SCALE DEVELOPMENT FOR LEAN IMPLEMENTATION IN INTERNATIONAL ENVIRONMENT

Olga Pavlovska
PhD student, PMP, Senior Business Consultant at Wilo SE, Germany, Dortmund
e-mail: olga.pavlovska@wilo.com

Irina Kuzmina-Merlino
Dr.oec., Professor, Transport and Telecommunication Institute
e-mail: Kuzmina.I@tsi.lv

Abstract

Purpose – Many organizations currently have looking for Lean methodology implementation. The causes of this are different - to increase profitability, expand into new markets, meet new business requirements or other reasons. The purpose of the paper is twofold. Firstly, to develop methodological approach – evaluation matrix, to exam successful/unsuccessful Lean implementation projects, and secondly to review collected cases through evaluation matrix, which has been designed by the authors.

Design/methodology/approach – Relevant databases was taken to search for case studies of Lean implementation under certain criteria. Literature sampling method – case studies demonstrate successful or unsuccessful results of Lean implementation, with 5 or more literature sources references, and was published in one of the peer reviewed journal. In total were checked 150 articles for taxonomy definition, and chosen 17 papers for evaluation.

Findings – The taxonomy of organisation attributes with the level of changes was developed to build-up a scale for Lean implementation measurement and dependences definition. The taxonomy later on was used for selected case study evaluation. This article summarizes a number 16 of organisations where Lean is working throw evaluation matrix previously designed. Most common application and outcomes are discussed on the case study examples.

Research limitations/implications – This research reviews case studies published from 2009 and focused on Lean implementation in various types of organizations. Systematization and classification was used for reviewed literature analysis.

Practical implications – The research can be used by business units for goals definitions, expectations management and assumptions tracking.

Practical value – This is the first paper to make a multi-level taxonomy of layers and problems for successful Lean applications. A new classification can be used for pre- and post-implementation phase comparisons, goals definitions and assumptions tracking.

Keywords: Lean production, Lean Implementation, Case study, Lean philosophy, Implementation measurement.

1. INTRODUCTION

In recent years, many companies have adopted Lean in an effort to improve processes and reduce costs. The background for this research was the authors' investigation into building a new controlling framework to serve as a powerful and cost efficient tool for performance measurement in international organizations. During the controlling framework reviews several contradictions in current practices were founded. The Lean concept has a visible potential to obtain solution of these contradictions and inconsistencies.

The concept of Lean has a long history going back to the 1940s to Japan Toyota factories (Holweg, 2007; Shimokawa and Fujimoto, 2009), but in its current understanding the concept has been used only since the 1980s (Krafcik, 1988; Womack and Jones, 1996). The Lean methodology in itself has been thoroughly discussed in recent years in various publications (Hines, *et al.*, 2004; Hopp and Spearman, 2004; Shah and Ward, 2003; Shah and Ward, 2007; Moyano-Fuentes and Sacristán-Díaz, 2012) and is not included in discussions of this paper. The implementation of this methodology is gaining a focus more often in the last 5 years. There are many possibilities to understand Lean methodology, that each company implement Lean absolutely unique way. It is important to differentiate this ways accordingly its potential benefit.

One special research, which needs to be pointed at the beginning, was done by Malaysian researchers (Wong *et al.*, 2009) for Malaysian electrical and electronics industry. There were

surveyed 58 different size companies with follows statement. Half of the 14 SMEs and 44 large companies showed as results inadequate understanding of the complex Lean approach. A majority of the respondents accepted that Lean was a time and cost reducing performance tool. Around 6% of respondents mentioned Group Technology as a relevant tool, but all of them was used Lean more than 10 years. As the main obstacles during Lean implementation processes was pointes - budget issues, employee resistance and cultural issues, such as company culture, or backsliding to the old ways of working.

The aim of this paper to develop methodological approach – evaluation matrix, to exam successful/unsuccessful Lean implementation projects, and secondly to review collected cases through evaluation matrix, which has been designed by the authors. The objectives of the paper are threefold. Firstly, analyze case studies and accumulate best practices. Secondly, develop organizational taxonomy based on MECE principle (mutually exclusive and collectively exhaustive) and cross it on matrix base with level of changes. Thirdly, evaluate with this matrix selected case studies to show the trends and benefit analysis.

