A Framework for Lean Transformation in Developing Countries: The Case of Saudi Arabian Industry

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FRAMEWORK FOR LEAN TRANSFORMATION IN DEVELOPING COUNTRIES: THE CASE OF SAUDI ARABIAN INDUSTRY

by

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ABSTRACT

Lean is a dynamic, knowledge-driven, and customer focused philosophy that continuously eradicates waste and generates value, with a goal to improve a company's productivity, efficiency, and quality. Successful implementation of lean does not only offer cost reduction and improved quality and productivity, but also provides efficient guidance for organizations to attain significant and continued growth. Although its adoption by companies has proven successful in developed countries, there is no sufficient evidence of its successful implementation in developing countries such as Saudi Arabia. A review of the literature indicates that there is a need to study lean transformation in developing countries as part of a comprehensive approach to their survival in the global economy. The purpose of this research is to develop a framework for a successful lean transformation in developing countries. The framework was developed by conducting a thorough literature review analysis and interviewing key personnel in ten local and eight multinational Saudi Arabian companies. The framework reacted to general data about lean transformation in developing countries, assessed a lean transformation level, and constructed the Interpretive Structure Molding (ISM) for barriers to achieve a successful lean transformation. Expert opinions were used for validation of the main components of this study, which are assessment, barriers, ISM and framework.

Similar to the literature findings which indicated that the level of successful lean transformation in developing countries is low, the assessment revealed that the lean transformation level in local companies in Saudi Arabia is between 30% and 40%, and in multinational companies the level is between 50% and 60%. Both local and multinational companies in the case of Saudi Arabian industry considered lack of suppliers' involvement, lack of cooperation from suppliers, lack of good quality suppliers, and slow response to market due to demand fluctuations as the root barriers that need to be addressed at the primary stages of lean transformation. The resulting framework provides clear phases with an estimated timeline for each phase, from the foundation phase to the excellence level phase. In addition, it involves executive leaders and a cross-functional team to mentor and assess the transformation after each phase. The framework comprises several methods and tools that can be considered critical success factors for lean transformation, which will enable companies in developing countries to move toward achieving a successful lean transformation and sustainability, as well as reaching higher and persistent levels of growth.

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LIST OF ACRONYMS/ABBREVIATIONS

ALJ	:	Abdul Latif Jameel Group
CAP	:	Competency Accomplishment Performance
CI	:	Continuous Improvement
EAP	:	Economic Achievement Performance
ERP	:	Environmental Responsiveness Performance
HR	:	Human Resources
IRB	:	Institutional Review Board
ISM	:	Interpretive Structure Molding
IWS	:	Integrated Work System at P&G company
JIT	:	Just-In-Time
KAQA	:	King Abdul Aziz Quality Award
KPI	:	Key Performance Indicator
LMS	:	Lean Management System
LPD	:	Lean Product Development
LPS	:	Lean production systems
LSS	:	Lean Six Sigma
M&W	:	Manufacturing and Warehouse System at PepsiCo international company
MICMAC	:	Cross-Impact Matrix Multiplication Applied to Classification Analysis

MPC	:	Material and Production Control
MS	:	Manufacturing Sustainability
OGSM		Objective, Goals, Strategies, and Measures
P&G	:	Procter and Gamble Company
PDCA	:	Plan - Do - Check - Act
PI	:	Process Improvement
SIPCO	:	Saudi Industrial Projects Company
SMED	:	Single Minute Exchange of Dies
SS	:	Six Sigma
SSIM	:	Structural Self-Interaction Matrix
TPM	:	Total Productive Manufacturing
TPS	:	Toyota Production System
TQM	:	Total Quality Management
VOC	:	Voice of the Customer
VSM	:	Value Stream Mapping

CHAPTER 1 INTRODUCTION

1.1 Overview

Lean was born after World War II by the Japanese automobile industry as a fundamentally more efficient system than standard mass production. It is a dynamic, knowledge-driven, and customer-focused philosophy that continuously eradicates waste and generates value, which improves the productivity, efficiency, and quality of the products or services of any organizations (Womack & Jones, 2010). However, lean must be applied properly as a whole organization system and in a significant time frame to show its enormous benefits. Ohno Taiichi, the father of the Toyota Production System (TPS)[1], maintains that TPS was not just a production system, but a total management system; it was developed and implemented through a series of innovations spanning more than 30 years (Ohno, 1988).

Although, lean is considered by many organizations all over the world, there are a number of organizations did not reach the desired level of success. " In spite of all the literature published on Toyota and lean, very few US companies implementing lean have come close to achieving the level of success that Toyota has" (Sisson & Elshennawy,

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[1] "TPS is an integrated sociotechnical system that can be defined as the major precursor to the more general concept lean manufacturing" (de Bucourt et al., 2011). Thus, in this study both terms will be considered as the same.

2015, p. 264). Moreover, Bhasin (2008) states that "ostensibly, less than 10 per cent of UK organizations accomplish successful lean implementations" (p. 670). Accordingly, this indicates that organizations in developed countries need to focus more on sustainable lean transformation in order to gain its massive benefits.

In the same context and even on a more inferior scale, a successful and sustainable level of lean transformation in developing countries is poor. *Transformation* is defined by American Heritage 4th Edition Dictionary as, "a marked change, as in appearance or character, usually for the better" (McCarthy, 2006). The World Bank and the United Nations use different terminology to define *developing countries*, also known as "less-developed countries" or "developing economies." The World Bank's main criterion for classifying economies is gross national income (GNI) per capita, previously referred to as gross national product, or GNP. The United Nations maintains that "there is no commonly agreed definition of developing countries."[2] (A list of developing countries is available in Appendix I).

Panizzolo, Garengo, Sharma, and Gore (2012) maintain that "research shows that initially, the lean implementation process was slow in India, similar to other developing countries" (p. 771). In addition, they claim that there is no specific percentage that identifies the level of diffusion of lean in India. Out of 120 surveys conducted in Saudi

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[2] Source: Library Of Congress Collections Policy Statements, retrieved from: https://www.loc.gov/acq/devpol/devcountry.pdf

Arabia to investigate effectiveness of lean implementation in manufacturing companies, only 30 companies responded. These companies have implemented only some lean tools, such as Computerized Planning Systems. Moreover, the study indicates that manufacturing companies in Saudi Arabia are more likely to implement and gain the advantages of lean manufacturing (M. A. Karim, Aljuhani, Duplock, & Yarlagadda, 2011).

Thus, it is crucial to learn from successful lean transformations in developed countries and determine the appropriate strategy that can lead the authorities in developing countries to have a sustainable lean revolution. The purpose of this research is to develop a framework for sustainable transformation through lean implementation in developing countries. The proposed framework was developed by conducting a thorough literature review analysis and interviewing key personnel in 10 local and eight multinational Saudi Arabian companies. The framework reacted to general data about lean transformation in developing countries, assessed a lean transformation level, and constructed the Interpretive Structure Molding (ISM) for barriers to achieve a successful lean transformation. In addition, expert opinions were used for validation of the main components of this study, which are assessment, barriers, ISM and framework.

1.2 Research Problem Statement

"50 percent of the auto suppliers are talking Lean, 2 percent are actually doing it" Jeffrey Liker[3] said (Bhasin, 2008, p. 675). Figure 1-1 shows the result of a survey conducted by the Association for Manufacturing Excellence (AME) in Arlington Heights, Illinois, to senior leaders in North American manufacturing companies regarding lean transformation. As shown in the figure, only three percent of the group indicated that they were on the lean enterprise transformation journey and were accomplishing great results. According to Koenigsaecker (2005), "their results tend to reinforce the impression that many manufacturing managers are all hat and no cattle when it comes to lean" (para. 1).

[3] Jeffrey K. Liker is author of "The Toyota Way 14 Management Principles from the World's Greatest Manufacturer". He is a cofounder and Director of the Japan Technology Management Program and the Lean Manufacturing and Product Development Certificate Program at university of Michigan. Winner of four Shingo Prizes for Excellence (J. K. Liker, 2004).

