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► **To cite this version:**

Barbara Resta, Paolo Gaiardelli, Stefano Dotti, Roberto Pinto. Towards a New Model Exploring the Effect of the Human Factor in Lean Management. Shigeki Umeda; Masaru Nakano; Hajime Mizuyama; Hironori Hibino; Dimitris Kiritsis; Gregor von Cieminski. IFIP International Conference on Advances in Production Management Systems (APMS), Sep 2015, Tokyo, Japan. IFIP Advances in Information and Communication Technology, AICT-460 (Part II), pp.316-323, 2015, Advances in Production Management Systems: Innovative Production Management Towards Sustainable Growth. <10.1007/978-3-319-22759-7\_37>. <hal-01431111>

**HAL Id: hal-01431111**

**<https://hal.inria.fr/hal-01431111>**

Submitted on 10 Jan 2017

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# Towards a new model exploring the effect of the human factor in Lean Management

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**Abstract.** Although lean popularity is rapidly growing, its implementation is far from problem free and companies may experience difficulties sustaining long term success. In this paper, it is argued that the human behaviour, affected by the implementation of both hard (defined as technical and analytical tools) and soft lean practices (concerning people and relations), plays a key role in achieving long-term superior performance. Through a single case research, the relationships between lean practices implementation, human behaviour and operational performance are explored. From the analysis a new construct emerged, namely “Individual characteristics”. As a result, an alternative research model for further statistical testing including individual behaviour as mediating variable and individual characteristics as moderating variable has been built.

**Keywords.** Lean Management, Human factor, Lean practices, Individual Behaviour (IB), Employees’ Affective Attitude (EAA), Operational performance.

## 1 Introduction

The philosophy and practices associated with lean production have been around for many years, and have been applied in a number of settings including both discrete- and process manufacturing environments, product development and to some extent services and product-services [1]. While there are great deals of lean success stories, a number of real cases has failed in achieving superior performance by applying a lean approach. Operations management (OM) scholars discussed several causes of this lack of success, many of which are indicative of the problems that arise in the human element during a changeover to lean [2]. As demonstrated by Veech [3], there is a fundamental difference between lean organizations and conventional organizations doing lean things: companies that fail in applying lean, fail in approaching and managing the human factor. It is not enough to just apply a lean principle or tool without a simultaneous strive for lean mind [4]. What is needed is a balanced whole system view that emphasizes improved performance through a focus on the persons delivering value to customers [5]. Thus, personal focus, involvement and motivation are

imperative when applying lean principles: “Focus on the people and the results will follow. Focus on the results, and you’ll have the same troubles as everyone else – poor follow-up, lack of interest, no ownership of improvements, diminishing productivity” [6].

In such a context, many studies have focused on the requirements of lean in terms of hard practices (defined as technical and analytical tools) but they paid less attention towards the human factor and the soft practices (concerning people and relations) that could support a lean journey [7][8], and that can ensure positive results in both the long and the short term [9][10]. It is thus essential to monitor and “engineer” human performance in the same way as the performance of the production systems is engineered to achieve a superior performance through lean management [2].

This paper aims at contributing to fill this gap by exploring the effects of both soft and hard practice implementation on the human behaviour and the effects of human behaviour on operational performance, adopting a longitudinal perspective.

The paper is organised as follows. Section 2 presents the theoretical background of the study and the research conceptual framework. In Section 3, the research methodology will be described and the empirical study carried out in a manufacturing company will be presented. In Section 4, the research findings and implications are presented. Finally, the last section closes the paper with the most relevant conclusions and future research directions.

## **2 Theoretical background**

### **2.1 Human behaviour**

The human factor is a key element for the success of lean efforts as most of the reasons for lean failure can be linked directly or indirectly to the human element. Human behaviour has been formalised in ‘80s by introducing the Individual Behaviour (IB) concept, defined as the attitude and actions or deeds of an individual working in an organization [11]. IB is affected by three factors, namely job satisfaction, commitment, and job stress, that represent the main components of the Employees’ Affective Attitude (EAA) construct [12]. In previous research, soft practices has been shown as effective tools for the change of working climate, working methods, and working experiences [13], able to influence EAA during a lean implementation [14]. In particular, lean soft tools are argued to promote employee empowerment and group activity, which have a positive influence on job satisfaction and employees’ loyalty [15]. At the same time, lean hard practices promotes resource optimization, reduction in variability of process, and defect free product leading to the improvement in performance, quality of work, and reduction in job stress [16]. Thus, the implementation of lean techniques in an organization can positively impact the three factors of EAA.