2. METHODOLOGY

Literature review was in use to summarize previous knowledge and development – as theoretical background, proof of topicality and definitions. This allow to find theoretical based for the research, detect main variables, describe terms and condition. Taking into consideration, that there are a lot of secondary information sources, with are not structured for this research but give broader view on problem, makes so important to choose right analytical methods. Evaluation of secondary information can cover incompletes of data and other limitation.

Case study was in use to analysis of real examples described by literature and practical cases, and leads to model development. This important step was chosen due to lack of relevant statistical information, in order to look on the problem broadly, and take-out some geographical and economical limitations. Case study, by itself, not enough quantitative, and request additional development of evaluation matrix, to conduct research on a high theoretical level. Especial modelling technologies could be in use for particular case, as namely: Ontology and Taxonomy development was in use as approach to create common vocabulary for model, processes and interactions. Outcome of this are several evaluation matrixes, which was applicable to convert chaotic case study description to measurable and quantitative dimension. The develop scale was in use to future development, as well, can be useful for similar studies, or viewed with respect to management field studies. Utilisation of this matrix provides a proper way to evaluate selected case studies. This approach gives a possibility to make analyses and comparison of selected cases based on one common scale. Taxonomy factors are described in the next chapter. Evaluation matrix was shown in Figure 1, and case-study analysis in the Tables 1 and Table 2.

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Articles were examined and reworked according to the basic breakdown structure, described in the next chapter. The relevant sources examination procedure adopted was as follows:

- Paper contains a description of the implementation,
- Peer reviewed,
- Description of internal and external parameters of the organization,
- qualitative or quantitative description of the implementation results,
- Factor impact is described or can be deducted,
- 5 or more citations,
- Year range is between 2009 and 2013.

Several previous studies have examined the impact of 6 Sigma quality practices on financial and operational results (Aboelmaged, 2010; Pepper and Spedding, 2010; Hasle *et al.*, 2012; Stone, 2012; Moyano-Fuentes and Sacristán-Díaz, 2012). Most of them focused on production companies, with the timeframe up to 2009. This study therefore was focused on the case studies published after 2009.

3. MULTI-LEVEL TAXONOMY OF ORGANIZATION'S ATTRIBUTES

However Lean implementation has been in focus for huge amount of management researches, it was founded only one study with try to present any breakdown structure for evaluation by Zayti (2010). There is a proposed taxonomy of the key company attributes for scaling and measurement developed by authors and has similarities to previous mentioned source. The upper level was divided into Industrial context, Business layer factors, Process layer factors and Service layer factors. In the 'Industrial context' factors were grouped SUPER-System factors – macro level, which can't be directly changed by the organization and depends on industry traditions and environment. The 'Business layer factors' incorporate an organizational position and external interactions (System). 'Process layer factors' describe the style of internal processes on the decision making level (SUB-System – micro level). And finally, the lowest – 'Service layer factors' – deducts most changeable, internal factors (SUB-SUB-System – nano level). Successfully addressed challenges on each layer can be represented via the 4 types of impact (contradiction range): Strategic contradiction, Conceptual problem, Technological problem, and Organizational problem (authors' adaptation of several authors (Zayati *et al*., 2010, Chen, 2006, Daclin and Chapurlat, 2008) ontologies). The next chapter discloses more precise definitions of each, and offers discussion.

3.1. FOUR LAYERS OF ATTRIBUTES, PROBLEMS AND CHANGES

To build up the matrix for case evaluation, there will be represented and discussed axes and values on them.

3.1.1. CHANGE LAYER DIMENSION

Industrial context.

There are not so many industries where examples of Lean implementation case studies can be found. Historically, most common examples are shown in the auto industry. This is logical, when we remember that Lean originated at Toyota. This means one-by-one knowledge transfer during implementation. One of the best reviews for this type of implementation was done by Moyano-Fuentes and Sacristán-Díaz (2012). They reviewed literature and made references to more than 120 cases of Lead implementation in the auto industry. To determine application sector various industries was take into consideration. Different industries have different product change requirements; product life-cycles also vary from case to case, as well product customization levels. These differentiations linked to customer segment of each observed company. Some sectors have big competitions, some have specific barriers, and these specificities also need to be taken into

consideration.

