Exploration of Lean Management Methods

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***Abstract*— In the context of this paper the adaptation of the classical Lean methods to the automated and ultramodern manufacturing processes of modern production is to be carried out. The Lean methods were developed in the automotive and mechanical engineering industries, so that they can often only be used to a limited extent for modern, highly automated mass production.**

Keywords—Lean Management, Exploration, Methods, NACE

I. INTRODUCTION

While Lean in the early years largely dispensed with information technology development, an important part of the third industrial revolution was the development of enterprise resource planning systems. The basic goal of an ERP system is to efficiently and effectively manage, influence and design the resources of all business areas. This paper will show a Lean exploration related on the focused methods of the hidden industries in the European union. So the mindset for a Lean shopfloor which could be automatized and provided by an successful ERP implementation.

Lean Management has been an established and efficient management tool since the end of the 1980s and enjoys great popularity in mechanical engineering and automotive engineering. During a period of more than ten years, clear tendencies can be observed that companies from other branches of industry as well as service companies are using Lean Management approaches to make their business processes significantly more efficient. From their own experience and coordination with other Lean experts, the idea has grown to review and evaluate the transformation and applicability in other areas. The problem of this research focuses on the manifold variance of various production plants and the interactive interface between human efficiency and personnel optimization, as it is required in Lean Management, as well as the logistically optimized production area. Only the areas of production and process development is considered, as the utilization factor is estimated at its highest and a consideration of all operational processes in the context of this article is estimated as not manageable. For methods with problems in the application [1], an adaptation for the special requirements is to be developed. The methods of Lean Management are to be applied as a fundamental approach to the entire production chain. At this point, a conflict arises between automated manufacturing, the classic one-piece flow and the pull strategy. The article will start at this point of conflict and identify suitable methods with quantitative and qualitative research and network difficult methods across industries.[2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14]

II. METHODOLOGY

A. Lean and ERP

When comparing the intentions of ERP and Lean, some, here only selected, cooperating goals can be determined. These include

- Efficient use of resources
- No waste
- Layout optimization
- Lead time optimization
- Minimization of consumables
- Optimization of the circulation stock
- Minimization of bearings
- Among other things

This shows a certain synergy effect which is controversially discussed in specialist media. This is due to the fact that the introduction of ERP systems works successfully in only 39% of cases, every fifth project fails and around 64% of all projects are too tight in terms of time. This shows that there is clear potential for improvement even during the introduction of ERP systems. For example, organizational methods such as FiFo, Just in Time, Just in Sequence, Kanban, Poka Yoke, Muda, Muri or even 5S [22, 23] can already be taken into account when setting up the ERP system. For customers, this results in two advantages: the process flow is made significantly more efficient and the security and traceability of the data in the system can be increased.

Extensive research by the Kufstein University of Applied Sciences under the direction of Prof. Dr. Martin Adam shows that almost half of ERP manufacturers support Lean Management in their software, but only a fraction of users use the functionalities. In his PhD thesis, Dr. Daryl Powell describes the connection between Lean and ERP as a paradox. As an example, he cites the controversial goals of fixed lead time for ERP in contrast to one-piece flow and just-in-time. With regard to this Symantik the inclusion of Lean in ERP systems is again not possible. Furthermore, he shows in his work that since the 1990s the demands placed on manufacturing companies have continued to change and that Lean Management requirements must be mapped in relation to a successful company. Modern ERP systems support this.

Lean Management has been used successfully for many years and has many supporters as well as some opponents. The same can be shown for the application of Lean

Management methods in the implementation and use of ERP systems by referring to the selected sources. In the following exploration, the optimal methodical Lean setup for the individual industries will be determined, which can be used both in the pre-structuring before the ERP implementation or in the ERP system for each industry.