### **2.2 Lean practices**

A systematic literature reviews reveals that different sets of soft practices have been put forward by different researchers. However, these practices can possibly be

grouped into a finite number of generic categories, common in lean implementation in different organisations. The proposed categories are [17]: i) management leadership; ii) management support; iii) top management commitment; iv) organisational culture; v) communication; vi) training and skill building; vii) financial capability; and viii) measurement framework. Similarly, in accordance with Dennis [18], lean hard tools and techniques can be categorised into three main classes: stability and standardization, Just In Time (JIT) and Jidoka (quality). In general, the majority of empirical studies supports the overall positive direct impact of lean practices on firm's operational performance [19], without considering the key role of individual behaviour in maintaining such superior performance in the long term.

### 2.3 Operational performance

When measuring the impact of lean practices, different authors have tried to connect and reflect the combined effect of these practices into one operational indicator [20], now popularly known as "leanness". It include [21]: i) quality; ii) speed; iii) dependability; iv) flexibility; and v) cost.

The resulting research conceptual model is depicted in Figure 1.

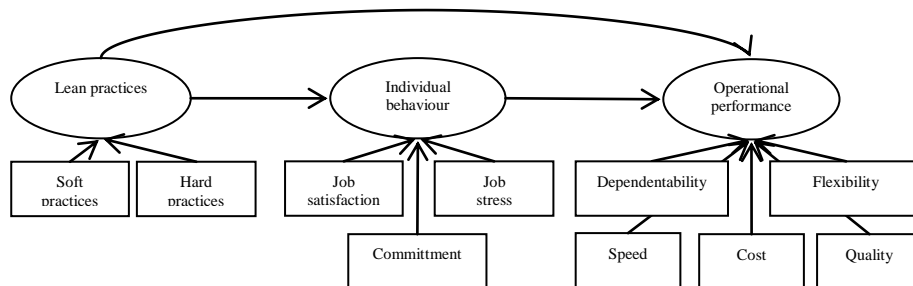


Fig. 1. The research conceptual model

## 3 Research Methodology

The paper is based on an exploratory case study conducted in company Alpha, a medium manufacturer of draft dispensing equipment for beer, wine, water and other soft drinks. The company, has recently expanded its production plants and has introduced a multi-year lean manufacturing project to continuously advance its production efficiency, drive out waste and increase the productivity of the whole supply chain. Based on the research conceptual model previously presented, a research protocol was designed and Alpha's management and operational employees were interviewed at two different times: before lean practice implementation and after 24 months from the

beginning of lean practice implementation. A structured questionnaire consisting of four sections was adopted, to carry out the interviews.

- *General information about the respondent* (years of experience in Alpha, age, gender, education, main activity, type of contract, participation to lean practice implementation);
- *Employees' Affective Attitude (EAA)*, addressed to operational workers, to assess their job satisfaction, commitment, and job stress on a 5-point Likert scale;
- *Lean practices implementation*, addressed to company's management, measured using a Likert scale (1 – 5) to understand the level of adoption of soft and hard practices;
- *Operational performance*: addressed to company's management after lean practice implementation, to assess the performance improvement achieved after the implementation of lean practices.

Based on responses from 64 operational workers and 3 managers (representing the totality of Alpha's employees) at a single lean site, the authors explored the relationship between the degree of lean implementation (soft and hard practices) and workers' EAA, as well as the EAA effects on operational performance.

## 4 Results and Discussion

A short description of the main results is reported in the following.

### 4.1 Lean practices implementation

As summarised in Table 1, it emerges that the company has started to implement some hard practices, but it is still in a preliminary step of its lean transformation. In particular, Alpha's efforts have been mainly focused on developing techniques and methodologies that support process flow efficiency and effectiveness. Nevertheless, lean methodologies devoted to production quality improvement deserve further significant investments.

**Table 1.** Hard practices implementation

	<i>Before</i>	<i>After</i>
Stability and standardization	0,00	2,17/5
Jidoka (Quality)	0,00	1,63/5
Just In Time (JIT)	0,00	2,99/5

Moreover, several soft practices have been applied to ease the success of lean implementation. In particular, as shown in Table 2, project goals and values have been set (Management Leadership), adequate resources and funding have been provided (Financial Capability) to create autonomy lean organisation, as well as to establish a system to properly plan, manage and measure process performances (Management Support and Measurement Framework) and to ensure those necessary mechanisms to

enable a cultural change across the whole organisation (Organisational Culture). However, internal and external communication initiatives to convey consistent information about lean and to demonstrate visible top management commitment are still lagging behind.

