the results of

the quantitative field research it becomes clear that only a very small part of the investigated companies (n = 1, ≙ approx. 2%) already uses all model components. Thus, it becomes clear that the field of research of the dissertation offers great potential for further research projects.

- Although the classification of the participating companies in the quantitative field survey is possible through the questionnaire, this was not part of the concrete evaluation of the results due to the objective of validating the applicability of the reference model. If the study sample is expanded, the questionnaire as an instrument can also provide insights into the knowledge and application status of the model contents in different companies. In this case, the aim would no longer be to test the model itself, but rather to examine potential differences within the sample. This in turn can lead to further scientifically novel findings.

6 Conclusion and Recommendations

The main objective of the dissertation, to develop a holistic approach for a standardized reference model for efficient innovation, has been achieved. The research questions of the dissertation are answered. The hypotheses derived directly from the research questions or connected to them are confirmed entirely within the framework of the two-stage primary research.

It is recommended to verify the applicability of the reference model in further detailed practical studies. This will allow to classify and evaluate the processes used in different companies. Furthermore, the model can be used as an implementation guideline in other settings by repeating the practice study, especially for companies that face other phases of corporate development and have a different degree of innovation or operate in other business contexts and/or industries.

In addition to the verification of the developed process model in different companies, the results of the application in the respective companies shall be evaluated. The evaluation and measurement of the final result of the application of the process model in terms of a new and/or improved innovation process is another challenging and future research area.

After the implementation of the reference model, a measurement and evaluation of the targeted increase in efficiency of the innovation process and the gain in competitive advantage must take place.

7 Publications

Breuer, Stefan (2013): Process-oriented Knowledge Management as a crucial Element for the Introduction of Lean Management Principles in Innovation Management, in: Schriften zur angewandten Mittelstandsforschung (SMf), hrsg. v. Rhein-Ruhr-Institut f. angewandte Mittelstandsforschung (RIFAM), Ausgabe 2/2013, ISSN 1869 280X

Breuer, Stefan (2015): Study book Kostenrechnung II und Controlling, study book for a distance learning program at IST-Hochschule für Management, Düsseldorf, B.A. Course Unternehmerische Entscheidungsgrundlagen, 190 p., published by IST-Hochschule für Management

Breuer, Stefan (2017): Study book Investitions- und Finanzierungsentscheidungen, study book for a distance learning program at IST-Hochschule für Management, Düsseldorf, B.A. Course Unternehmerische Entscheidungsgrundlagen, 186 p., published by IST-Hochschule für Management

Breuer, Stefan; Kah, Evylin (2018): Study book Betriebliches Rechnungswesen und Controlling, study book for a distance learning program at IST-Hochschule für Management, Düsseldorf, Course Geprüfter Wirtschaftsfachwirt (IHK), 210 p., published by IST-Hochschule für Management

Breuer, Stefan; Szillat, Patrick (2019): Leadership And Digitalization: Contemporary Approaches Towards Leading In The Modern Day Workplace, Electronic magazine "Dialogue", D. A. Tsenov Academy of Economics, Svishtov, Bulgaria, issue 1 year 20, pages 24-36. ISSN: 1311-9206.

Breuer, Stefan (2019): Personalbezogene Herausforderungen in der Organisationsentwicklung von KMU – Die Mitarbeiterbefragung als Werkzeug in der Organisationsentwicklung am Beispiel eines deutschen mittelständischen Unternehmens, Journal article, Gazdaság & Társadalom (Journal of Economy & Society) of the University of Sopron, 2019/1, pages 43-66. ISSN 0865 7823. DOI: 10.21637/GT.2019.1.03.

Breuer, Stefan (2020): Lean Innovation - Efficiency increase in innovation and product origination processes, Conference Proceedings – International Scientific Conference “Modern Economy, Smart Development” organized by the Alexandre Lamfalussy Faculty of Economics of University of Sopron, 07-11-2019, pages 419-441. ISBN: 978-963-334-348-7

Szillat, Patrick; Breuer, Stefan, Biermann, Jörg (2020): Introduction into the Global E-Sports Industry - Historic Perspectives, Journal article, International Journal of Humanities Social Sciences and Education (IJHSSE), 7 (11), Nov. 2020, pages 8-12. ISSN 2349 0381. DOI: 10.20431/2349-0381.0711002

Breuer, Stefan (2021): Change Controlling – Measuring Change Success Using the Example of a University of Applied Sciences, Conference Proceedings – International Scientific Conference “Crisis and Recovery: Innovative Solutions” organized by the Alexandre Lamfalussy Faculty of Economics of University of Sopron, 05-11-2020, pages 358-374. ISBN: 978-963-334-372-2

Presentations held on international scientific conferences

Szillat, Patrick; Breuer, Stefan (2018): Encountering Adolescent Brain Drain - Research Approach Towards the Identification of Employer Branding Strategies of Medium-Sized Enterprises for the Generation Z in Albania, Presentation - 7th International Conference „Towards European Union, integrating research and innovation" organized by the Faculty of Economy of the University of Elbasan „Aleksander Xhuvani", Albania. The conference took place on November 17th 2018

Breuer, Stefan (2019): Lean Innovation - Efficiency increase in innovation and product origination processes, Presentation - International Scientific Conference "Modern Economy, Smart Development" organized by the Alexandre Lamfalussy Faculty of Economics of University of Sopron, Hungary. The conference took place on November 07th 2019

Breuer, Stefan (2020): Change Controlling – Measuring Change Success Using the Example of a University of Applied Sciences, Presentation - International Scientific Conference "Crisis and Recovery: Innovative Solutions" organized by the Alexandre Lamfalussy Faculty of Economics of University of Sopron, Hungary. The conference took place on November 5th 2020