B. Surveyed Industries

The NACE classification, the statistical classification of economic activities in the European Community (French: Nomenclature statistique des activités économiques dans la Communauté européenne) was developed by the European Union on the basis of the ISIC (International Standard Industrial Classification of all Economic Activities) of the United Nations. [15] This development goes back to the 1960s, when the ISIC was already being worked on by the UN in 1948. In Germany, a standardized aggregate called aggregate A*38 or A*38 code was created for the national accounts, which represents the NACE classification in 38 categories. [16] Although this classification does not correspond to NACE, it can be mapped directly in the system. The following table shows the comparison of the 2008 NACE revision with the A*38 code. [15, 16] In the middle is the simplification of the standards in order to generalise and simplify the statistical surveys of the article.

A*38-Code	**NACE Rev. 2**
CA	10 to 12
CB	13 to 15
CC	16 to 18
CD	19
CE	20
CF	21
CG	22 to 23
CH	24 to 25
CI	26
CJ	27
CK	28
CL	29 to 30
CM	31 to 33

As the work draws its experimental focus from semiconductor and microsystems engineering and data processing and digitalization, Division 26 of the NACE classification has deliberately been divided into three subgroups: data processing, electronics/optics and semiconductors/MST. Divisions 10-18, 22-25 and 27-30 are completely preserved in their meaning, only their names are simplified. Divisions 19-21 have been combined under the generic term of the chemical industry, since the chemical-pharmaceutical industry is also spoken of in professional associations and similarities are assumed in the shop floor.

With this separation of the industries related to a successful Lean Management method implementation the pre-job for ERP projects is done. Each company could be provided before starting an ERP implementation project with the best acting methods for optimizing the company.

While in Germany and Austria there is compulsory membership in the chamber structure for many areas, in Switzerland there is no comparable obligation in the chamber and economic structure, which makes it difficult to consider all German-speaking countries. For this reason, the consideration in Switzerland is left out and only the German-speaking area of Germany and Austria is considered. The focus for ERP implementation is set in the German speaking area, so with the substitutional choosing of the most important industries this set up with the twelve biggest sectors is used.

C. Exploration

The explorative cross-industry research is carried out with a survey of fifteen Lean experts from industry and science. The most of them also have and process and enterprise resource planning background. 15 experts are seen as the lower optimal limit of specialist interviews. In preparation, a research of all available Lean methods was carried out. The identified Lean methods were then described and defined. This elaboration is then implemented in the interview guideline in order to provide the Lean managers with clues for possibly unknown methods. [17] Due to the known problems in various industries, the explorative survey is carried out with specialists from these areas and also from other areas to identify problems in the application environment and to optimize the composition of the expert team for the performance of the research. The explorative survey is conducted in three dimensions. For each method, a decision must be made as to whether the application is conceivable in the professional environment, whether the method has already been used and in which other branches of industry the application is conceivable. Numbered scales are used, but they are described verbally for each point. In general, the participant has a better description available and therefore the questions do not have to be scaled personally. The disadvantage is the ordinality of the data, as these cannot simply be evaluated. In this questionnaire, an evaluation level from "1" to "10" is provided, which is described in advance for each level in textual form. With this questionnaire representation, the advantages and disadvantages of the questionnaire technique are to be optimally used for this survey in the form of an ordinal scale. The degree of application is to be answered with a number from "1" to "10", where "1" stands for a 100% possibility of application/experience and "10" for no suitability at all. This describes the quantitative part of exploration.[18] Bortz and Döring [19] also describe the ordinal scale as a suitable type of scale for such surveys. The survey was conducted online and anonymously.

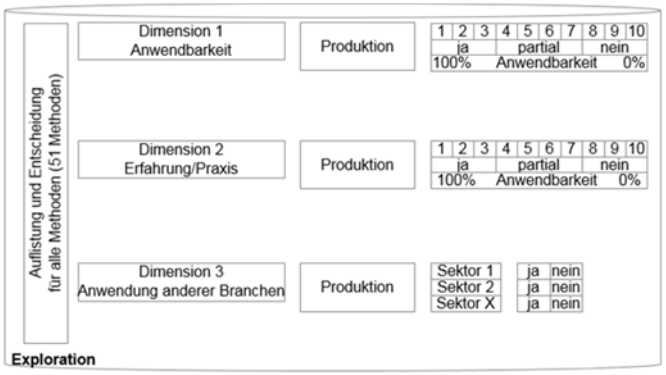

Fig. 1. Dimension of the survey

The three-dimensional survey shown must be carried out for each method in the areas of production and production development. From the approach of the survey several directions of answers result, which are composed as follows:

- Assessment of the applicability of the respective method in production/process development from 0% to 100%;
- own practical experience with the respective method in production/process development from 0% to 100%;
- Assessment of the applicability of the respective method in the production/process development of the individual branches of industry from 0% to 100%;

In order to be able to make a statement of the highest possible quality, the group of experts interviewed is made up as follows:

- Key Expert Lean Production of a leading optoelectronics company
- Production engineer of a leading optoelectronics company
- Head of microtechnology training at a world-leading technology group
- Plant manager of a medium-sized electronics company in the Upper Palatinate
- Production technician of a worldwide leading automotive supplier
- Production manager of a German pressing plant
- Lean manager of a German stamping plant
- IT production expert for a European pharmaceutical company
- Project engineer and member of the examination board for production technology at an educational institution in Bavaria
- Head of a Master's programme in Business Process Management at an Austrian university of applied sciences
- Professor for Operations Management at a German University of Applied Sciences
- Professor of Industrial Production at a State Academy of Studies
- Professor of International Management and Head of an Institute for Management and Information at a German University of Applied Sciences
- Professor of General Business Administration at a Hungarian University
- Senior Process Engineer of a leading optoelectronics company

The questionnaire asks 51 of the most common Lean methods. The methods have been researched in detail. After initially identifying 100 Lean methods, 51 methods were retained after shortening the methods with the same content but different names and combining combined methods. For each question, the interviewee should decide whether he/she has his/her own experience with the method and how he/she will look into its applicability in the simplified industries.

The evaluation is to be carried out in whole numbers from "1" to "10" for one's own experience and each industry. Levels 1-3 indicate that the method is applicable; 4-7 corresponds to a partial, i.e. problematic, applicability of the method. 8-10 indicates that the method is not applicable. The gradations within the answer groups should give the participant the opportunity to create gradations within the group. The levels should have the following description [18]:

1: The method can be used without restriction, there are no obstacles in the implementation.

2: The method can be used without restrictions, an introduction to the topic is required.

3: The method can be used without restrictions, further training in the subject is required.

4: The method is partially applicable, small modifications for the application must be made.

5: The method is partially applicable, modifications for the application must be made.

6: The method is partially applicable, larger modifications for the application must be made.

7: The method is partially applicable, large modifications for the application must be made, the application usually shows no success.

8: The method is not applicable, although the structure corresponds to an applicability.

9: The method is not applicable, the structure would have to be changed significantly to make the method applicable.

10: The method is not applicable; no possibilities are seen to modify this method to make it applicable.

It is analysed whether there are significant differences in individual methods and where the median and the arithmetic mean are located. At the same time, the standard deviation and the number of participants and experts in this field are noted and compared, as it were, from which area this evaluation comes. [20] The evaluation is carried out under the following conditions. A method counts as safe to use in the industry if the addition of the mean with the standard deviation is less than 3.5. This ensures that the mean variation is within the safe limit. This evaluation is determined for all participants of the explorative analysis and for the specialists of the respective industry. If the standard deviation is greater than the applicability limit of 3.5 when added to the mean, it is no longer ensured that the applicability of the method is within the safe applicable limit. The method is then assessed as applicable. This assessment is determined for all participants of the explorative analysis and for the specialists of the respective industry. A method counts as partially applicable in the industry if the mean of the measurement is greater than 3.5 but less than 7.5. This evaluation is determined for all participants of the explorative analysis and for the specialists of the respective industry. A method counts as not applicable if the mean is greater than or equal to 7.5. This evaluation is determined for all participants of the explorative analysis and for the specialists of the respective industry.