**Table 2.** Soft practices implementation

	<i>Before</i>	<i>After</i>
<i>Management leadership</i>	0,00	2,87/5
<i>Management support</i>	0,00	2,88/5
<i>Top management commitment</i>	0,00	1,88/5
<i>Organizational Culture</i>	0,00	2,56/5
<i>Communication</i>	0,00	1,67/5
<i>Training and Skill Building</i>	0,00	2,60/5
<i>Financial Capability</i>	0,00	3,06/5
<i>Measurement Framework</i>	0,00	3,33/5

#### 4.2 Individual behaviour

The analysis of the 64 received responses that compose the total sample -whose main features are summarized in Table 3- underlines that the application of lean hard and soft practices have a positive impact on workers individual behaviour. Indeed, while both the satisfaction and the commitment increase, the level of stress remains nearly unchanged (Table 4). Moreover, the detailed analysis of the individual behaviour of each category characterising the sample suggests that:

- The higher the age and the years of experience in the company of the respondents the lower their satisfaction and commitment about lean manufacturing, whilst a direct relationship with stress emerges. Results underline the existence of a direct relationship between lean and cultural change and that lean approach encounters major difficulties if implemented in organisations, where the capabilities that have been acquired over time may limit management engagement in adaptive change.
- Different types of commitments emerge considering the educational level of respondents, their age, their work experience and the type of contracts. In particular, people with a primary school educational level subject to short term contracts present the highest level of commitment in doing activities. Young people with a very short experience, are characterised by a high level of commitment in taking operational decisions, while people with an high educational level declare having a very strong commitment in creating new solutions. Such results underline how lean manufacturing ease the cooperation at any level of the organisation, eliminate the cultural barriers, and stimulate vertical and horizontal information sharing.
- Satisfaction and commitment are higher in those departments where specific lean projects have been developed. Moreover, people involved in training activities and lean projects declare a major satisfaction, commitment and brand loyalty. Conversely, those workers and employees that have not participated at any lean project appear dissatisfied and not happy about the company. This result underlines how a

right internal communication could avoid internal dissatisfaction especially of those people who are not been involved in lean initiatives.

**Table 3.** Respondents' characteristics

<i>Gender</i>	Male	75,00%
	Female	25,00%
<i>Age</i>	< 35	13,06%
	between 35 and 45	55,69%
	> 45	31,25%
<i>Years of experience in Alpha</i>	< 2	21,88%
	between 2 and 10	29,68%
	>10	48,44%
<i>Education</i>	Primary School	35,94%
	High School	50,00%
	University	14,06%
<i>Main activity/Department</i>	Production	55,93%
	Logistics	15,25%
	Other departments	28,82%
<i>Type of contract</i>	Long term	81,25%
	Short term	18,75%
<i>Lean experience</i>	Yes	14,06%
	No	85,94%

**Table 4.** Individual behaviour measurement

	<i>Before</i>		<i>After</i>	
	Average	Std.dev/Average	Average	Std.dev/Average
<i>Satisfaction</i>	2,78/5	0,47	3,27/5	0,40
<i>Commitment</i>	2,93/5	0,51	3,29/5	0,37
<i>Stress</i>	1,72/5	0,93	1,75/5	0,93

### 4.3 Operational performance

Looking at operational performances achieved through the application of lean initiative, interesting results emerge in terms of quality, time and costs (Table 5).

**Table 5.** Operational performance measurement

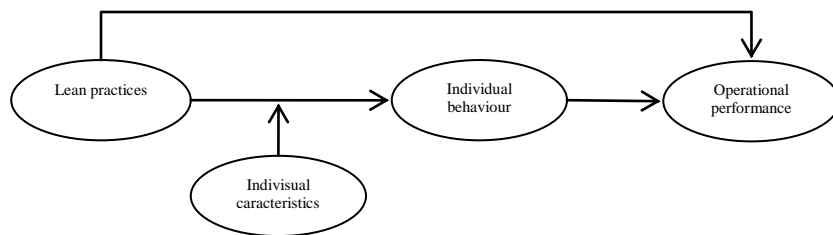
	<i>Average</i>		<i>Variation</i>
<i>Quality (Defects)</i>	- 30%	<i>Dependability</i>	n.a.
<i>Speed (Lead Time)</i>	- 30%	<i>Flexibility</i>	n.a.
<i>Speed (Cycle Time)</i>	- 25%	<i>Cost</i>	- 20%

#### 4.4 Research finding and hypotheses

Based on the results described above, a new construct emerged from the analysis, named “Individual characteristics” (Figure 2). How these relationships occur should be further analysed:

Hypothesis 1 – There is a positive relationship between lean practice implementation and individual behaviour, with the moderating effect of individual characteristics;

Hypothesis 2 – There is a positive relationship between individual behaviour and operational performance.



**Fig. 2.** New research model: Individual behaviour as mediating variable and individual characteristics as moderating variable

## 5 Conclusion

To achieve long-term benefits of a lean approach, a focus on individuals is an essential part. Empirical evidence from this study shows that the human behaviour, affected by the implementation of both hard (defined as technical and analytical tools) and soft lean practices (concerning people and relations), plays a key role in achieving long-term superior performance. Moreover, a new construct, named “Individual behaviour” and representing individuals’ characteristics, emerged. As a result, two alternative research frameworks, for further statistical hypotheses testing, have been built. The research could also be further developed by measuring the operational performance dimension through quantitative key performance indicators (i.e., OEE, throughput time, WIP, etc.) and expanding the performance construct to other types of performance, in line with a triple bottom line approach (economic, environmental and social).

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