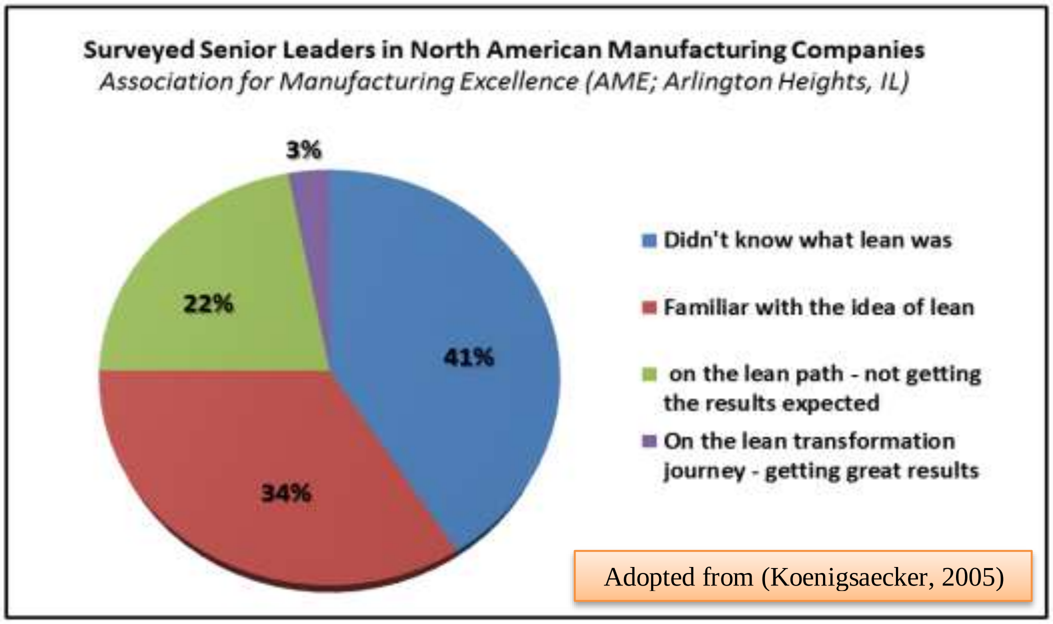

Figure 1-1: Response of Senior Leaders in North American Manufacturing Companies

In the same context, Badurdeen and Gregory (2012) maintains that,

> the mystery is why so few companies outside Toyota and its suppliers have been successful in adopting lean manufacturing. Exact data is not available, but some estimates put the success rate as low as 2 percent for those who tried to adopt lean. (p. 50)

One of the main problems that causes a lower success rate in adopting lean is that organizations look at lean as cost reduction only, and they only consider certain lean tools instead of appropriating lean as full system for the entire organization. Monden (2012) maintains that the "cost in the Toyota Production System include not only manufacturing cost, but also sales cost, administrative cost, and even capital cost" (p. 1). In fact, it is believed that increasing profits through cost reduction is not likely to be sustainable and must be incorporated with innovation that leads to sales growth, new product development, and process improvement (N. Bateman, 2002; Bhasin & Burcher, 2006; Dimancescu, Rich, & Hines, 1997; Hanson & Voss, 1998). Consequently, it is necessary to determine avenues or roadmaps for successful and sustained lean implementation in a developing country.

Likewise, in comparison to these countries' Western counterparts, the adoption of lean in developing countries is not widely diffused (Zargun & Al-Ashaab, 2014). Stephen Corbett, a principal at McKinsey's Toronto office, maintains that the prime challenges of implementing lean in the developing world or in nonindustrial environments are "to know which of its tools or principles to use and how to apply them effectively" (Corbett, 2007, p. 1). Therefore, due to the shortage of lean implementation in developing countries as a philosophy for managing business, and due to the lack of experience and knowledge in adopting the lean approach, the need for designing a roadmap or framework for organizations in developing countries is essential.

Additionally, it is important to determine what are the barriers and roadblocks that prevent or delay organizations in developing countries to adapt the lean as a philosophy. The analysis of the barriers based in methodological approaches will help to define the correct route for sustainable lean transformation. Inappropriate paths of adopting lean transformation will increase the wasting of company time and resources, which will negatively affect financial gain and cost saving, and the expected result will be much lower than what it should be (Almomani, Abdelhadi, Mumani, Momani, & Aladeemy, 2014).

1.3 Research Questions

Dennis (2002) states that "the lean system has proven difficult to grasp as a whole" (p. 18). Thus, in order to discover how organizations in developing countries can grasp lean as a whole and attain the successful, sustained level of lean improvement at the level of Toyota, it is essential to first to determine the level of lean implementation in developing countries and then assess the barriers that the organizations face to reach a sustained level of lean. Accordingly, the research questions are as follows:

- What is the extent of lean transformation in developing countries?
- How to identify, analyze the relationships, and prioritize the barriers to lean transformation in developing countries?
- How can organizations in developing countries achieve successful, sustained lean improvement?

1.4 Research Objectives

The objectives of this research are to:

- Examine the level of lean transformation in developing countries.
- Identify, analyze the relationships, and prioritize the barriers to attain a sustainable lean transformation in developing countries using Interpretive Structural Modelling (ISM).
- Develop a roadmap for successful and sustainable lean transformation in developing countries.

1.5 Research Contributions

Although the benefits of lean are at length recognized from the success stories at Toyota, from the practitioners' perceptions the present roadmaps and frameworks look incomprehensible (Mostafa, Dumrak, & Soltan, 2013). It is evidenced from the literature review findings that there are existing models focused on successful lean transformation in developed countries; nonetheless, there is a lack of established frameworks or clear roadmaps that addressed the issue in developing countries. Therefore, the developed framework is first one that offers step-by-step actions for successful lean transformation in developing countries. In addition, unlike the other frameworks found in the literature, part of the procedures to develop this framework included an assessment for the lean implementation level in developing countries. Also, another part of the framework development procedures studied the barriers to attaining a successful level of lean transformation in a scientific and methodological approach using a soft operation research method called Interpretive Structural Modeling (ISM), which will offer a more accurate result that transforms unclear, poorly articulated mental models of a system into visible well defined, hierarchical models.

The distinction of the proposed framework came from the involvement of experts in lean transformation in multiple case studies of the local and multinational Saudi Arabian companies. The resulting framework comprises a combination of long-term philosophy, leadership, processes, people, training, culture, and problem solving. In addition, it provides clear phases with an estimated timeline for each phase, from the foundation phase to the excellence level phase. Accordingly, this will enable companies in developing countries to move toward achieving successful lean transformation and sustainability as well as reaching higher and persistent levels of growth. Finally, the proposed framework will help companies to identify their weaknesses and opportunities for improvement and make them prepared to reach to an excellence level of performance. Rymaszewska (2014) believes that “early identification of weaknesses will make companies more aware of their own capabilities. Moreover, it has potential for making them better prepared for lean implementation and more consistent in their process” (p. 987). This research can be a baseline for researchers to study lean transformation in governmental or non-profit sectors such as universities, public transportation division, charities, and others, which require more focus on reducing cost and increasing productivity than for-profit companies.

1.6 Document Structure

Chapter One contains an overview of the research, including the research goals, aims, and questions. It gives a brief history of the research problem as well as the challenges of implementing lean in developing countries while providing evidence of its successful adoption in some cases developed countries.

The second chapter provides an overview of relevant literature related to the research topic, which includes historical evolutionary perspective of Toyota Production System (TPS), lean definition, lean benefits, lean applications, lean assessment, barriers of implementing lean, lean implementation, lean implementation in developing countries, and a research gap analysis.

The third chapter, which addresses this paper's methodology, describes the research process and addresses the issues of research philosophy. It contains an explanation of the research design as well as the choice and implementation of data collection methods. Moreover, this chapter demonstrates an overview of the applied methods and techniques used to achieve the objectives of the study and answer the research questions.

Chapter Four, the data collection and analysis chapter, discusses the outcomes of the data analysis as it is related to lean assessment and barriers analysis using ISM for the case study companies. The nominated companies included eight multinational and ten local Saudi Arabian companies. A non-probability snowball sampling technique was utilized in this study, as well as expert sampling, in order to gather data from candidates who fulfilled the research requirements and who have some knowledge and proficiency in the research area.

Chapter Five introduces the lean concept framework, and also describes the framework via each of its components. It also gives an overview of the framework validation, which was based upon four key quality measures of the case study design.

Finally, Chapter Six reveals the conclusions and the recommendations of the present case study, as well as describes both the limitations of the study and possible future research that can be expanded upon utilizing the present case study as a foundation.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

When reviewing many resources such as books, articles, and so forth, the phrase *true lean* appears in most of these sources. This indicates that lean as concept is not understood well or needs to be identified clearly. Accordingly, there are some researchers who maintain that the concept of lean is not clear to many companies and managers, and they focus on defining the concept of lean by reviewing it as a system, a philosophy, a path for a company to evolve, and so on. Hines, Holweg, and Rich (2004) claim that there is a lack of definition of lean which led to confusion and fuzzy boundaries with other concepts of management. Shah and Ward (2007) address the fact that there is a confusion and inconsistency associated with lean production, and "any discussion of lean production with managers, consultants, or academics specializing in the topic quickly points to an absence of common definition of the concept" (p.786). The same issue is clear in developing countries; for instance, Nordin, Deros, and Wahab (2010) confirm that the one of the main obstacles for lean manufacturing system implementation in Malaysian automotive industries is the lack of understanding of lean concepts.