The evaluation of the explorative analysis is carried out using simple statistical means. Since a complete statistical evaluation with distribution considerations is very difficult for a maximum of 15 participants and industries, some of which are only represented by one participant, and since statistical certainty is far from being established in the population as a whole. Since a distribution can only be tested with great uncertainty with such a small number of participants in an exploration, a comparison is made here between the mean value, standard deviation and median in relation to the response of all experts and the response of the experts within the industry. The evaluation is carried out using Microsoft Excel and Camline Cornerstone. Since a number of 15 participants is far from representative of the entire population, no typical distribution functions are used here, but only a simple statistical evaluation is carried out to evaluate the significance of the answers of all specialists. By looking at the standard deviation in relation to the mean value, it is shown, even with a small sample of n maximum 15, how large the dispersion of the results around the mean value is.

In order to exclude this effect in the survey, the mean and median are used. After collecting the data, the mean, median and standard deviation are calculated for each question group. Depending on whether the mean value and median are very different, a larger dispersion of the values can be assumed. In the comparison of the arithmetic mean, the result of which includes all distributions of the results, with the median, which lies centrally in the absolute numbers of the values. If both values deviate from each other, this indicates that there is no equal distribution on both sides around the mean value. In the overall consideration of the subtraction/addition of the mean value with the standard deviation in comparison to the median, a fundamental statement can thus be made about the certainty of the result and the dispersion of the answers. Further consideration of the standard deviation gives an impression of the width of the distribution in relation to the position of the mean value compared to the distribution shift in relation to the median. The decision of the evaluation is made according to the description.

From this statistical statement, the methods are identified which have to be analysed in the qualitative part of the work. Based on this description, the authors formulate hypotheses, which should form a suitable basis for the expert evaluation. These hypotheses represent specific relationships between the individual areas.

The methods that are confirmed with "pass", a green mark, are not subject to further investigation for the time being. Methods marked with "partial", a yellow mark, must be worked on in the expert workshop. The experts are expected to provide a qualitative statement and a response based on their experience. Thus, the artefact is also based on an expert report. For each individual sector, the mean is evaluated in column "2", the standard deviation is calculated in column "3", the mean is added to the standard deviation in column "4" and subtracted in column "5". In the sixth column, the median is calculated. Column "7" contains the number of responses for this area and column "8" defines how many experts from this industry participated.

In addition, a quotient is calculated, which defines the proportion of survey participants in relation to the participants from the industry. This figure gives a qualitative impression of how representative the industry is. In column nine, the number of responses is divided by the number of experts in the field. This ratio is used to determine a certain degree of certainty in the statement. If there are factors greater than 100%, this answer was answered by more participants than by specialists in this field. If the factor is greater than 0% but less than or equal to 100%, fewer participants answered this question than specialists in this field are available. If the value is exactly 0%, no expert has evaluated this industry.

The visualisation of the evaluation of the explorative survey is carried out with the help of a table and two diagrams per examined method. In the table, the mean value, the standard deviation, the standard deviation are subtracted from the mean value, the mean value plus the standard deviation, the median, the number of participants, the industry, the number of experts per industry and the factor described above are determined for the individual industry sectors and the individual experience. The evaluation is carried out according to the criteria of safe applicability, applicable, partially applicable or not applicable. The first diagram serves as a statistical representation of the method. The crossed line in the middle visualizes the mean value of the method. The wide bars describe the confidence interval around the mean with plus and minus a standard deviation. The boundary points describe the extreme values of the evaluation. With the help of this diagram, the statistical representation of the methods is to take place and a clear evaluation is to be represented. The second diagram shows the mean value, the median, the mean value plus the standard deviation and the mean value minus the standard deviation. This should help to illustrate whether the method is about a very large dispersion or whether the mean and median are far apart or close to each other, this should give an indication of the distribution of the answers and show the reader whether there is a continuous or statistical fluctuation over the small number of participants in the exploration.

