

# The Missing Quantitative Approach of Lean Management

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## ABSTRACT

The methodologies used to research lean management have gone largely unchallenged for 25 years. This paper explores the growth of the lean body of information and shows that, although qualitative, the vast majority of work depended heavily on subjectivity of the researcher. Quantitative analyses are needed to validate and reinforce existing literature, and in particular to confirm the essential factors for lean performance. The aim of this work was to re-evaluate and recalibrate the course of lean study, identify the best way to resolve the inadequacies and thus advance the knowledge base. The aim is to determine which scientific approach and unique research method to achieve this objective is better suited. Various hypotheses were established requiring testing, and experiments were suggested integrating Structural Equation Modelling. The aim of this work was to re-evaluate and recalibrate the course of lean study, identify the best way to resolve the inadequacies and thus advance the knowledge base. Such studies would advance practice in the industry, providing the tangible statistical evidence needed to educate practitioners.

## Keywords

Lean, Management Review Research Quantitative, Structural Equation Modelling

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## Introduction

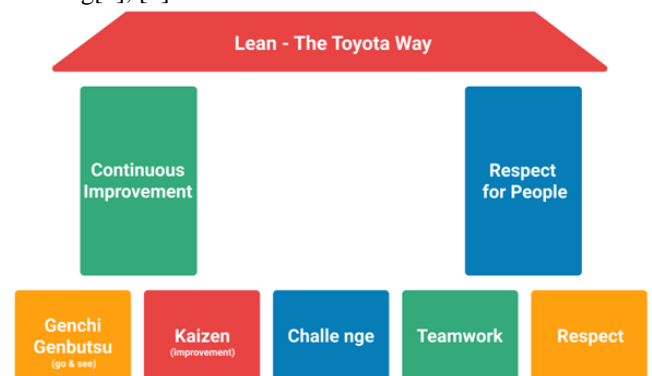
Lean developed as a management technique in the Japanese automotive industry. It focuses on continuous enhancement in value development with waste elimination. Lean management is now extended far beyond its roots in manufacturing and claimed to consistently boost corporate practices. But it is subject to a fad's lifecycle as a popularized management system; growth, progress, and eventually decline over time.

Although the industry standard for systemic productivity improvement is considered, the performance of lean in a wide range of industries is influenced by many unsuccessful implementations with 60–90 percent of improvement projects failing re-ports. Because of this, lean was branded as a fad in manufacturing, and blamed for not being acceptable outside mass production. Earlier critiques were presented as misunderstanding lean but the issue of what is contingent or reliant on effective lean management is still being asked. And although direct acceptance of criticism will ignore the increasing number of positive implementations in a large variety of industries, the high rate of failure and disparate views on its advantages and even its meaning indicate inadequacies in the information body[1]–[3].

The aim of this work was to re-evaluate and recalibrate the course of lean study, identify the best way to resolve the inadequacies and thus advance the knowledge base. The aim is to determine which scientific approach and unique research method to achieve this objective is better suited.

While there have been several reports of lean management over the past 25 years, the research methods and methodologies used in these reports have not been called into question. This is not that the methods used are inherently incorrect, but because other approaches to analysis may have been ignored or other methods may not

have been used to their full potential. This is not that the methods used are inherently incorrect, but because other approaches to analysis may have been ignored or other methods may not have been used to their full potential. Such approaches may reinforce weaknesses in existing studies, providing additional insight and understanding of lean and success factors. More work that establishes and applies a better understanding of lean can be encouraged by defining the type of questions to be asked and the particular approaches to be taken. Ultimately, what the fad is, should be distinguished from what gives organizations real meaning[4], [5].



**Figure 1:** Toyota Production System.

Lean management is currently a concept widely adopted across diverse industries. It originally originated, however, from the Toyota Production Network Figure 1, which was developed some 70 years ago.

**The Birth of Lean:**

When Toyota laid the foundations of Lean manufacturing back in the late 1940s, they aimed to reduce processes that do not bring value to the end product. In doing so, they succeeded in gaining major production, performance, cycle time and cost savings improvements. Thanks to this notable

effect, the Lean philosophy has spread through many sectors and has developed into five core Lean management concepts as defined by the Lean Management Institute. Indeed, the word Lean was written in his 1988 post, "Triumph of the Lean Development System," by John Krafcik (current CEO of Google's self-driving car project Waymo).