The second challenge in this factor group is geographical location. Cultural traditions, country development level and availability of qualified human resources can visibly impact on the success or failure of the Lean process. Off-shore outsourcing possibilities should also be mentioned. From cost point of view off-shore outsourcing may be acceptable, but an example of call centre Lean implementation (Piercy & Rich, 2009) shows this approach does not yielding desired results in certain industries.

Business layer factors

Business layer factors include the size of the organization (in respect to turnover, people employed, customers and aggregate gross assets), its age, Outsourcing, Strategic plan and Supplier type. This factor is a legacy of growth and development of the organisation, and changes to this layer will have a waterfall impact on other layers. From the Lean philosophy point, this is the main layer of changes. This type of project will definitely be time and cost consuming, involving consultants, additional analysis, strategic plan adjustment, cultural change, employee training, process reengineering, infrastructure, reporting and accounting changes.

Process layer factors

Organization management style, rewarding systems, autonomy, internal resistance - are the components, logically attached to this layer. These can cause some of the major challenges for the Lean implementation and have the biggest risk impact. There were two papers published in recent years (Johansson and Abrahamsson, 2009, Pedersen and Huniche, 2011) analysing this layer, where was represented that Lean processes is not accepted by unions and workers. Looking for a balance between maximal utilization of human resources and employee internal negative feeling about this. As well as internal resistance against change will be part of the layer challenges.

Service layer factors

Organizational infrastructure, HR quality, and are collection on this layer. Many simple and quick initiatives labelled as "Lean" associated with the layer. In most cases, it is enough to use one or two simple tools to get required improvements in this layer.

3.1.2. CONTRADICTION DIMENSION

Strategic contradictions

This contradictions appear, during or after the strategy of the organisation is redefined, or core target is adjusted, without proper waterfall change application. As outcome, the underlying processes are no longer support the new strategy, or existing mismatch between them. A decomposition approach should be adopted to address this challenge to lower levels, and an impact of every layer adjustment should be controlled. Processes will be drilled down till last independent variable, which have impact in the result, and aligned to targets. The critical point is to re-design all processes and get a balance in the new structure. To address infringe this situation, a new type of problem should be defined.

Conceptual problem

This problem types are responsible for the inconstancies of created processes to a higher layer solutions or decisions, which are detected during the testing or post-implementation phase. Associated problem solving methods can be met with resistance from employees, or management. Only outcome with high added value would raise a question - to rebuild stable solutions, or change some previous decisions.

Organizational problem

These are the problems associated with authority and responsibility of work conditions. These problems are always very sensitive, and resistance to change and/or sabotage should be expected. Possible solutions always are time consuming and at times uncomfortable for those involved.

Technological problem

In most cases this is a question of performance. With speedup of the observed process or

increase data/work of volume - existing solutions cannot cope and perform to the required quality, or within the requested time. Changes of technological solutions can often solve these challenges easily. From a human perspective this is quite a simple case: identify the problem, find technical solutions, and implement them with personal training. Costs associated with new technology implementation can potentially cause issues. We can now assemble a matrix for layer and problem type detection for Lean implementation. Visualization is shown on the Figure 1, which is developed by the authors.

