



Faculty of Manufacturing Engineering

**A FRAMEWORK FOR SUSTAINING LEAN THINKING WITH
SYSTEMS THINKING IN MALAYSIAN AEROSPACE COMPANIES**

Suraya binti Ahmad

Doctor of Philosophy

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**A FRAMEWORK FOR SUSTAINING LEAN THINKING WITH SYSTEMS
THINKING IN MALAYSIAN AEROSPACE COMPANIES**

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**A thesis submitted
in the fulfilment of the requirements for the degree of Doctor of Philosophy**

Faculty of Manufacturing Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2018

DECLARATION

I declare that this thesis entitled “A framework For Sustaining Lean Thinking With Systems Thinking in Malaysian Aerospace Companies” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name :

Date :

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award Doctor of Philosophy.

Signature :

Supervisor Name :

Date :

DEDICATION

To my beloved husband , my daughters and my grandsons.

ABSTRACT

The purpose of this study is to explore how lean thinking can be sustained with systems thinking in Malaysian aerospace companies. Literature indicated that various companies failed to achieve full lean benefit. Lean has been treated as a piecemeal and should be viewed as a system. Systems thinking is an approach that sees the organization as a system that consists of interacted elements and subsystems. The study started with investigating the status of lean, the challenges encountered by the companies when practicing lean, the extent existence of systems thinking traits and to what extent the companies exhibit a learning organization. Conceptually, this study is framed within lean principles, two approaches of systems thinking with learning organization as the foundation. This study adopted qualitative multiple case study as the methodology. Three main steps in the case study protocol were followed. The data was collected through semi-structured interviews of sixteen respondents from four different companies in the aerospace industry. Thematic analysis was conducted for every case study together with the cross-case analysis. The results of this study verified that all companies faced resistance from the employees. However, there is evidence of lack of commitment from the top management and the influence of culture in the local companies. The research also confirmed that all the respondents acquired the basic systems thinking traits and the companies exhibited some characteristics of a learning organization. A framework was developed for sustaining lean thinking with systems thinking. This framework served as the foundation for enhancing the performance of lean aerospace companies. The output of this study contributed to the realization of Malaysian aerospace industry in becoming the number one in South East Asia (SEA) for parts and components sourcing before 2030.

ABSTRAK

Tujuan kajian ini ialah untuk meneroka bagaimana pemikiran kejut boleh ditingkatkan dengan pemikiran sistem di dalam syarikat aeroangkasa Malaysia. Literatur telah membuktikan bahawa pelbagai organisasi tidak mencapai kebaikan kejut sepenuhnya. Kejut hanya di laksanakan sebahagian dan sepatutnya perlu dilihat sebagai satu sistem. Pemikiran sistem adalah satu pendekatan yang melihat organisasi sebagai satu sistem yang terdiri daripada elemen dan subsistem yang sentiasa saling berhubungan. Kajian ini dimulakan melihat status pelaksanaan kejut di dalam syarikat-syarikat yang dikaji. Di samping itu, kajian ini juga mengkaji cabaran yang dihadapi oleh syarikat-syarikat ini apabila melaksanakan kejut serta mengkaji tahap ciri pemikiran sistem dan sejauh mana syarikat-syarikat yang mempamerkan ciri-ciri organisasi pembelajaran. Kajian ini menggunakan kaedah kualitatif. Protokol kajian kes juga diikuti. Dari segi konsep, kajian ini dirangka dalam prinsip kejut dan dua pendekatan pemikiran sistem dengan organisasi pembelajaran Senge sebagai dasar. Data diperolehi melalui temu bual semi berstruktur enam belas responden daripada empat syarikat yang berbeza dalam industri aeroangkasa. Analisis untuk setiap kajian kes beserta analisis kes rentas telah dijalankan. Keputusan kajian ini menunjukkan semua syarikat ini menghadapi tentangan daripada sebahagian pekerja. Walau bagaimanapun terdapat bukti yang kuat tentang kekurangan komitmen daripada pihak pengurusan tertinggi dan pengaruh budaya dalam syarikat-syarikat tempatan. Kajian ini juga mengesahkan bahawa semua responden mempunyai ciri-ciri asas pemikiran sistem dan syarikat-syarikat ini juga mempamerkan beberapa ciri organisasi pembelajaran. Satu kerangka konseptual telah dibina untuk meningkatkan prestasi kejut dengan pemikiran sistem. Kerangka ini menjadi asas kepada mempertingkatkan prestasi syarikat aeroangkasa kejut di Malaysia. Keluaran kajian ini menyumbang kepada usaha industri aeroangkasa Malaysia untuk menjadi pengeluar utama bahagian dan komponen di Asia Tenggara sebelum tahun 2030.