Benefits of Lean Management:

The increasing popularity of the Lean principles stems from the fact that they are actually focused on improving every aspect of a work process and involving all levels of the hierarchy of a firm.

- There are a number of big opportunities from which administrators will benefit.
- Concentrate. You'll be able to reduce waste activities by applying Lean. Therefore your workforce will focus on value-bringing activities.
- Improving efficiency & productivity. When workers concentrate on providing value, they can be more effective and successful, so undefined assignments won't interrupt them.
- Smarter (Pull System) method.
- By setting up a pull system, you will only be able to deliver work if the demand is real. Which leads to another.
- Better Resource Use. When the supply is focused on real demand, you can only use as much resources as you require.

As a result, your company (team) will be much more flexible and will be able to respond much quicker to consumer needs. In the end, the principles of Lean management will allow you to create a stable production system with a higher chance of improving overall performance.

### Methodology

This study did not replicate the analysis of contemporary systematic reviews but was intended to provide the next step for lean research and a definite course. To do this, they first examined the body of information and its creation. Second, the research methods used in its production have been criticized and the key research shortcomings established. Third, and based on the initial results, a Structural Equation Modeling (SEM) approach was proposed to resolve the gaps in lean science. Finally, the existing lean-SEM literature has been thoroughly reviewed and the empirical findings in question have been expanded. For the primary term optionally combined with 'implementation,' 'performance,' 'manufacturing,' 'development' and 'management,' the general literature searches took 'lean.' Originally it used the EiCompendex database based on engineering and then Google Scholar used its index for a more inclusive search and citation. Searches focused on lean literature, publishing its coining and distribution with other earlier and associated integrated publications. Industry sector had not limited the literature reviews. The origins of lean research are in manufacturing and it is useful to consider its application by industry, e.g. lean service, in the public sector, in construction, in food supply transportation, health care, or in information work[6], [7]. It is argued, however, that the lean principles, methods, and challenges of change apply across

sectors. So that a latest 'lean output' analysis will include products from various service industries.

### The Body Of knowledge

It is important to understand how the body of knowledge evolved to understand the shortcomings in lean research. The lean body of knowledge developed solidly in the West from the 1980s, being specifically defined by Womack et al.'s works in the 1990s, interpreting the success of Japanese manufacturing. The emphasis in this century has been how the advantages of a lean management system can be achieved and maintained.

By the late 1970s, Toyota had developed a unique Japanese production system and, along with Japanese management in general, it started to be recognized in the West. With documentation, analysis, and implementation, the lean body of information continued to advance through the 1980s. Early implementation was strong in some places, due to the local concentration of forward thinking managers, e.g. in Connecticut. Nevertheless, most western manufacturers also felt that Japan had nothing to know. They led to cultural differences in Japanese prosperity, fortune (luck), and perceived lower prices, high rates of automation, as well as government orchestration and policies.

They were slow to realize the Japanese had stumbled upon a system of superior management. Many strong and in-depth studies of Japanese manufacturing, JIT and the Toyota Production System have existed since the turn of the century that integrated empirical work and tackled implementation issues that practitioners are facing in order to fully advance the lean body of knowledge. Recently, the research responded to the criticisms of lean, showing that lean progressed from a prescription stage[7]–[10] where consultants usually recommended tools and techniques to a deeper stage of understanding unique contexts and the needs involved, in particular human aspects, and how to apply the methods.