In addition, there are different measurement methods to identify the level of lean implementation; nevertheless, none of them are approved universally to be used, such as an index. Bhamu and Singh Sangwan (2014) mention that there is an absence of standard lean manufacturing implementation processes or frameworks.

Moreover, lean implementation, like any other improvement initiative, is associated with challenges which are addressed in many studies. However, there is no doubt that these challenges vary and each culture or country has different issues. J. R. Jadhav, Mantha, and Rane (2014) state that "few [research] focused on the comprehensive coverage on lean barriers" (p. 124). Thus, it is important to illustrate a comprehensive literature review on this progressive and thought-provoking subject matter.

This chapter provides an overview of relevant literature related to the research topic which includes historical evolutionary perspective of Toyota Production System (TPS), lean definition, lean benefits, lean applications, lean assessment, barriers to implementing lean, lean implementation, lean implementation in the developing countries, and a research gap analysis.

2.2 Toyota Production System (TPS)

It is observed that researchers and practitioners may use different terms for the Toyota Production System, such as *Toyota Management System, lean manufacturing, lean production*, or *lean management system* (Emiliani & Stec, 2005; Pentlicki, 2015).

Therefore, this section covers a historical perspective of Toyota Production System (TPS) and how it progressed to be called by various names.

TPS is the next major evolution in efficient business processes after the mass production system invented by Henry Ford. It is an improvement philosophy that is implemented around a problem-solving methodology (Chalice, 2007). The origin of TPS has developed through many years of trial and error to improve efficiency based on the Just-in-Time concept developed by Kiichiro Toyoda. It began in the mid 1950s with help from Taichii Ohno, who established the Toyota Production System (TPS) and built the foundation for the Toyota spirit of "making things." By the 1960s, TPS was a powerful philosophy and the company relayed the principles to their key suppliers. In the early 1980s in Japan, the concept helped the automotive industry drive down cost. Then in 1988, the term *lean production system* was initiated by John Krafcik. Later, in the 1990s, the concept became popular through the book *The Machine That Changed the World* by Womack and Jones, and began to be recognized outside of Toyota as Lean Production (LP) (Jasti & Kodali, 2016; J. K. Liker, 2004; Ohno, 1988; "The origin of the Toyota Production System," ; Womack & Jones, 2010).

In his book *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer*, Liker (2004) describes TPS as a unique approach to manufacturing for Toyota, and further depicts it as a source for much of the lean production movement that has dominated manufacturing trends for the last decade. In addition, he posits, "what exactly is a lean enterprise? You could say it's the end result of applying the Toyota Production System to all areas of your business" (J. K. Liker, 2004).

2.3 Lean Definition

The main concept of lean, or TPS, is reducing waste and maximizing customer value without significant supplementary resource requirements. Indeed, from the first time that lean was utilized in Japan after the Second World War and up to the twenty-first century, the concept has been evolving. Hines et al. (2004) states that "lean as a concept has evolved over time, and will continue to do so" (p. 997). Accordingly, it is not easy to state a consistent definition of lean because in the research there are a plethora of definitions of lean with divergent aims, elements, and scopes (Bhamu & Singh Sangwan, 2014; Dennis, 2002; Ohno, 1988). Although the literature shows that there is an absence of a consensus definition of lean, discussing different definitions by various authors provides a better understanding for organizations to acknowledge the different lean variations, and also to raise the awareness of the input in the implementation process (Kovacheva, 2010; Pettersen, 2009). The following table expresses the most common definitions of lean within different eras:

Table 2-1: Lean Definitions

Author	Definition
(Shingō & Dillon, 1989)	Shigeo Shingo[4] claims that when individuals are asked about TPS, 80% would believe TPS is a *Kanban*[5] system, 15% might know its function by saying it is a production system, and only 5% who would understand its purpose and state "it's a system for the absolute elimination of waste" (p. 26)
(Womack, Jones, & Roos, 1990)	Lean combines the best benefits of craft and mass production, while averting the high cost of the former and the rigidity of the latter. It is a continuous improvement method with a dynamic process of change driven by a systematic set of principles and best practices.
(J. K. Liker, 1997)	Lean is "a philosophy that when implemented reduces the time from customer order to delivery by eliminating sources of waste in the production flow" (p. 481).

[4] Shigeo Shingo is the author of the book titled "A Study of the Toyota Production System from an Industrial Engineering Viewpoint." He is considered as the world's leading expert on manufacturing practices and on TPS.

[5] *Kanban* is a small card attached to boxes of parts that regulates pull in the Toyota Production System by signaling upstream production and delivery (Womack & Jones, 2010).

Author	Definition
(Dennis, 2002)	“Toyota Production System is also known lean production, means doing less – less time, less space less, human effort, less machinery, less material – while giving customer what they want” (p.13).
(Levinson & Rerick, 2003)	Henry Ford defined lean in one sentence: “we will not put into our establishment anything that is useless” (p. xiii)
(Chalice, 2007)	The Toyota lean production is “an improvement philosophy or framework that is implemented around a problem-solving methodology” (p. 70)
(Bayou & de Korvin, 2008)	State that the definition of being lean is to have “continuous improvement of the combined efficiency–effectiveness attributes" (p. 289). In other words, being lean is to attain the level of having the least amount of input with the best goal achievements.
(Womack & Jones, 2010)	Lean thinking is a system that helps organizations “to do more and more with less and less - less human effort, less equipment, less time, and less space - while coming closer and

Author	Definition
	closer" (p. 15) to exactly meeting the customers' requirements. Moreover, it "provides a way to make work more satisfying by providing immediate feedback on efforts to convert *muda* into value" (p. 15). *Muda* means waste.
(R. Brown, 2014)	Lean thinking evolved from TPS and the success rested on two pillars: continuous improvement and respect for people. People who respect these pillars should consider: include line staffs in identifying and solving problems, and make sure that they have the knowledge and skill to both do and improve the work.
(Yusup et al., 2015)	"Lean production is known as a social-technical management philosophy that encompasses multiple disciplines that focus on increasing the manufacturing productivity by emphasizing on the elimination of waste, and increasing the value-added activities" (p.116).

In summary, it is crucial to know that lean is more than a set of tools (Bicheno, 2004). Indeed, it is a continuous improvement philosophy which is applied around a problem-solving methodology, taking in consideration the principle of eliminating all non-value-adding activities and waste from the business and extends that through the whole value stream or supply chain which include the suppliers and subcontractors (Chalice, 2007; Levinson & Rerick, 2003).

2.4 Lean Benefits

All organizations nowadays need to be at least as good as any of their other competitors and even superior in order to be successful and competing today's economy. Lean implementation can be the most compatible system which contributes to having efficient and effective procedures as well as practices that lead to the achievement of high competitiveness and excellent business performance (Alukal, 2003; Bozickovic & Maric, 2013). The core goal of lean companies is to fulfill their customer's needs and include high-quality products with a discounted cost in a short time through continuous elimination of *muda,* or waste (Bahaitham, 2011; Dennis, 2002). Therefore, types of waste should be identified because they have a direct impact on performance, quality, and cost (Gupta & Jain, 2013). Table 2-2 clarifies the eight forms of waste, adopted from (Dennis, 2002; Ohno, 1988; Womack & Jones, 2010):

Table 2-2: The Eight Forms of Waste

Waste Type	**Explanation**
Defects	Defects in the product require corrections actions and rework, or it could be scraps. This *muda* comprises all the resources such as material, energy, time to fix the defect.
Inventories	Any unnecessary storing of goods such as materials, parts, and works in process (WIP) awaiting further processing or consumption.
Waiting	Waiting by workers for process equipment to finish its work or on an upstream activity. Moreover, delay waste can boost the lead time (time between getting customer order and delivering the product).
Motion	This *muda* includes poor ergonomic designs that affect the productivity and cause unnecessary movement of people and unnecessary transport of goods. In addition, poor layout of machines positions can cause more motion.
Transport	Conveyance waste can be from insufficient workplace layout, traditional patch production process, or the large size of equipment.

Waste Type	Explanation
Processing	Any unnecessary processes that is not needed to the customer. The over processing *muda* and be due to poor tools, product, or process design.
Overproduction	Shingō and Dillon (1989) demonstrate that waste of overproduction can be: ▪ Quantitative: producing more than what is required. ▪ "Early: making the product before it is need it" Taiichi Ohno, believes that overproduction is the root of all manufacturing evil. It is also a foundation of other kind of *muda*. For instance, since it is not desired by customer it can be considered as motion (employees doing unnecessary effort), and as conveyance (unneeded transportation for materials, parts and finished goods).
Knowledge Disconnection	This *muda* can occur due to poor flow of knowledge, ideas, and creativity within any organization horizontally or vertically which might cause frustration of utilizing the skill of workers. In addition, it could be because of poor relationship among supply chain partners.