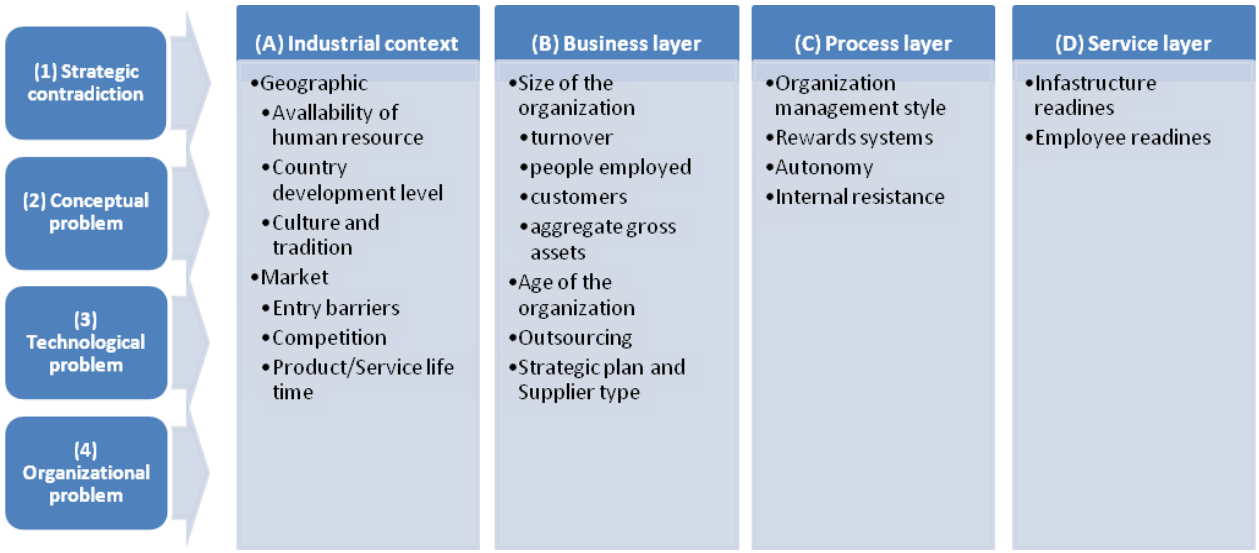

Figure 1. Evaluation matrix
Source: designed by authors based on chapter 3 described factors

4. CASE STUDY REVIEW BASED ON DEVELOPED EVALUATION MATRIX

The matrix was used to evaluate selected cases, and highlight the most common trends in Lean implementations. The results are represented below in Table 1 and the discussion of is following.

Table 1

Case studies' review

Nr	Reference	Company profile	Organization layer, problem and changes according to the matrix classification A-D vs 1-4	Results
1	Singh, B., Garg, S. K., Sharma, S. K., & Grewal, C. (2010)	Components for diesel traction fleet, railway maintenance, Thailand, Middle or small size, local - one city - Pattaya	D4 – infrastructure adaptation	Reduction in lead time - 83.14 %, in processing time - 12.62 %, in work-in-process inventory - 89.47 %, and in manpower requirement - 30 %. Rise in productivity - 42.86 %.
2	A. Laureani, J. Antony, A. Douglas, (2010)	Service industry, Call centre, Big competition, fast-growing area	D4 – infrastructure adaptation	Increase in first-call resolution ratio, reduction in operator turnover and streamlining of processes
3	Nahmens, I., & Mullens, M. (2009, 2011)	USA, Construction industry, HUD-code homes for a moderate market segment, Small size, local, change supplier, change products	D4 - infrastructure adaptation according to new processes	New and old products at lower costs, no real measurement (total improvement was shown in the 2011 case study)