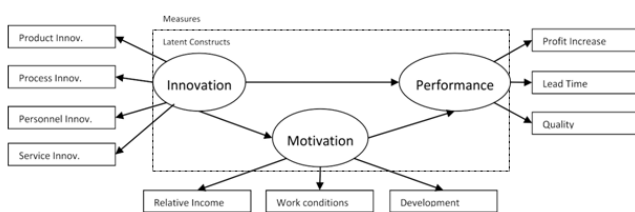
### Filling The Quantitative Gap Verifying The Qualitative Theory

In order to advance the lean body of knowledge, addressing the shortage of empirically validated lean theory, it is important to first identify which theories need validation and second, the best methodology for this systematic literature reviews of theory are needed to extract the specific factors, identify core frameworks [e.g. 32] and other components for justification of the lean principle. Since lean research is not quantitatively verified, any of the hypotheses from lean literature, especially current models and frameworks, could be verified in this way. To answer the various hypotheses this would take several studies. However, due to their significant import to practitioners, some of these theories should be addressed first. The remaining unaddressed criticism of lean, as discussed in the introduction, is linked to the factors on which lean achievements rely.

This is reflected in the high implementation failure rate, and practitioners tend to struggle to maintain lean practices. To analyze the many lean performance factors, we need in-depth analyses of actual implementations. These studies will

balance cases for sector, size of company and form of product, as well as check the lean methods used along with other critical factors for lean implementation and growth of organization. Within these studies of balance current systems may be integrated. A specific example of this will be to test the lean iceberg model. This research could survey a broad sample of lean implementations to see which variables are most significant, such as employee participation compared with the different lean methods. Such a research, if of a large sample, could also test the universality of lean by moderating the size of the company and the variety of items. Certain aspects common to lean, such as the presence of consultants and their usage as opposed to internal resources, or human resource management issues, may be evaluated concurrently. Also the effectiveness of six-sigma-based implementations with undergone criticism, or the real relationship between the five concepts of lean and business efficiency. These problems were dealt with conceptually in lean literature but results have not yet been properly checked.

Additional research may examine the impact of increased lean awareness on understanding how lean it is and gaining its competitive advantages. The manner in which lean is characterized and thus understood could have profound effects on perceived and realized advantages. Even though lean is operationalized to an extent it is difficult to crystallize correct definitions. An analysis of this may entail a fairly short survey that examines participants' perception of the different lean components and their potential profit. The findings of the studies suggested above will tackle both the detractors of lean, by checking the benefits of lean implementation and assisting practitioners in reaping those benefits. These studies include the undertaking of several systematic literature reviews to crystallize critical success factors, including those in current frameworks. There are certainly cases of such research but further development, refinement and then validation are needed. These reviews should embody not only the lean literature but also broader operations management literature including leadership change with organizational development.



**Fig. 2.** Example layout for a Structural Equation Model showing measured and latent variables and paths (computations not shown).

## Limitations

The authors used the study of SEM papers to focus on subjective classification. This research also incorporates the details of systematic analyses found in others. Although considered unnecessary to replicate the study of others instantly, it is understood that such assessments contain subjective classification outside the scope of this research. Lean-SEM studies had a fairly low sample size for the systematic study. That is a sample of 53 versus 254 for other studies. This was inevitable because of the narrowness of

the area under investigation but a constraint nonetheless. Other techniques, experiments and data can add value to the qualitative work as well. A new phenomenon is study of 'Big Data,' e.g., consumer behaviours. Innovative use of all available data to assist analysis involves further study along with various related areas, including agile approaches and general quality improvement or kaizen, which have similar problems but were beyond the reach of this review.

## Conclusion

The goal was to re-evaluate and recalibrate the course of lean science. While there have been several studies over the past 25 years, there has been no challenge to the research theories and the general methodologies employed. This has left room in the lean body of information for weakness. This review showed that (1) the vast majority of re-search in this field has been empirical or qualitative in nature, relying heavily on the subjectivity of the researcher; (2) quantitative analyses are required to validate these past studies and reinforce the knowledge base; (3) these studies should use the statistical methods common to managerial sciences, in particular the structural equation model; (4) this quantitative research will be used to examine the complex causality among the core factors required for lean success rather than the minor issues discussed in current SEM studies; and (5) this form of study would provide a clearer understanding of the factors influencing lean implementation, providing the concrete statistical evidence required to inform and resolve practitioners. Similar hypotheses have been identified needing confirmation, and several systematic analyses of the lean and related literature are required to better identify the factors. Finally, (6) practitioners should not, without thought, take any lean views.

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