III. ANALYSIS

A. Overview of analysis

In general, automotive technology and semiconductor and microsystems technology are best represented. This is because Lean Management is most widespread in automotive engineering. The electrical engineering, mechanical engineering and electronics and optics industries are still well represented, with two participants each. One representative will be provided from the fields of metal construction, plastics, data processing, food and chemical industry. There will be no representatives from the textile and wood industries. Thus, the results can be well represented for the industries of automotive engineering, electrical engineering, metal and mechanical engineering, which are widespread in Germany and Austria, as well as for many adjacent industrial sectors such as the semiconductor industry, the food industry or the electronics and optical industry. Uncertainties in the valuation are seen for smaller branches of industry such as the wood industry or the textile industry. Industries with very high valuation factors such as the chemical industry, the food industry, data processing or the plastics industry should also be critically evaluated in the exploration sector. For many methods, it can be seen that they can be applied across all areas. Particular importance should be attached to these methods, which differ widely in individual sectors.

In the following chapter the partial and not usable methods are presented. For the ERP setup it's good to see that there is not sucha big variance in the methods. The focus is more on some not usable methods. For implementing efficient and optimized ERP processes and setups a setup of around 45 to 50 Lean methods can be used. ERP provider should be used the LM methods in two ways. Value stream and process structured methods, like value stream mapping or Chaku Chaku, should be used inside the ERP systems as process managing support. On the other side the easy to use and shopfloor optimizing methods should be part of each ERP implementation project, because the shopfloor and the logistics are more leaned and structured. So the implementation is easier and faster.