Because of the lean power as strategy of eliminating muda and increasing the value-added activities to give the customer what they want, proper lean implementation can dramatically reduce cost, shorten the lead time of customer orders, double productivity, improve efficiency, raise quality to an acceptable level, increase the profit, uplift competitiveness, encourage innovation, enhance better flexibility, and obtain a good market share (Gupta & Jain, 2013; Nithia, Noordin, & Saman, 2015; Womack & Jones, 2010). Furthermore, Gupta and Jain (2013) state that there are many hidden benefits of lean implementation, including improvement in safety, time reduction for traceability, development of culture change, and a decline fatigue and stress.

Another aspect that endorses the benefits of lean implementation is that lean implementation contributes to boosting the development performance of sustainable manufacturing. Figure 2-1 illustrates the influence of lean performance on manufacturing sustainability performance. It shows how lean techniques are able to affect and make a sustainable manufacturing practice. Competency accomplishment performance (CAP), economic achievement performance (EAP), and the environmental responsiveness performance (ERP) are the three manufacturing sustainability (MS) that influenced by the performance of lean. For example, it can be shown from the figure below that lean performance items such as increase value-added activities, reduce production lead time, and reduce operation costs can contribute in increasing the level of EAP (Yusup et al., 2015).

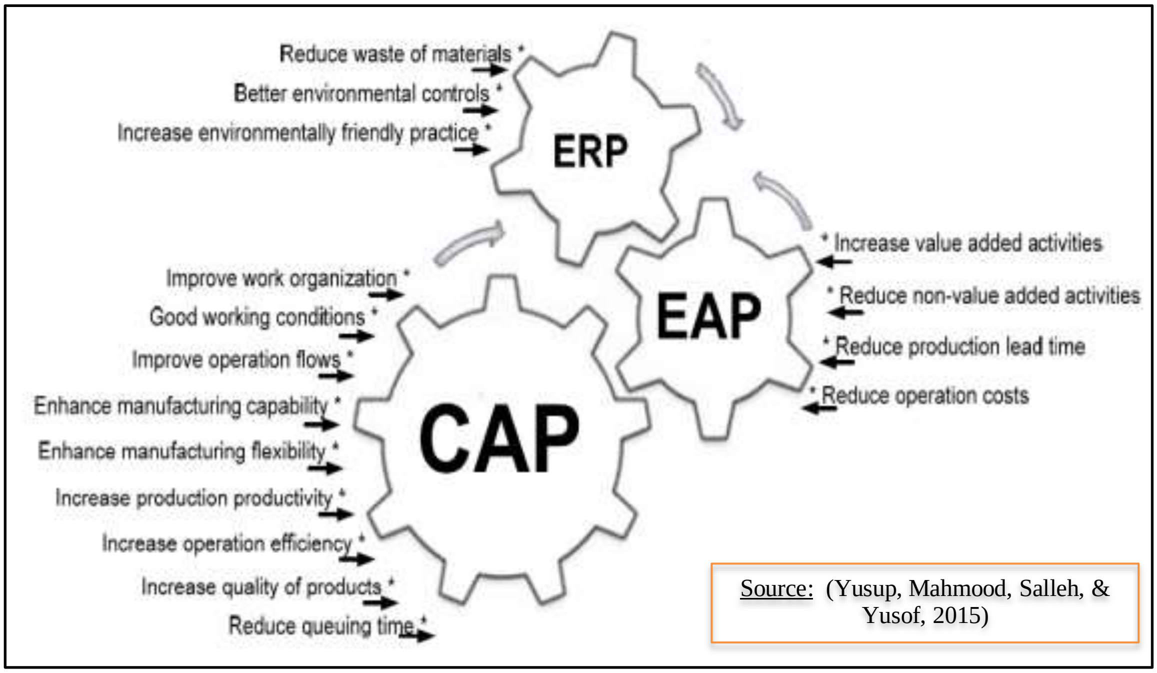

Figure 2-1: Impact of Lean on Manufacturing Sustainability Performance

2.5 Lean Applications

Lean or lean manufacturing was at the beginning focused on the automotive industry, since it was initiated at Toyota. Nevertheless, this situation has changed particularly after the publication of the powerful book *The Machine That Changed the World* by Womack, Jones, and Roos (1990). Lean application has become more recognized and has been applied to a wide range of cases in a variety of industries (Crute, Ward, Brown, & Graves, 2003).

In fact, the evolution of lean has caused a transference to lean implementation from manufacturing plants only to operations of all kinds in many different industries: "insurance companies, hospitals, government agencies, airline maintenance organizations, high-tech product development units, oil production facilities, IT operations, retail buying groups, and publishing companies, to name just a few" (Corbett, 2007). Masai, Parrend, and Zanni-Merk (2015) mention that when business leaders provide support from the top and apply lean principles consistently to create value and transform their company, they deliver superior results and are able to transform any sector or company. Examples of these applications are *Lean Product Development, Lean Start Ups, Lean IT, Lean Healthcare,* and *Lean Government*.

It is clear from the literature that the goal of adopting lean in different sectors improves the organization's performance in the operating metrics in order to have a competitive difference by increasing employees' capabilities to eliminate unnecessary activities and other forms of operational waste (Corbett, 2007). Table 2-3 reviews various lean applications in different sectors in both developed and developing countries. It is adapted from the article *Lean Manufacturing: Literature Review and Research Issues* (Bhamu & Singh Sangwan, 2014).

Table 2-3: Lean Applications Examples in Developed and Developing Countries

Author	Country	Sector	Description
(Katayama & Bennett, 1996)	Japan and UK	Automotive, electronics, refrigerator manufacturing	Examines lean production's role in coping with the current demands of Japanese companies
(Boyer, 1996)	USA	Metal working	Investigates the relationship between an organization's commitment to LP and management action plans
(Storch & Lim, 1999)	Korea	Shipbuilding	Improved shipbuilding industry productivity through adopting lean production, group technology, and flow principles
(Robertson & Jones, 1999)	UK	Telecommunications	The application of agile manufacturing and LP strategy in the telecommunications sector
(Clare L. Comm & Mathaisel, 2000)	USA	Aerospace	Developed eight-step paradigms in a military aerospace sector to evaluate and benchmark LP
(Mason-Jones, Naylor, & Towill, 2000)	UK	Precision products, carpet making, and electronics	The influence of the marketplace environment on the selection between of lean, agile, or leagile strategies to achieve the optimal supply chain performances

Author	Country	Sector	Description
(Furterer & Elshennawy, 2005)	USA	Local government	Improved local government services' quality and timeliness through the implementation of TQM, Lean, and Six Sigma principles and tools
(Taj, 2005)	China	Electronics, telecommunications, and IT	Developed a lean assessment tool to identify gaps and areas of improvement of high-tech manufacturing plants in China
(Seth & Gupta, 2005)	India	Cottonseed edible oil	Utilization of the Value Stream Mapping (VSM) approach to identify the supply chain's waste in the Indian edible cottonseed oil industry to advance the productivity and capacity imposition
(Kumar, Antony, Singh, Tiwari, & Perry, 2006)	India	Die casting SME	Developed a framework to integrate lean tools within Six Sigma DMAIC methodology to achieve cost reduction, the end result, and increase customer loyalty
(Piercy & Rich, 2009)	UK	Service (Call center)	The application of lean practices to increase service quality with a marginal investment in the service business to achieve a better financial result and bottom-line result

Author	Country	Sector	Description
(Yu, Tweed, Al-Hussein, & Nasseri, 2009)	Canada	Construction	Analyzed the current construction practices, processes, and restructuring the processes to develop a Lean Production model using the VSM approach
(Puvanasvaran, Megat, Hong, & MohdRazali, 2009)	Malaysia	Aerospace	Investigated the relationship between a communication process and the successful deployment of the lean approach in the context of an aerospace manufacturing company
(Wee & Wu, 2009)	Taiwan	Automotive	Addressed the lessons learned from Toyota's success in cost reduction and enhancing quality to list guidelines and ideas to facilitates lean implementation in other industries
(Cooper Jr, 2010)	USA	Academic institution	Proposed an implementation model for utilizing lean principles in a university's curriculum
(Al-Tahat, 2010)	Jordan	Foundry	Evaluated and compared the performance of two pattern-making systems, the traditional and the automated approaches using VSM

