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Lean Management Effects - An Empirical Evidence from Machine Building Industries in Europe

Andreas Mueller, Stanisław Strzelczak

Warsaw University of Technology, Faculty of Production Engineering, Warsaw, Poland
a_mueller_84@yahoo.de, s.strzelczak@wip.pw.edu.pl

Abstract. This paper investigates planned and side effects from Lean Management implementations. Case studies from machine building industries in Europe were used as an empirical base. The focus of presented research is to provide a relevant data, that could help to explain, why the side negative effects of Lean Management implementations take place. The empirical evidence presented herein with regard to the issue, is wider than in any available publication. Also the way of analyzing effects in this paper goes beyond the existing literature.

Keywords. Lean Management effects • Lean Management assessment

1 Introduction

Lean Production or Lean Management is often and worldwide used by companies nowadays. From successful Lean enterprises significant results can be reported, which makes Lean Management interesting for many business sectors. Toyota is often named as the benchmark, which reports 60-90% lead time reductions, decrease of inventory levels by 10-50%, or improvements of productivity by 5-25% [1]. Toyota considers Lean as a philosophy, following the principle of just reducing the time line from receiving a customer order to customer delivery, by removing any waste [2].

Lean Management is fuzzy understood by Western, who modified the original intention of the original Japanese concept and tend to understand it like a top-down driven restrictive framework for short or medium term projects, typically targeting localized or punctual improvements. The responsibility for success is normally assigned to project managers who are set in charge of expected improvements. Aimed Lean effects are commonly linked to cost savings, growth targets and utilization improvements. However, the sustainability of expected gains is not surely protected. Negative side effects become visible, which typically appear in a form of additional costs, decreased quality of products or services, customer dissatisfaction and others [3]. The above mentioned misperceptions of what Lean Management is and how it should be implemented and managed, seem to corrupts sustainability and long-term success of implemented Lean Management initiatives. This paper provides an extended empirical evidence of Lean effects, including the side negative effects. It is based on a broad basis of case studies, which were aiming a detailed and multi-perspective evaluation of Lean Managements projects.

2 Existing knowledge

The Japanese approach to implementation of Lean Management is often described in five steps [4]: (i) identify a change agent; (ii) find a teacher to facilitate learning; (iii) build a challenge to motivate organization; (iv) map the entire value stream of products; (v) start removing waste at a point that quickly makes an impact and continue then with the rest. The Lean Management in Western world allows various modes of implementation, caused by literature and influence of consulting, which modifies the original Japanese concept of Lean Management [6]. Instead of thinking in terms of value streams and flows, Western managers and executives often focus on short-term-savings, or functions and departments which are in charge of implementation. Managers and project leaders receive bonuses to achieve targets, while the value stream perspective is avoided due to complexities. This is in line with tradition of management control based on standard costs accounting and common focus on utilization of machinery and workers as a major performance indicator [5]. Researchers sometimes describe today interpretation of Lean Management as "considerable variation in scientific and grey literature" being either applied as "philosophy, toolbox, strategic goal or a change process", or even considered as a multidimensional-concept compromising hybrid models, which lead to more vague Lean thinking.

Away from the Lean Management original intentions, the Lean Enterprise Model proposed by the Lean Enterprise Institute introduces a different sequence for implementations: identification of a problem, devising processes to be improved, develop people to continuously improve, allocate managers with right thinking to drive correct leadership, to finally embed the Lean thinking in the company [7]. It is questionable how to combine typical Western approaches with the ideas of Toyota and align the company in long term with Lean thinking, where typically waste in selected processes from value stream analysis is removed i.e. by applying Kanban, Just in Time, Single-Piece-Flow, Levelling, 5S, Kaizen, TPM and diverse other principles.

Many Lean Management publications focus on advantages [5] and suggest that its implementations surely lead to improved performance [8,9,10,11,12,13]. Some papers even state that "the research question of primary interest in the literature is no longer whether lean can benefit performance" [14]. Interestingly all reviewed papers report the effects of Lean Management implementations which were targeted, while eventual side effects are not considered. This exhibits at methodological failure. If one does not look at the side effects, which can be observed elsewhere, they are just not seen at all. The recent empirical evidence neglects the unilaterally positive outlook of Lean by a multi-perspective assessment confirms the existence of side negative effects [3].