B. partial and not usable methods

Methode	Bereich	Exploration branchenübergreifend	
		An	Anwendbarkei
7W-Fragen	Erfahrung	10	partiell anwendbar
Alibi	Erfahrung	6	partiell anwendbar
Alibi	Halbleiter/MST	4	partiell anwendbar
Alibi	Kraftfahrzeugt.	4	partiell anwendbar
Alibi	Elektrotechnik	5	nicht anwendbar
Alibi	Maschinenbau	5	nicht anwendbar
Alibi	Metallbau	5	nicht anwendbar
Alibi	Kunststoff	4	partiell anwendbar
Alibi	Datenverarbeit.	4	partiell anwendbar
Alibi	Elektronik/Optik	4	partiell anwendbar
Alibi	Nahrungsmittel	5	partiell anwendbar
Alibi	Chemieindustrie	5	partiell anwendbar
Alibi	Textilindustrie	4	partiell anwendbar
Alibi	Holzindustrie	4	partiell anwendbar
Andon	Datenverarbeit.	9	partiell anwendbar
Autokorrelation	Erfahrung	8	partiell anwendbar
Autokorrelation	Datenverarbeit.	3	partiell anwendbar
Jidoka/BandStop	Erfahrung	9	partiell anwendbar
Jidoka/BandStop	Halbleiter/MST	9	partiell anwendbar
Jidoka/BandStop	Metallbau	9	partiell anwendbar
Jidoka/BandStop	Datenverarbeit.	7	partiell anwendbar
Jidoka/BandStop	Elektronik/Optik	9	partiell anwendbar
Jidoka/BandStop	Holzindustrie	9	partiell anwendbar
Blackbox	Chemieindustrie	11	partiell anwendbar
ChakuChaku	Erfahrung	11	partiell anwendbar
ChakuChaku	Halbleiter/MST	8	partiell anwendbar
ChakuChaku	Kraftfahrzeugt.	8	partiell anwendbar
ChakuChaku	Elektrotechnik	8	partiell anwendbar
ChakuChaku	Maschinenbau	9	partiell anwendbar
ChakuChaku	Metallbau	8	partiell anwendbar
ChakuChaku	Kunststoff	7	partiell anwendbar
ChakuChaku	Datenverarbeit.	8	partiell anwendbar
ChakuChaku	Elektronik/Optik	8	partiell anwendbar
ChakuChaku	Nahrungsmittel	8	partiell anwendbar
ChakuChaku	Chemieindustrie	8	partiell anwendbar
ChakuChaku	Textilindustrie	8	partiell anwendbar
ChakuChaku	Holzindustrie	8	partiell anwendbar
Hancho	Erfahrung	11	partiell anwendbar
Hejunka	Erfahrung	11	partiell anwendbar
Hejunka	Halbleiter/MST	9	partiell anwendbar
Hejunka	Elektrotechnik	9	partiell anwendbar
Hejunka	Maschinenbau	10	partiell anwendbar
Hejunka	Metallbau	10	partiell anwendbar
Hejunka	Kunststoff	9	partiell anwendbar
Hejunka	Datenverarbeit.	8	partiell anwendbar
Hejunka	Elektronik/Optik	9	partiell anwendbar
Hejunka	Nahrungsmittel	10	partiell anwendbar
Hejunka	Chemieindustrie	10	partiell anwendbar
Hejunka	Textilindustrie	9	partiell anwendbar
Hejunka	Holzindustrie	9	partiell anwendbar
Just in Time	Halbleiter/MST	9	partiell anwendbar
Just in Time	Metallbau	10	partiell anwendbar
Just in Time	Datenverarbeit.	8	partiell anwendbar
KanBan	Halbleiter/MST	9	partiell anwendbar
Kreidekreis	Datenverarbeit.	10	partiell anwendbar
LCIA	Erfahrung	9	partiell anwendbar
LCIA	Halbleiter/MST	7	partiell anwendbar
LCIA	Elektrotechnik	7	partiell anwendbar
LCIA	Maschinenbau	6	partiell anwendbar
LCIA	Metallbau	6	partiell anwendbar
LCIA	Kunststoff	6	partiell anwendbar
LCIA	Datenverarbeit.	7	partiell anwendbar
LCIA	Elektronik/Optik	7	partiell anwendbar
LCIA	Nahrungsmittel	7	partiell anwendbar
LCIA	Chemieindustrie	7	partiell anwendbar
LCIA	Textilindustrie	6	partiell anwendbar
LCIA	Holzindustrie	6	partiell anwendbar
Milkrun	Erfahrung	10	partiell anwendbar
Milkrun	Halbleiter/MST	7	partiell anwendbar
Milkrun	Elektrotechnik	7	partiell anwendbar
Milkrun	Maschinenbau	7	partiell anwendbar
Milkrun	Metallbau	8	partiell anwendbar
Milkrun	Kunststoff	6	partiell anwendbar
Milkrun	Datenverarbeit.	7	partiell anwendbar
Milkrun	Elektronik/Optik	7	partiell anwendbar
Milkrun	Nahrungsmittel	8	partiell anwendbar
Milkrun	Chemieindustrie	8	partiell anwendbar
Milkrun	Textilindustrie	6	partiell anwendbar
Milkrun	Holzindustrie	7	partiell anwendbar
Mizusumashu	Erfahrung	9	partiell anwendbar
Mizusumashu	Halbleiter/MST	8	partiell anwendbar
Mizusumashu	Datenverarbeit.	7	partiell anwendbar
Multi-Machine	Datenverarbeit.	7	partiell anwendbar
Multi-Machine	Elektronik/Optik	9	partiell anwendbar
OEE	Datenverarbeit.	11	partiell anwendbar
Segmentierung	Erfahrung	11	partiell anwendbar
SMED	Halbleiter/MST	8	partiell anwendbar
SMED	Maschinenbau	8	partiell anwendbar
SMED	Metallbau	8	partiell anwendbar
SMED	Datenverarbeit.	7	partiell anwendbar
SMED	Nahrungsmittel	9	partiell anwendbar
SMED	Chemieindustrie	9	partiell anwendbar
SMED	Textilindustrie	8	partiell anwendbar
SPC	Datenverarbeit.	8	partiell anwendbar
Supermarkt	Halbleiter/MST	8	partiell anwendbar
Supermarkt	Datenverarbeit.	7	partiell anwendbar
Taktzeit	Erfahrung	10	partiell anwendbar
Taktzeit	Halbleiter/MST	7	partiell anwendbar
Taktzeit	Elektrotechnik	7	partiell anwendbar
Taktzeit	Kunststoff	7	partiell anwendbar
Taktzeit	Datenverarbeit.	6	partiell anwendbar
Taktzeit	Elektronik/Optik	7	partiell anwendbar
Taktzeit	Nahrungsmittel	8	partiell anwendbar
Taktzeit	Chemieindustrie	8	partiell anwendbar
GD3	Erfahrung	8	partiell anwendbar