Author	Country	Sector	Description
(Wong & Wong, 2011)	Malaysia	Electrical and electronics	Assessed the processes, procedures, and tools to implement lean in four electrical and electronics companies in Malaysia. The study also included the encountered problems, required changes, and lessons learned
(Taj & Morosan, 2011)	China	Electronics, garments, chemical, etc.	Analyzed the relationship between lean operation practices and design and the Chinese manufacturing's performance factors
(Staats, Brunner, & Upton, 2011)	India	Software services firm	Explored the validity of LP to knowledge-based industry through case studies of Indian software services companies
(Agus & Hajinoor, 2012)	Malaysia	Non-food Malaysian manufacturing	Investigated the connection between LP of SCM and the business performance and the quality improvement of manufacturing sector in Malaysia
(Atkinson & Mukaetova-Ladinska, 2012)	UK	Health services	Explored the impact of lean thinking in a nurse-led liaison service for elderly adults and the enhancement of the care quality and the access to mental health service for older medically ill inpatients
(Ming-Te, Kuo-Chung, & Pan, 2013)	Taiwan	Food service	Developed a model using a data mining technique to conduct the performance assessment of lean service

2.6 Lean assessment

In the past two decades, researchers have developed numerous methods to evaluate the lean level in a country or to measure the leanness in an organization. Taj (2005) maintains that "assessment is a valuable tool that must be used to study the current state" (p. 630). Almomani et al. (2014) believe that:

> lean assessment represents the first step of all proposed lean implementation frameworks. Its aim is to define the current leanness level of the organization. Reviewing lean literature and case studies, different algorithms to conduct lean assessment […], and there is no unique assessment tool that can fit all enterprises. (p. 162)

Thus, it is essential to determine the level of awareness of lean implementation or transformation in developing countries. This section covers a review for methods, tools, and cases that focused on lean assessment, performance measurement, readiness and awareness level.

Andijani and Selim (1996) maintained that for a country like Saudi Arabia venturing into the industrial era aiming for success and the ability to be competitive, the implementation of material and production control (MPC) tools should be up-to-date. MPC includes automation, computer integrated manufacturing systems (CIM), just-in-time (JIT), material requirements planning (MRP), and total quality management (TQM).

Moreover, they stated that MPC techniques are essential tools to be used in industry in order to achieve high-quality products and low production costs. Therefore, they examined how far the MPC techniques are implemented in the industries of the Eastern Province of Saudi Arabia. It is found that the majority of the interviewed companies had considered MPC tools in their future planning, that the most common used techniques are MRP and TQM, that not all firms that installed an MPC system have a full appreciation of it, and that companies with a foreign partner attained some of the techniques more than those without a foreign partner. Boyer (1996) conducted a survey of 202 plants in the metalworking industries located in Dearborn, Michigan in the United States to examine the implementation of lean tools (i.e., JIT and TQM). The result indicated that metalworking industries appeared to be making strong efforts to provide the necessary support to JIT and TQM programs.

Goodson (2002) developed an assessment tool to precisely measure a factory's leanness solely from visual cues and from conversations with employees. The tool Rapid Plant Assessment (RPA) is based on a 30-minute tour by an expert to evaluate the lean in a factory. The RPA process contains two assessment tools: a rating sheet and a questionnaire. The first contain 11 categories including safety, scheduling, inventory, teamwork, and supply chain that determine a plant's leanness. The second features 20 yes-or-no questions that focus thinking within the categories. Lee (2004) developed a user-friendly Excel spreadsheet for lean assessment, which assists the management to investigate, evaluate, and measure key areas of manufacturing. Nine key areas of manufacturing include inventory, team approach, processes, maintenance, layout/handling, suppliers, setup, quality, and scheduling/control; these were evaluated using the Excel sheet with a scoring system. Taj (2005) has used Lee's Excel spreadsheet as an assessment tool in his study that focused on evaluating the current state of manufacturing in certain plants in electronics, telecommunication/wireless, and computer industries in the Republic of China. Shah and Ward (2007) have identified 10 dimensions of lean production that can be used as a tool for managers to assess the state of lean production in their specific operations. The 10 dimensions mainly focus in reducing the variability related to supply, processing time, and demand.

Bhasin (2008) proposed a dynamic multi-dimensional performance framework which focuses on intangible and intellectual assets to examine via a holistic approach whether lean has indeed implemented successfully in a respective firm. The dynamic multi-dimensional performance framework contains five dimensions: financial, customer/market measures, process, people, and future. However, this framework did not consider the performance measurement across the whole value chain. Bayou and de Korvin (2008) integrated a model that outlines leanness as a dynamic, relative, and long-term concept. The model's characteristics are: relative, dynamic, long-term fuzzy logical, integrative, holistic, and objective. A case study implementing the assessment to compare the production leanness of Ford Motor Company/General Motors and Honda

Motor Company was selected for benchmarking firm. Just-in-time, Kaizen, and quality controls were chosen as lean attributes. Puvanasvaran et al. (2009) suggested a technique to gauge the degree of leanness possessed by an organization as well as the roles played by communication process in lean practice. A case study of a Malaysian aerospace manufacturing firm was examined. The tool was a questionnaire that contained two parts. In the first part, respondents rated nine variables: elimination of waste, continuous improvement, zero defects, just-in-time, pull instead of push, multifunctional teams, decentralized responsibilities, integrated functions, and vertical information functions. The second part measured the managerial commitment and their support in the following infrastructure components: worker empowerment, training, group problem solving, and quality leadership. Wan and Chen (2009) advanced a web-based decision support tool using adaptive a lean assessment approach. The model generated a survey questionnaire to gauge the manufacturing system and derive the decision support information.

Singh, Garg, and Sharma (2010) explored the leanness concept and discussed the development of a leanness index for an Indian automotive industry. Twenty-six issues related to the application of lean were identified in a questionnaire which was sent to 300 industries. Based on expert’s judgments, 127 responses were categorized into five parts: customer issues, organizational issues, supplier issues, market issues, and top management issues. Saurin, Marodin, and Ribeiro (2011) introduced a framework for evaluating lean production practices in manufacturing cells. The framework consisted of four phases that included defining the proper practices and their attributes, defining the evidence to examine the existence of each attribute, and expert's opinions based on a survey to draw the model of the relationships among lean practices. A set of 18 lean practices were considered in the framework and a case study of manufacturing cells from an automobile parts supplier was examined. M. A. Karim et al. (2011) designed a questionnaire to investigate the extent of applying lean manufacturing in a country as well as to evaluate the benefits and the barriers of implementation. A case study of Saudi Arabian manufacturing companies was presented. Vinodh and Chintha (2011) designed a measurement model integrated with multi-grade fuzzy approach in order to measure the leanness in an organization. The conceptual model focused on five enablers: management responsibility leanness, manufacturing management leanness, workforce leanness, technology leanness, and manufacturing strategy. Each enabler contained a different criteria and each criterion had several attributes. Moreover, organizations can determine the areas of improvement by identifying weak areas that the model offers.

Ramakrishnan and Testani (2012) developed a framework to examine an organization's readiness for lean transformation and also advance a monitoring system to ensure that the lean transformation is meeting the company's goals. The study focused on the IBM Path Forward Lean Transformation Methodology with three phases: readiness for change, lean skills development, and continuous learning. Panizzolo et al. (2012) developed an assessment tool to study the implementation of lean production and to investigate the lean practices deployed by the small- and medium-size enterprises. The tool was advanced based on a literature review of improvement programs and lean best practices. These programs conceptualized different areas that included process and equipment, manufacturing planning and control, human resources, product design, and supplier/customer relationships. Case studies of four Indian companies were examined to validate the model.

Wahab, Mukhtar, and Sulaiman (2013) planned and developed a conceptual framework for leanness measurement application in the manufacturing sector. The researchers designed a conceptual model using factors and dimensions in the manufacturing sector. The identified dimensions were planning and scheduling, process and equipment, relationships with suppliers, visual information systems, workforce and product development, customer relationships, and technology. The result showed that there was a relation between these seven dimensions and waste elimination in the manufacturing industry. To illustrate the interaction involved, the authors categorized the dimensions into input, transformation, and output. This classification helped the researchers better understand lean dimensions and how they relate to the wastes in the manufacturing industry. Camacho-Miñano, Moyano-Fuentes, and Sacristán-Díaz (2013) reviewed literature that empirically analyzed how lean management influences financial performance to determine the most useful models for assessment. The findings indicated that the most valuable models consider financial aspects such as sales and profits, operational indicators such as inventory level and workers commitment, contextual factor size (number of employees), and period (years of implementation).

Almomani et al. (2014) maintained that the first step to lean implementation is to determine the current leanness level of the organization. Therefore, they proposed an assessment tool called the Lean Radar score (LRS) to assess an organization's leanness level by collecting data through a survey. Their survey focused on seven key areas: inventory, employee issues, maintenance, suppliers, safety, production, and customer; each area consisted of a set of detailed elements. A team of experts then assigned scores for each element and calculated the final scores. The result indicated that LRS "will help the company to identify the problems that are occurring in each area preventing it from being a lean-oriented one and, therefore, point efforts in a managed way to solve these problems" (p.163). Pakdil and Leonard (2014) developed a comprehensive model called the Leanness Assessment Tool (LAT). It counts both quantitative and qualitative approaches to measure a lean implementation level. Eight quantitative performance factors were taken in consideration, including cost, time effectiveness, human resources, quality, process, customer, delivery, and inventory. "The LAT also uses five qualitative performance dimensions: quality, process, customer, human resources and delivery, with 51 evaluation items". Fuzzy logic was constructed in order to utilize the perceptional (qualitative) and measurement (quantitative) approaches simultaneously. Moreover, radar charts were used to illustrate an immediate and comprehensive view of the weakness areas.