The danger of side effects of Lean Management implementations is possibly manifested in spectacular ways. Volkswagen recently reported shortages of components resulting in shutdown of plants. Mercedes and other carmakers report long customer lead times in Europe and USA. BMW extended shipping costs budget for aircraft carriage for urgent deliveries [15]. Bosch established internal task forces to cope with material shortages. ZF Friedrichshafen claims that a many of their strategic suppliers face a difficulty to cope with demand. In USA million car recalls in 2013-2014, caused by faulty airbags or other quality issues were reported [16]. Unfortunately no

single publication has systematically identified or quantified the root causes of above listed observations. Although the unwelcome effects were not deeply explained, from the described circumstances they seem to be rooted in some particular Lean Management implementations, like e.g. leaning the supply base.

The above exhibits both, the practice gap and the research gap, and calls for extended empirical evidence and further methodological research.

3 Methodology and findings

The problem stated evidently requires for a sound empirical evidence. It is due to the unilateral view of Lean Management effects presented in the literature, as well as because of the potential difficulties to explain why side negative effects occur.

After the literature review, which could help to identify side negative effects of Lean Management implementations, a series of case studies was considered. All together 16 machine building companies were approached, which are listed in Table 1.

Table 1. Researched companies

Company	Workforce	Lean Topic	Interviewees
A-Case1	1000+	Product Development	Chief technical officer Head of product development
B-Case2	600+	Procurement LCC	Head of procurement Senior category manage
A-Case3	1000+	Assembly Tact	Head of assembly Head of outgoing goods
C-Case4	500+	Assembly LCC	Head of assembly Diverse sales managers
C-Case5	500+	Engineering Relocation	Head of engineering Head of business excellence IT
A-Case6	1000+	Production LCC	Head of assembly Head of human resources
D-Case7	1000+	Machine Investment	Head of production Head of quality management
B-Case8	600+	Staff Exchange	Head of assembly Head of production
A-Case9	1000+	Sales KPIs	Head of sales Managing director
F-Case10	200+	Development of control units	Head of assembly Head of product development
A-Case11	1000+	Optimization of precision measuring for geometrical levelling	Head of production Head of product development
C-Case12	500+	Shift from control of statistical data to electrical regulation	Head of commissioning Head of product development
D-Case 13	1000+	Sale of more standard machines	Head of key account Head of assembly
E-Case14	300+	Relocation of machine Centre to LCC	Head of production Managing director
E-Case15	300+	Closing of plant, relocation to LCC	President operations Head of machining
B-Case16	600+	Build up Machining in LCC	Head of machining

The case studies are grounding the research plan, which is presented in Table 2. The professionals from approached companies have been involved in semi-structured interviews and later in expert panels. Results of the two series of meetings compose the baseline of research. All interviews were centered on three key issues. Firstly, the intention to identify the field of project in devised environment. Secondly, the targeted effects as planned before the project. Thirdly, the actual effects - appearing after project. All the three issues have been based on a multi-perspective viewing of the potential side effects. This was crucial for their identification and further assessment. The applied approach is fundamentally different to published researches of that kind.

Table 2. Plan of research

Phase	Scope	Methods / Tools
Initial	Problem conceptualization Theory and practice of Lean Mgmt. Evidence of effects in theory	Analysis of literature
Empirical	Case studies	Semi-structured interviewing Expert panels (2nd iteration)
Analysis of results	Results assessment Summary of findings	Simple statistical analysis
Synthesis of results	Conclusion	Theoretical synthesis

Due to confidentiality, companies and performance indicators remain unnamed or being published in a synthetic way. Using this basis, some statistical analysis of the gathered data could be provided.