4	Ray, S., & John, B. (2011)	India, business process outsourcing (BPO) services provider for European finance service industry, Middle size company, local	D4 - infrastructure needs to be adopted to new work load, a simple technological problem solving	Increase processing speed from 600 records per hour to 2400. Reached the target SLA.
5	Stoiljković, V., Trajković, J., & Stoiljković, B. (2011)	CIM Group and bioMérieux Belgrade Office, Sample analysis process in a microbiological laboratory	D3 & D4 - one process was affected	On average a 25% improvement in working time
6	Halwachs-BaumannG. (2010).	Austria, laboratory of Central Hospital. Hospital consists of 2 sites. The larger - 700 beds (in a town of 40,000 inhabitants), 21 clinical departments. A laboratory is available 24/7 and supports a lot of internal processes.	C3	Workload increased by >30%, cost reduction of 9%, and 2 FTE reduction keeping SLA
7	Villa, D. (2010)	Italy, hospital laboratory Lean implementation	C3	Some operations were improved twofold or more, other only by 20-50%. Overall results are presented qualitatively, not quantitatively
8	LaGanga, L. R. (2011)	USA, outpatient community mental health centre with 18 outpatient clinics located throughout Denver, large, non-profit	C3	27% total improvement
9	Acharya T.K. 2011	India, assembles Medium Voltage Switchboards and Circuit Breakers	C3	Process time reduction of 56%, Material handling reduced by 39%
10	Sarkar, A., Mukhopadhyay, A. R., & Ghosh, S. K. (2013)	India, life insurance, Middle size company, head office and branches	C3 - management style change, Infrastructure adaptation to new work load	Increased claim transparency and processing speed, matched SLA.
11	Martinez, D., & Gitlow, H. S. (2011)	USA, part of organization, purchasing department at the University of Miami	C3 - management style change, Infrastructure adaptation to new work load	Reduced processing time for a service request from 168 hours to 2.27 hours
12	Arumugam, V., Antony, J., & Douglas, A. (2012)	UK, Airport security check, Middle size company, local with international dependencies	C3 - change leadership style, training people	Improved airport security check process
13	Nepal, B. P., Prakash Yadav, O., & Solanki, R. (2011)	USA, Lean product development project for a moderately large and complex product used in office buildings	B2 - full range of changes according to a full Lean methodology	Real achievement of Overall improvement 32% reduction of time and resources on the 1st project phase, and goals to increase this reduction for up to 50%.
14	Song, W., Tan, K.H. and Baranek, A. (2009)	OCBC Bank, international, very large international company	B2 - full range of changes according to a full Lean methodology	Manpower requirement reduced by 27%, unit processing time improved by 27%, internal defect rate reduced by 50%, unit processing cost reduced by 16.5%, productivity increased by 35%.
15	Song, W., Tan, K.H. and Baranek, A. (2009)	Building service provider based in China, founded in 2002, Large local provider	B2 – a full range of changes according to a complete Lean methodology	Improved process quality by 43%, reduce processing time by 38%, employees utilization by 29%, operations cost by 50%, supply chain management by 30%
16	Piercy, N., & Rich, N. (2009)	UK, call centre	Training and analysis for off-shore outsourcing	No positive results, implementation had cultural and economical barriers
17	Eriksson, P. E. (2010).	EU, Sweden, Scania is a manufacturer of heavy vehicles (trucks and buses), five connected partners DynaMate	Change in cooperation, lean pilot project based on a full range of Lean principles	Biggest result in supply chain, but mostly in cooperation, than in Lean implementation

Source: designed by authors

The top of the table presents the most common cases bases on various Lean tools and methodologies where adjustments are only affect one process in the organization, but never the less

- gives a big impact to particular operation, as shown in the laboratory case (Stoiljković *et al*., 2010), or the SLA effort arising from the extreme increase in received document volumes (Ray, 2011). As the most important Lean tools application on this level, should be pointed - the visual problem searching method. It also allows define the target, which not always achievable, but potential benefits are ready for analysis stage. Several authors (Singh *et al*., 2010, Laureani *et al*., 2010, Nahmens and Mullens, 2009, Nahmens and Mullens, 2011) have demonstrated this approach perfectly in different industries.

In the process layer of the organization typically organizational solutions are implemented, as shown in the case study for non-profit organization in the health industry sector (LaGanga, 2011). In the laboratory Lean implementation case (Halwachs-Baumann, 2010) bigger improvements and problem solutions for more complex cases are illustrated. There was provided possibilities for bigger improvements in one particular department of the organization. Another example of technical and organizational problem solving in the laboratory was described based on the Italian experience by Villa (2010). This case study showcases wasted movement and the inadequate technical solution, as well as presenting separate process results. Typical manufacturing case by Acharya (2011) presents good results in Indian Electric Switchboard assembly firm for a standard production example.

Life insurance case (Sarkar *et al.*, 2013), is the next example of the process layer changes - susses a solution for organizational problem which yields quality and time improvement outcomes. Both factors are definitively important for service oriented companies. A purchase department case by Martinez in 2011 for University of Miami shows a huge improvement – a reduction from 168 hours to 2.27 for service request processing. The last example of this layer's solution implementations is an airport security check (Arumugam *et al.*, 2012). Shorter waiting times at the security control positive impacts the airport's branding and reputation.