Ravikumar, Marimuthu, and Parthiban (2015) proposed a combined method of interpretive structural modelling (ISM) and analytical hierarchy process (AHP) models to examine the implementation of lean manufacturing concepts in Micro, Small and Medium Enterprises (MSMEs) in India. Specially, the models investigated the extent to which lean can be implemented given the various financial constraints businesses find themselves in via the current economic environment in India. Fuzzy was used to compare the criteria weights in order to validate the AHP outputs, which showed the best in lean implementation from a group of six MSMEs. The research contributed to determine a set of 11 factors that affected lean implementation in any organization.

Al-Ashaab et al. (2016) developed an assessment tool that enabled organizations to assess the leanness of their product development process. The four perspectives of a balanced score card were adapted to define the enablers of the lean product development model. Five enablers were used in this model: value, knowledge (or learning), continuous improvement, chief engineers, and set-based concurrent engineering. Aerospace and automotive companies were selected as case studies to validate the model.

2.7 Barriers Identification and Analysis

It is noticed that many industries experience failure when they attempt to reach a beneficial level of lean implementation and only consider it a philosophy. Decision makers who are interested in lean implementation in developing countries (e.g., China or India) witness many challenges. They cannot adopt the lean tools and techniques which were applied in manufacturing operations in Moline, Illinois in the United States or Munich, Germany due to differences in everything from culture to infrastructure (Corbett, 2007). Panwar, Jain, and Rathore (2016) maintained that the main reasons for not adopting lean practices in the Indian process industry are unfamiliarity with lean, lack of education and training, lack of expertise, and lack of management support.

In fact, implementing lean is not a simple mission because for any change in an organization to take hold and succeed, the resistance forces or barriers need to be recognized (J. R. Jadhav et al., 2014; Nordin et al., 2010). Thus, it is crucial to study these challenges and roadblocks in order to address the issues and improve a strategy for a successful lean application in order to gain the tremendous benefits. This section reveals barriers identification through a literature review with a focus on developing countries. Moreover, it presents a review of studies that focus on barriers analysis using Interpretive Structure Molding (ISM).

2.7.1. Barriers Identification

Hindrances to the achievement of a successful lean transformation include several aspects such as managerial structure, human attitude, educational levels, the lean process itself, government, and finance, among others (Yang & Yu, 2010). On the other hand, Bollbach (2012) compared lean implementation barriers to social and technical barriers, and identified six obstacles of lean implementation as follows: high employee turnover, weak supplier performance, market conditions, lack of lean knowledge, intercultural communication, and work styles. The following is a review of the barriers of attaining a successful level of lean transformation in developing countries:

Table 2-4: Lean Transformation Barriers in Developing Countries

	Barriers	Description	Sources
B1	Lack of awareness about lean	Many people and organizations have not heard of lean. In addition, this hurdle includes the lack of customer and government awareness which influence the pressure of being lean.	(Al-Najem, Dhakal, Labib, & Bennett, 2013; Almeida Marodin & Saurin, 2015; Čiarnienė & Vienažindienė, 2013; Koenigsaecker, 2005; Panwar et al., 2016; Salem, Musharavati, Hamouda, & Al-Khalifa, 2016; Yang & Yu, 2010)
B2	Disbelief about lean benefits	Some stakeholders of continuous improvement such as owners, managers, workers, and suppliers have insufficient understanding of the potential benefits of lean. They believe that lean is only a way of production and is meant for specific companies, particularly where it originated (Japan). Moreover, they have difficulty recognizing the financial benefits.	(Almeida Marodin & Saurin, 2015; Bhasin, 2012, 2015; Panizzolo et al., 2012; Pentlicki, 2015; Sharma, Panda, Mahapatra, & Sahu, 2011; Sisson & Elshennawy, 2015; Yang & Yu, 2010)
B3	Lack of technical knowledge of lean (know-how)	Many organizations face technical knowledge difficulties of lean implementation, which impose extra costs in training or hiring a consultant. The lack of clarity related to lean concepts is a root of unsuccessful implementation.	(Al-Najem et al., 2013; Almeida Marodin & Saurin, 2015; Bhasin, 2012; Bollbach, 2012; Forno, Pereira, Forcellini, & Kipper, 2014; Mirdad & Eseonu, 2015; Rymaszewska, 2014; Sami El-Khasawneh, 2012)

	Barriers	Description	Sources
B4	Poor performance of managers and workers, thus lack of education	A shortage of skilled technical workers and managers. Also, there is an educational gap within the workforce.	(Al-Najem et al., 2013; Almeida Marodin & Saurin, 2015; Bhasin, 2012; Bollbach, 2012; J. R. Jadhav et al., 2014; Linderman, Schroeder, Zaheer, Liedtke, & Choo, 2004; Sami El-Khasawneh, 2012; Seth & Tripathi, 2005)
B5	Poor work styles	The work style in developing countries is one of the obstacles. A high workload and long hours cause problems and decline any time for improvement. Also, human attitude such as not following of instructions and absence of maintaining standards is included.	(Aoki, 2008; Bhasin, 2012; Bollbach, 2012; R. Brown, 2014; Čiarnienė & Vienažindienė, 2012; Deflorin & Scherrer-Rathje, 2012; J. R. Jadhav et al., 2014; Sami El-Khasawneh, 2012)
B6	Lack of a motivation system	Motivations such bonus, reward, or incentive systems are essential for continuous improvement. Workers seem demotivated after a few years, and thus cause an incompatibility of lean.	(Ab Rahman, Shokshok, & Abd Wahab, 2011; Almeida Marodin & Saurin, 2015; Bhasin, 2015; R. Brown, 2014; Chay, Xu, Tiwari, & Chay, 2015; J. R. Jadhav et al., 2014; Wong & Wong, 2011)
B7	High employee turnover	The rate at which an employer gains and loses employees is one of the biggest problems in developing countries. This delays any improvement initiatives.	(Ab Rahman et al., 2011; Aoki, 2008; Bollbach, 2012; M. A. Karim et al., 2011; Sami El-Khasawneh, 2012; Taj, 2005)

	Barriers	Description	Sources
B8	Lack of a strategic planning system	Lack of leadership focus. Absence of a long-term development vision such as a strategic action/logistical planning system.	(Ab Rahman et al., 2011; Dave, 2013; Emiliani & Stec, 2005; J. R. Jadhav et al., 2014; M. A. Karim et al., 2011; Koenigsaecker, 2005; Rymaszewska, 2014; Sisson & Elshennawy, 2015)
B9	Poor management style	Restrictions of the hierarchical organizational structure which cause; for instance, lack of operator empowerment and inadequate supervisory skills.	(Bhasin, 2012; Bollbach, 2012; R. Brown, 2014; J. R. Jadhav et al., 2014; Pentlicki, 2015)
B10	Lack of top and middle management involvement	Lack of commitment and support from top and senior management contribute to the ineffectiveness or even disruption on the delivery and coordination of the entire lean system.	(Almeida Marodin & Saurin, 2015; Chay et al., 2015; Deflorin & Scherrer-Rathje, 2012; J. R. Jadhav et al., 2014; Panwar et al., 2016; Sharma et al., 2011; Sisson & Elshennawy, 2015; Yang & Yu, 2010)
B11	The lack of resources to invest	Shortage of human, financial structure, materials, machines which advance technology; expert guidance and time.	(Almeida Marodin & Saurin, 2015; Bhasin, 2012, 2015; Dave, 2013; M. A. Karim et al., 2011; Rymaszewska, 2014; Sami El-Khasawneh, 2012)