Fig. 2. Methods with partial or not usable ratings

IV. CONCLUSION [25]

Hypothesis 1 (Many methods follow general approaches and are fully applicable in all industrial sectors): The largest single area of evaluation is shown by the applicable methods. This confirms the first hypothesis that many methods are fully applicable and each ERP implementation could use this methods for optimizing and implantation in ERP software. A positive aspect of the general use of Lean Management in all industries is that there are no methods that are not applicable. Conversely, this means that for all methods examined in the context of this research question, there is an applicability or at least a partial applicability for each method in each industry.

Hypothesis 2 (A small proportion of Lean methods show problems in implementation in all industrial sectors due to their complexity.): The second hypothesis is limited by the fact that there are no methods that are not applicable. Thus at least everywhere a partial applicability is given. However, there are methods that show predominantly partial applicability in all industries and thus speak against a simple implementation due to the complexity of the methodology. This hypothesis is thus partially confirmed. This methods could be analyzed and used for the ERP implementation in industries with significant positive results.

Hypothesis 3 (Methods that relate to the logistics process within production show significant differences in the individual industries): The only exceptions are the Kanban and FiFo methods, which can be applied in almost all industries, at least according to the qualitative analysis. Other logistic methods such as Chaku Chaku, Hejunka, Just in Time, Milkrun, Mizusumashu [21, 22, 23], segmentation and supermarket show predominantly significant differences or also partial applicabilities in the result. The expression here is significantly higher than with the other methods, thus the third working hypothesis is also confirmed. This methods are also relevant for the shopfloor restruction and the software

implantation related on ERP topics for industries with positive results.

Hypothesis 4: (Lean experts and internal users as well as end users have a differential perception of usability, based on different interpretations). The fourth research hypothesis is also confirmed, since significant differences have occurred in various methods. Thus, the assumed research questions, which arose from practical experience, can largely be regarded as confirmed, except for the second hypothesis. With this research model, a fundamentally successful attempt was made to confirm or refute the four hypotheses. The research model has proved successful in its application and could use in different ways. Only Lean implantation could be one part of the use, on the other hand the combination with ERP topics for restructuring the shopfloor and implementing Lean ERP software is very helpful.

V. Future Work

For further research, it would therefore be necessary to set up a working group on industry-related colleges, universities and employers' associations that can work with the necessary access to the whole. The expansion of the work should take place both in the research design and in the extension to service and health sectors or also the public sector, in order to consider the overall economic effectiveness. It should be mentioned here that the literature research of the theoretical part shows that Lean Management finds more and more applications in the areas of Health Care, Administration, Green and Sustainability and Services. Also the setup in ERP models and ERP software is growing and discussed. The public sector also includes many administrative areas and could benefit significantly from Lean Management approaches in the workflow. This work provides a first insight into the industrial sectors, a similar approach for non-industrial sectors is identically possible and also a big customer sector for the ERP business. Many research topics from recent years have dealt with implementation determination, Lean design approaches or evaluation models for the transformation of Lean Management in various industries [9, 14]. These assessment models can be found in various industries and the original industries of Lean Management [10]. In this research it was not assumed that Lean Management methods are generally applicable. In the context of an academic thesis, the implementation of the scoring model on the results reflected here would be possible quickly and successfully. [11, 12] The combination on practical Lean implementation and Lean optimization is a helpful requirement basement for successful ERP implementation. The project members get in contact with the production structures of the customer company and the acting would be with two big benefits. The shopfloor is getting more efficient and the ERP implementation is nearer on the production level. Using a suitable analysis method, the rankings of the methods and the taxonomies [21], the implementer would have to create cascades of the applicability of the methods and identify through qualitative investigations what a suitable question setup for the evaluation could look like. [13, 24]

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