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LIST OF ABBREVIATIONS

CEO	-	Chief Executive Officer
CMO	-	Chief Marketing Officer
DMAIC	-	Define- Measure – Analyze –Improve- Control
GST	-	General systems Theory
HRM	-	Human Resource Management
IST	-	Individual systems thinking
JIT	-	Just In Time
LO	-	Learning Organization
LSS	-	Lean Six Sigma
MD	-	Managing Director
MIDA	-	Malaysian Investment Development Authority
MIGHT	-	Malaysian Industry Group for High Technology
MITI	-	Malaysian International Trade Industry
NADI	-	National Aerospace & Defense Industries Sdn. Bhd.
OEM	-	Original Equipment Manufacturer
OL	-	Organizational learning
SDM	-	Systems Dynamic Modeling
SoS	-	Systems of Systems
SoSE	-	Systems of Systems Engineering
SSM	-	Soft Systems Methodology
ST	-	Systems thinking
TPS	-	Toyota Production System

- TQM - Total Quality Management
- VSM - Viable System Model
- VSM - Value Stream Mapping

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1. Ahmad, S, 2017. The challenges of lean implementation: A multiple case study in Malaysian Aerospace Companies, *Journal of Asian Vocational Education and Training*, 10(1), pp. 103-120.
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CHAPTER 1

INTRODUCTION

1.1 Background of the study

In this competitive global environment, organizations are always seeking ways to survive and sustain their businesses. Since the early 1990s when lean has become famous in the western world with the preface of *The Machine That Changed the World* book, manufacturing goods have then, increased significantly in both the quality and efficiency (Womack, Jones and Roos, 1990). Lean manufacturing has been used by many organizations to compete globally and it is considered an evolution in the continuous improvement process in manufacturing concept (Womack, Jones and Roos, 1990; Womack and Jones, 1994). Lean Manufacturing, deriving from the Toyota Production System (TPS), is defined as an improvement approach that seeks to identify waste, create values for customers and promote change across organizations. Lean improves efficiency and effectiveness through the elimination of waste in all business aspects (Lewis, 2008). Lean, which is successfully implemented and sustained, can facilitate organizations to achieve and succeed in manufacturing industries through continuous process improvement and customer satisfaction.

Lean potential awareness has heightened the number of organizations to adopt several forms of lean programs. Over the past few decades, lean has been used by many industries as a method of process improvement. Airbus (Drew, McCallum and Roggenhofer, 2004), Boeing (Leitner, 2005; Dane and Kleiner, 2016), General Motors (Liker, 2004; Moore, Mothersell and Motwani, 2014), Chrysler and Ford (Cable, 2009; Dane and Kleiner, 2016), Porsche (Prakash and Kumar, 2011) are among large and prominent organizations

that have adopted lean practices. This phenomenon has resulted in enormous literature on the definition of lean and how to implement lean. Stone (2012) extensively and systematically studied the evolution of lean within four decades in more than 200 articles. He found that lean manufacturing has evolved from a manufacturing environment to be applied throughout the organization and in industries outside manufacturing realms. He also discovered that most lean literature is dominated by “how to do lean” and its consequences and lean transformation appears to be successful when strategically aligned throughout the enterprise.

Baker (2002) discovered that only ten percent of UK organizations have successfully implemented lean. Menawat (2009) also revealed that only twenty percent of the companies that implement lean is the best in its class. According to the Industry Week/Manufacturing Performance Institute Census of Manufacturers (2007), about seventy percent of manufacturers in the USA have implemented lean approach for operational improvement, but only twenty percent of companies that have lean programs achieve their anticipated results. According to Stone (2012), the most apparent void within lean literature is that the lack of connection between lean theory and lean thinking paradigm. Lean is seen as a manufacturing tool and not as a business methodology.

Years ago before lean was born, Krafick (1988) discovered that Toyota Production System (TPS) focuses on the integrative approach of lean and the importance of systemic focus on the interrelationship between human resource management and manufacturing strategy. Bhasin (2011; 2012a) emphasized that lean cannot be viewed as a set of tools, techniques and practices but a holistic approach that goes beyond the boundaries of the shop floor. Organizations need to apply lean holistically by focusing on improving the entire processes of manufacturing. TPS is an example of how the systemic nature of lean can be simplistically described and discussed (Liker, 2004). Lean as a philosophy, considers the

interrelationship and synergistic effect of lean practices to improve overall levels of productivity and product (Scherrer-Rathje, Boyle and Deflorin, 2009). Implementing a range of lean initiatives blindly is not beneficial for the organization as a whole system without any systemic alliances. Any selection of lean tools may only provide a temporary localized improvement.

Systemic, synergistic, holistic and relationship are some of the words that describe systems thinking. The term systems thinking has a rich definition and understanding. Senge (1990) defined systems thinking as a way of thinking and a language for describing and understanding, the forces and the interrelationships that shape the behavior of systems. Ackoff and Emery (2005) recognized systems thinking by looking at the relationships (rather than unrelated objects), connectedness, process (rather than structure), the whole (rather than just its parts), the patterns (rather than the contents) of a system. Systems thinking emerged in the 1950s in the form of a general systems theory. In essence, systems thinking is a holistic approach to view the system as a whole. It focuses on the linkages and interactions between components that comprise the system. Systems thinking stands in contrast to the reductionist approach where all phenomena can be understood by reducing the components to their simplest element. Systems thinking views the dynamic interrelationship processes that exist in an organization by not just focusing on the key processes and it has proven its value in dealing with complex problems. It is a discipline of its own that has developed over time and is "trans-disciplinary" (Jackson, 2010). Some of the prominent systems thinking pioneers and their groundbreaking approaches are Bertalanffy (1968); *General Systems Theory*, Checkland (1981); *Soft Systems Methodology*, Ackoff (1981); *System of Systems*, Senge (1990); *The Fifth Discipline*, Beer (1985); *Viable System Model* and Seddon (2003); *Vanguard Method*. Seddon and Caulkin (2007) stressed the importance of systems thinking on lean implementation for long-term sustainability.