All investigated case studies exhibited seven common characteristics of implementations. All of them were following a common management control structure, which is illustrated below:

(I) Planning
- (1) Financial business plan
- (2) Steering committee, consisting of:
  - -Minimum one executive manager
  - -Controlling associates
  - -Project Manager
  - -Member of interfacing departments
- (3) Milestone plan for implementation
- (4) Basic risk assessment

(II) Control
- (5) Regular project meetings, including:
  - -Progress of implementation
  - -Financial results review, mainly cost and benefits
  - -Coaching from steering committee to achieve aimed targets
- (6) Budget conformity according to annual budget plan
- (7) Verification of financial results

The case studies enabled to identify both, the planned effects of Lean Management implementations, as well as the side negative effects. All of them are listed in Table 3.

Table 3. Overview of targeted and side effects

Case	Field and Topic	Targeted Effects	Negative Effects
1	Sales KPIs	Low development cost Transparent spending	Additional capex costs Quality issues Customer dissatisfaction
2	Development of control units	Saving supply cost LCC quote	Additional one-time costs Penalties, Fall outs Quality issues
3	Optimization of precision measuring for geometrical levelling	Cost savings Double output Productivity increase	Additional capex costs Increased stock
4	Shift control of statistical data to electrical regulation	Saving personnel costs Saving production costs Low cost suppliers	Additional costs Customer dissatisfaction Reduced sales volume Non-acceptance by own staff
5	Sale of more standard machines	Saving production costs Utilization of plants Standardization	Additional capex costs Quality issues Missing responsibility
6	Relocation of machine Centre to LCC	Saving production costs Low investment cost Growth in market	Additional costs Quality issues Non-acceptance by own staff
7	Closing of plant, relocation to LCC	Saving production cost Technological advantage Utilization	Additional one-time and capex costs
8	Build up Machining in LCC	Revenue increase Better motivation	Additional training costs Quality issues Customer dissatisfaction
9	Sales KPIs	Revenue increase Motivation	Additional costs Customer dissatisfaction Quality issues
10	Development of control units	Technological advantage Saving personnel cost	Additional capex cost Customer dissatisfaction Quality issues
11	Optimization of precision measuring for geometrical levelling	Saving personnel costs Higher quality	Quality issues Additional cost
12	Shift from control of statistical data to electrical regulation	Saving personnel costs	Additional one- time cost Quality issues
13	Sale of more standard machines	Lower production costs Mass production benefit Utilization of plant	Customer dissatisfaction Higher stock High qualified engineers leave
14	Relocation of machine Centre to LCC	Lower production costs Lower personnel costs	Quality issues Customer dissatisfaction Higher stock
15	Closing of plant, relocation to LCC	Lower production costs Lower personnel costs	Quality issues Image damage, penalties Loss of qualified staff
16	Build up Machining in LCC	Lower personnel cost	Quality issues Additional capex cost

The project based setup within companies indicates that planning and control are essential for Lean Management projects. The five most common scopes of targeted effects can be categorized as follows:

- Slimmed waste in different departments, along exact processes or within functions
- Reengineered products to minimize costs of goods sold
- Reduced fixed costs or minimized other expenditures by outsourcing
- Improved performance/competitiveness by investment in technology or automation
- Ensured cash flows due to increased sales by high or steady order entries

All investigated cases targeted single elements or hybrids of the above shown scopes of effects.

The most frequent side negative effects resulting from the reviewed projects can be categorized as:

1. additional costs, i.e. unplanned costs, which in some instances even outranked the planned benefits (in nearly all projects);
2. quality issues (in more than every second project);
3. fall-outs and/or resulting penalties (in every third project);
4. higher stock or loss of competencies (in every fourth project).

The quantification of these effects is illustrated below in Fig.1.