	Barriers	Description	Sources
B12	Lack of formal training for managers and workers	Lack of training courses, consultancy, and mentorship. Stakeholders are supposed to be supplied with the necessary training to enable them attaining the essential knowledge and skills.	(Bollbach, 2012; Chay et al., 2015; Hoyte & Greenwood, 2007; J. R. Jadhav et al., 2014; Linderman et al., 2004; Panizzolo et al., 2012; Panwar et al., 2016; Sisson & Elshennawy, 2015)
B13	Slow response to market due demand fluctuations	Continuously changing demand environment causes fluctuations in raw materials availability and prices. The advantages of becoming lean are compromised when demand fluctuates, custom orders increase, or simply a balanced workload cannot be achieved. A well-designed lean system allows for an immediate and effective response to fluctuating customer demands and requirements.	(Cudney & Elrod, 2010; Eswaramoorthi, Kathiresan, Prasad, & Mohanram, 2011; J. R. Jadhav et al., 2014; Pentlicki, 2015; Rymaszewska, 2014; Taleghani, 2010; Wan & Chen, 2009)
B14	Lack of technical expertise and consultants	Experts or training organizations in lean transformation are needed in developing country to attain the required level of transformation. Since the transformation requires tremendous change in culture, habits, attitude of employees, and management as well as systems, experts are necessary.	(Čiarnienė & Vienažindienė, 2012; Cudney & Elrod, 2010; Hoyte & Greenwood, 2007; J. R. Jadhav et al., 2014; Panwar et al., 2016; Pentlicki, 2015; Rentes, Araujo, & Rentes, 2009)

	Barriers	Description	Sources
B15	Cultural and language barriers	Some researchers believe that the cultural issues are the biggest barrier. They interact with many other obstacles, such as the human attitude (e.g., operators do not feel responsible for using lean practices and solving problems), management style (e.g., lack of operator empowerment). Translation of lean concepts and terms is crucial for successful transformation in developing countries.	(Al-Najem et al., 2013; Bhasin, 2012; Bollbach, 2012; R. Brown, 2014; Cudney & Elrod, 2010; Deflorin & Scherrer-Rathje, 2012; J. R. Jadhav et al., 2014; Nordin et al., 2010; Sami El-Khasawneh, 2012; Sarhan & Fox, 2013)
B16	Resistance to change	Operators may resist because they are afraid of layoffs due to improvements. Fear of failure may influence the management's strategies. The main reasons for resistance are "often a lack of clarity and uncertainty of the change, pressure, interference with interests and the challenge to learn something new" (J. R. Jadhav et al., 2014, p. 127)	(Almeida Marodin & Saurin, 2015; Axelsson, Rozemeijer, & Wynstra, 2005; Bhasin, 2012; Čiarnienė & Vienažindienė, 2013; Dave, 2013; J. R. Jadhav et al., 2014; M. A. Karim et al., 2011; Yang & Yu, 2010)
B17	Poor communication	Internal communication between workers and managers, and external communication with customers and suppliers. If management does not involve frontline employees, it will cause problems in applying lean.	(Almeida Marodin & Saurin, 2015; Bhasin, 2015; Čiarnienė & Vienažindienė, 2013; Dave, 2013; J. R. Jadhav et al., 2014; Rymaszewska, 2014; Yang & Yu, 2010)

	Barriers	Description	Sources
B18	Lack of good quality suppliers	The performance of suppliers affects the lean transformation. For example, the amount of time required to wait for parts and arrival of materials. Moreover, it causes waste such as scraps and rejects by the customer.	(Bollbach, 2012; Clare L Comm & Mathaisel, 2005; J. R. Jadhav et al., 2014; Shah & Ward, 2007; Taj, 2005)
B19	Lack of suppliers involvement	Suppliers should be treated as perpetual extensions of the organization for a successful transformation of lean. Lack of involvement of suppliers disrupts lean schedules.	(J. R. Jadhav et al., 2014; Rymaszewska, 2014; Sami El-Khasawneh, 2012; Sisson & Elshennawy, 2015)
B20	Lack of cooperation from suppliers	Poor commitment from vendors must be aligned with the lean transformation of the organization. It is important to know that successful supplier relationships must occur over a long time period.	(Clare L. Comm & Mathaisel, 2000; Cudney & Elrod, 2010; J. R. Jadhav et al., 2014; M. A. Karim et al., 2011; Rymaszewska, 2014)
B21	Lack of perseverance	This includes not sustaining the improvements in the medium and long term, backsliding to old ways, and weak standardization practices without periodic checking that standards are continuously adhered to.	(Almeida Marodin & Saurin, 2015; Bhasin, 2015; Emiliani & Stec, 2005; J. R. Jadhav et al., 2014; Womack & Jones, 2010; Wong & Wong, 2011)

2.7.2. Barriers Analysis Using ISM

The philosophical perspective of Interpretive Structural Modelling (ISM) was first initiated by Warfield (1973). ISM is a well-established and powerful methodology for structuring complex issues and for identifying and summarizing relationships among specific elements such as barriers and factors, which define a problem or an issue. It enables decision makers to transform unclear, poorly articulated mental models of a system into visible well-defined, hierarchal models. In addition, ISM categorizes the factors according to their influence on others (driving power), and their dependence on others (depending power); the higher the driving power, the greater the importance of the factor. ISM was applied for barrier analysis in a wide range of fields such as supply chain management, entrepreneurship, human resource management, education, and engineering (A. Jayant, Mohd. Azhar, & Singh, 2015; Alidrisi, 2015; Attri, Dev, & Sharma, 2013) . However, studies that use an ISM approach for barrier analysis to achieve successful lean transformation in developing countries are limited. The following is a review for ISM and lean.

Upadhye, Deshmukh, and Garg (2011) presented a theoretical framework for lean manufacturing system implementation using ISM. A systemic relationship was advanced among lean manufacturing implementation issues, which were identified from various literature sources. The model emphasized that the important issues which have the highest driving and dependence power are management support and total employee involvement.

Almeida, Marodin, and Saurin (2015) introduced a framework for managing barriers to lean production implementation (LPI) in specific companies, which is comprised of five steps: (i) description of the context, (ii) identification of the barriers, (iii) analysis of the influence of the context on the barriers, (iv) analysis of the relationships among the barriers using ISM, and (v) a feedback meeting to discuss the results of data collection, which also informs the development of an action plan to control the barriers. A set of 14 barriers were identified and prioritized to four levels based upon the ISM approach. The model shows that barriers 10, six and seven, and 12 are the foundation level, which indicates that these obstacles are the first challenge that company should undertake.

2.8 Frameworks for Lean Implementation

There are several strategies, frameworks, and roadmaps found in the literature. Originally the focus was on manufacturing; subsequently, these items saturated all areas of business, including service business, logistics, supply chains, project management, and so on. Most of these frameworks attained common goals such as cost effectiveness, a high level of production quality, or rendering services with a low level of risks and high paybacks. In addition, the focus of these models is on CI, TQM, quality, lean, and other topics related to lean. The following analysis is a review of the models, frameworks, and roadmaps that focus in lean implementation or lean transformation.

One of the most broadly known formulas for sustainable growth and success are in lean thinking principles by Womack and Jones (1996). The principles were three core items (i.e., identification of value, elimination of waste, and the generation of smooth flow). Then in 2003, researchers developed two further expansions which included activating the demand pull by synchronizing customer demand and information flow and the perfection of all products processes and services (A. Karim & Arif-Uz-Zaman, 2013). Organizations can use these the five principles of lean thinking as a powerful method that is available for eradicating *muda* and value-creating activities from concept to product launch, from order to delivery, and from raw materials into the hands of the consumer (Womack & Jones, 2010).

Panizzolo (1998) proposed a model that represents a conceptualization of lean production as involving several improvement programs or best practices characterizing diverse areas of the company, such as process and equipment, manufacturing planning and control, human resources, product design, supplier relationships, and customer relationships. The model mainly deals with the challenges presented by lean production principles for operations management. A multiple-case study approach was used to explore how the lean production model has been adopted by 27 excellent firms operating in international markets and to recognize the areas characterized by major problems.

Lathin and Mitchell (2001) developed a matrix that included both people and culture for a successful implementation of lean manufacturing. The matrix focused on integration of social and technical aspects. They claimed that "socio-technical systems integration is a conceptual model that enables organizations to effectively introduce the new processes and methods of lean manufacturing" (p. 40). A survey was used to identify whether each cell in the matrix was an enabler of, neutral to, or an inhibitor to implementation. After that, plans could be developed to address the inhibitors. Won, Cochran, Johnson, Bouzekouk, and Masha (2001) examined two recent attempts to develop frameworks to explain the Toyota Production System (TPS). A comparison of two approaches were discussed: the Four Rules which are captured from TPS, and the Manufacturing System Design Decomposition (MSDD) to develop the framework that communicates and satisfies the attributes of successful manufacturing systems.

Hines et al. (2004) conducted a literature review summarizing lean evolution and then proposed a framework for understanding the evolution of lean and its implementation within an organization at a strategic and operational level. Furterer and Elshennawy (2005) developed a framework for local government services that combined the principles and tools of Lean Enterprise and Six Sigma. The framework provided a premium way of improving the productivity and quality of providing financial services at a local government level. Christopher, Towill, Aitken, and Childerhouse (2009) suggested a logical framework for the implementation of a scheme for value stream classifications and assessments through a variety of industries.