Business layer changes are not so commonly described. There are few examples of success stories in Lean philosophy implementation. Solutions in this layer are time and budget consuming. The implementation stage contains training phase, and Customer Value Stream development and adjustment. Such complex approach has a higher risk and requires a lot of efforts, but outcomes are much more detailed and notable. Nepal, Prakash Yadav, and Solanki (2011) describe manufacturing company improvements as a complex case. Starting from a target definition "In 2006, the senior management of ABC Manufacturing challenged its product development organization to reduce their time- to-market cycle time by 50% in the next development cycle." this process chain includes 7 steps: need recognition, design specification, concept development, detail design, testing and refinement, production, and marketing. For the other target for achievement - "increasing the number of ideas with high market share and payback potential by driving "big win" innovation and understanding market needs", when comparing this to the previous layer the production time is reduced.

The next relevant case study describes an international Bank, founded in Singapore (Song *et al*., 2009). Several processes were restructured, and conceptual, organizational and technical problems were solved. At the same time headcount reduction with process time improvement was achieved, along with quality and productivity increase and cost reducing. The additional complexity of this case is its geographical location - time and cultural differences, languages, and other aspects, which were taken into consideration. The same article shows another full Lean implementation case - building services provider based in China, founded in 2002. As a large local company with a high layer of implementation and various problem solving techniques, the company achieves perfect results - big impact was realised in resource utilization, supply chain management and costs.

Last two case studies are provided to show failures in Lean implementation. Piercy and Rich (2009) describe a call centre case, where during a Lean methodology analysis, outsourcing operations to India was found to be the best solution from a cost point of view. This approach held several service quality problems, and as a result Customer Value was lower. This went against the current adopted methodology, thus the project was rejected. Eriksson (2010) observes a project in

Scania, where during a pilot project cooperation between partners were improved, but really Lean process wasn't implemented. This is a temporary situation - project needs more time, more training and involvement. Both these cases illustrate Lean project implementations that are not deep enough. In the Table 2 below the summary of case studies analysis is shown.

Table 2

Case studies' review summary

	Industrial context	Business layer	Process layer	Service layer
Strategic contradiction	16, 17 can be disused here			
Conceptual problem		Case 13 to 15 overall increase 30-40%		
Technological problem			Case 6 to 12 40 – 50% increase in particular part	
Organizational problem				Case 1 to 5 – increase of productivity in particular process

Source: designed by authors

5. CONCLUSIONS

From originally being a production philosophy of Japanese car manufacturers, Lean is fast becoming a new panacea to improve productivity, quality, and employee satisfaction in the public sector, private and non-profit organisations. This methodology promises a lot, but only in a case of full implementation and acceptance. However, Lean implementation is not a trivial task. It is easy to slip into a simple technical improvement of one particular business process, without over-arching business logic to validate it. An organisation's full potential can only be achieved with a thorough change to business processes.

This article investigates multi-level taxonomy of the organisation's layer of Lean changes, and problem types. The matrix classification of these bi-directional variables offers a scale to measure implementation. 17 implementation cases from 2009 till 2013 were evaluated as examples using this matrix. Based on these observations, the following trends can be deducted:

1. Many companies simplify Lean to a separate tool from the full range of methodology. This approach leads to shallow Lean methodology implementation, and limited future improvement.
2. In the process layer of organisation, challenges incorporate not only technological, but also organisational. Relevant implementation often includes training and management style change. The biggest risks in this layer include resistance to change and lack of management support.
3. International and large local organisations show perfect results following full Lean philosophy adoption and implementation. Starting from the business layer and going through all layers, the implementation of changes, under each of them to address various problems can yield a balanced approach for the whole system. This case is time and cost consuming, but the relevant outcome gives a big strategic advantage.
4. The next step for Lean philosophy is the industrial context change. Currently only auto industry can be described as Lean-full industry, but this trend is expected to expand into other sectors. Most attractive for Leanness are service sectors - health, finance and similar.
5. Based on two unsuccessful implementation cases - Industrial context layer, as well as Strategic contradictions is most challenging field for Lean implementation.

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