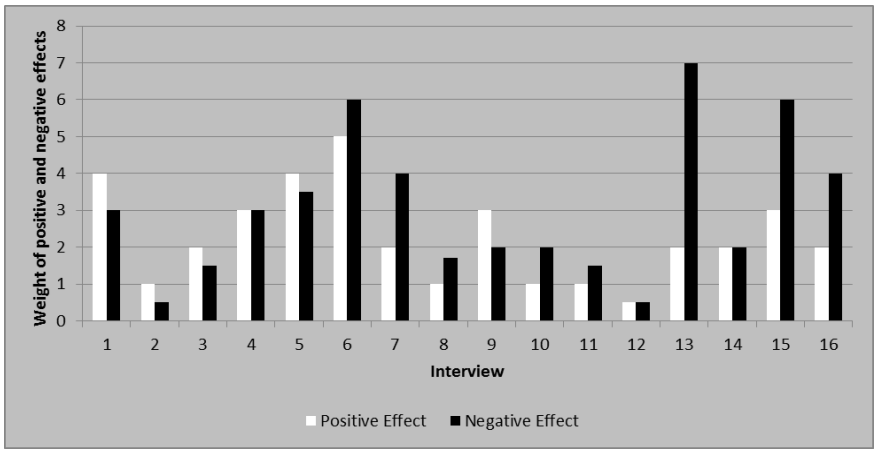

Fig. 1. Absolute quantification of Lean Management target and side effects

In order to illustrate the impact of side negative effects, i.e. in contrast to planned positive effects, a weight scale from zero to seven has been applied, where 0 is the minimum rank and 7 the maximum. The findings provide a proof that negative effects exist and often outrank the planned targets. In first instance the above shown absolute quantifications of effects [Fig.1] have been broken down to major categories of side effects, as illustrated in Table 4.

Table 4. Breakdown of side negative effects

Interview	Extra Cost	Quality Issue	Fall Outs	Higher Stock	Competence Loss	Others	Sub-Total
1	2	0,3	0,6	0	0	0,1	3
2	0,1	0,2	0,1	0	0	0,1	0,5
3	1	0	0	0,4	0	0,1	1,5
4	1	0	1,6	0	0,2	0,2	3
5	2,7	0,3	0	0	0,5	0	3,5
6	3	0	0	0	2	1	6
7	4	0	0	0	0	0	4
8	1,5	0	0	0	0	0,2	1,7
9	0,8	0,2	1	0	0	0	2
10	0,5	0,6	0,8	0	0	0,1	2
11	0,8	0,5	0	0	0	0,2	1,5
12	0,2	0,3	0	0	0	0	0,5
13	0	0	4	2	1	0	7
14	0	0,4	1	0,6	0	0	2
15	0	0,9	2,7	0	2	0,4	6
16	3,3	0,5	0	0	0	0,2	4
Total	20,9	4,2	11,8	3	5,7	2,6	48,2
% of Total	43%	9%	24%	6%	12%	5%	100%

The main impact of side effects results from unplanned “extra costs” of different nature, i.e. higher than assumed project related investments or capex related costs (43%), followed by costs of “Fall Outs”, e.g. customer penalties or cancelled orders (24%). The third highest effects can be linked to “Competence Loss” (12%), which is described as unplanned leave of experts or specialists, carrying on unplanned costs. Fourth ranked category is “Quality Issues” (9%), mainly appearing during project implementation or after project. Second last category is “Higher Stock” (6%) consisting of increased stock levels, extended costs for warehousing, and additional staff for internal or external logistical efforts. The last category “Others” (5%) summarizes other costs involved, i.e. cost of reorganization, recruitment or administration costs.

4 Summary and further research

The data collected along interviews shows that Lean Management implemented in the European machine building industries follows a project based approach. It exhibits a planning and control systematics, which can be considered as a deviation from the Japanese philosophical approach towards Lean. Projects aim reduced costs, reengineering, outsourcing, technology improvements or increased sales, while the intention of Lean Management should be rather to reduce the timeline between customer orders to customer payment. All cases show that side effects have a major impact and significantly reduce, or in many instances even exceed, the planned effects. The empirical data from case studies provides insights into complexity of Lean Management implementation. The critical factor for elicitation of the side negative effects of Lean Management implementations was the multi-perspective approach to their identifica-

tion and assessment. Consequently it is needed to extend the research towards causal analysis of the side negative effects. Its results could then facilitate development of a method for multi-perspective and holistic assessment of Lean Management implementations.

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