John Lucey (2009) expanded the (2004) model that he, Bateman, and Hines proposed for long-term sustainability in a major lean transition which contains six actions: learn from past failures, engage staff, get feedback, embed ownership, provide an engagement survey, and give feedback to staff. Lucey's 2009 expansion proposed a "Lean Sustainability Zone" based on a range of employee engagement scores.

Parry, Mills, and Turner (2010) proposed a methodology for lean implementation impact through the enforcement of the core competence theory. The methodology decreases the risk of damaging a company's key resources and abilities. It followed four steps: market analysis, visible values stream, customer values analysis, and financial modeling. Hines (2010) explored how multi-site organizations can advance a sturdy lean culture. He proposed the "Lean Sustainability Iceberg Model," which was categorized in two parts: above (visible) and under the waterline (enabling). The above-waterline section includes technology, tools, techniques, and process management while the below-waterline section contains strategy and alignment, leadership, and behavior and engagement. Hines (2010) maintained that "the sustainable lean thinker needs to learn to see and act below the waterline, as well as above it" (p. 29)

Anvari, Zulkifli, Yusuff, Hojjati, and Ismail (2011) proposed a dynamic model for a lean roadmap for dynamic conditions of a high-variability environment. It focused on the successful implementation of lean at a very practical level through three phases (Preparation, Design, and Implementation) that incorporate 22 steps to leanness. Wang, Ming, Kong, Li, and Wang (2011) explored a lean product development (LPD) framework and provided the steps involved in implementing the framework. The steps of the framework are value and waste analysis, identification of value stream, product flow, pull and striving for perfection. Nordin, Deros, Wahab, and Rahman (2012) developed a framework to guide manufacturing organizations to implement lean system successfully. The model offers practitioners an enhanced comprehension of lean change, while at the same time reducing conflicts likely to arise during lean manufacturing implementation with the Delphi method. The model involved collecting opinions from relevant experts aimed at achieving a converged solution in order to solve real issues. Opinions were collected iteratively until there was stability. The experts provided comments and suggestions which later helped in improving the validated framework.

Mostafa et al. (2013) maintain that even though the benefits of lean are at length recognized from the success stories at Toyota, the present roadmaps and frameworks from the practitioner's perceptions appear incomprehensible. Thus, they proposed a project-based framework with four implementation stages along with the appropriate practices and decision tools for each stage. The phases are conceptualization, implementation design, implementation and evaluation, and a complete lean transformation. Powell, Alfnes, Strandhagen, and Dreyer (2013) conducted a scientific study that analyzed typical lean and Enterprise resource planning (ERP) implementation processes, and proposed an ERP-based lean implementation process. It was indicated that the "implementation of a contemporary ERP system can act as a catalyst for the application of lean production practices" (p. 324). A. Karim and Arif-Uz-Zaman (2013) proposed a framework for implementing lean manufacturing strategies and a leanness assessment metric using continuous performance measurement (CPM). The framework was based on the five lean-thinking principles by Womack and Jones which generated a process flow map with general measures for each principle. Selvaraju and Peterson (2013) discussed the critical success factors for analytics of a lean transformation. They projected a framework that assists organizations in understanding its readiness for including technology in a lean transformation, determining the most proper problem-solving approach to disband the business challenge, and using analytics to observe adoption rates in the technology and transformation. Cil and Turkan (2013) proposed a model that provided a holistic view to the lean transformation process by investigating the relationships among the elements of lean transformation using the Analytic Network Process (ANP) approach. A case study of one of Turkey's global industrial manufacturing companies was presented to validate the feasibility of the proposed approach and to give some managerial insights into the methodology. The author maintained that "the implementation of this lean enterprise transformation model contributes to improve the effectiveness, transparency, and integrity of any organization" (p. 1129).

Sundar, Balaji, and Kumar (2014) developed a lean route map for organizations to implement a lean manufacturing system based on an analysis of the exploratory survey results which were obtained to exemplify the implementation structure of lean elements in a volatile business environment. The output was synthesized to improve a unified theory for adoption of lean elements. Perez (2014) presented an enterprise architecture framework for a lean enterprise transformation that assisted organizations in moving towards operational excellence. This framework integrated the important mechanisms of transforming a traditional enterprise to a lean enterprise, which helped the organizational system to be more productive.

Masai et al. (2015) focused on developing a formal model of lean enterprise and proposed model with four components (KREM). The K (Knowledge) component contains domain knowledge about lean in the form of several ontologies, the R (Rules) component is articulated by probabilistic rules, the E (Experience) component defines the practices (Kata), and the M (Meta-data) component explains the context of the application of lean. The framework goal is "to better understand the success factors of Lean and to facilitate more successful implementations in different environments" (p. 234). Sisson and Elshennawy (2015) proposed a framework to determine the strategic interrelated factors of successful, sustained lean transformation. The framework included six categories: Deployment, Engagement, Training, Processes, Driers, and Culture. Each category had a set of propositions that successful lean companies recognized in order to achieve to a successful, sustained lean transformation level which was similar to Toyota.

2.9 Frameworks for Lean Implementation in the developing countries

During the past ten years, many organizations in developing countries such as China and India were interested in transforming their traditional systems to be more productive by adopting lean (Panizzolo et al., 2012). However, the adoption of lean in developing countries is not yet comparable to developed countries (Zargun & Al-Ashaab, 2014). Therefore, it is rare to find sustainable lean transformation frameworks in a developing country in the literature. Instead, a review of the frameworks, model, roadmap, and critical factors for lean implementation in developing countries is represented in this section.

Kumar et al. (2006) developed a Lean Sigma framework to reduce a defect occurring in the final product (automobile accessories) manufactured by a die-casting process. The framework is an integration of lean tools (current state map, 5S System, and Total Productive Maintenance [TPM]) within Six Sigma DMAIC methodology to improve the bottom-line results and earn customer’s loyalty. Sahoo, Singh, Shankar, and Tiwari (2008) suggested a systematic approach for the implementation of lean principles in a forging company in India with a focus on radial forging production flow lines. The approach mainly focused on the application of value stream mapping (VSM), and Taguchi's method to improve performance in the company. Wee and Wu (2009) provided industrial insight for those industries planning to implement lean production and follow a four-step problem-solving process to effectively develop their lean supply chain like Toyota. The methodology was based on a case-based approach from the Ford Motor Company in Chung Li, Taiwan. Lean supply chains (LSC) through value stream mapping (VSM) were examined using the Ford case study.

Anand and Kodali (2009) proposed a conceptual framework that provides comprehensive information about what constitutes lean manufacturing (LM). The framework remedied the issue of inappropriate understanding by both management and employees that leads to lean adoption failure. Ninety-six elements of LM were identified, principles, tools and techniques, and some practices were considered. A case study of the automotive components of a supplier company in Maharashtra, India was used for validation. Al-Tahat (2010) proposed using VSM to investigate the performance of traditional methods and fully automated pattern-making processes in order to improve process and decision making. A case study was tested in a foundry company in Jordan. Ramesh and Kodali (2011) proposed a decision framework that guaranteed accurate selection of an ideal VSM tool based on a novel formulation of the integrated analytical hierarchy process (AHP) and pre-emptive goal programming (PGP). The framework aided the decision maker in identifying and reducing all waste in the system, thereby maximizing organizational performance in the shortest timeframe.

Hofer, Hofer, Eroglu, and Waller (2011) developed an institutional-theoretic framework that explored the interplay among economic, socio-cultural, and regulative forces that may shape the adoption process of lean production practices in China. The framework was developed after an assessment was conducted to measure the current state of implementation of lean production in China as compared to the United States. Heap (2012) investigated and suggested a set of recommendations for applying lean manufacturing in a developing economy. The study was sponsored by the United Nations Industrial Development Organization (UNIDO) to help improve aspects of Pakistan's industry. The result indicated that lean manufacturing might be a step too far at this stage. Therefore, it is proposed to UNIDO to adopt a lesser form of lean called *Lean Lite*.

Roslin, Shamsuddin Ahmed, and Dawal (2012) reported the critical success factors of lean manufacturing through a case study of an automotive parts manufacturing company in Malaysia which had a successful lean adoption. It was proposed that factors such as continuous management commitment, teamwork, and organization-wide involvement are crucial to lean adoption success. Rose, Deros, and Ab. Rahman (2013) investigated the extent of lean manufacturing perception and implementation in the Malaysian automotive component industry and found that the actual LM implementation is still low. Al-Najem et al. (2013) developed a measurement framework to evaluate the lean readiness level and lean systems within Kuwaiti small- and medium-sized manufacturing industries. The methodology was focused on a comprehensive literature review, semi-structured interviews with 27 senior managers, and a quantitative survey administered to 50 companies in Kuwait. It was found that the quality practices within Kuwaiti small- and medium-sized companies are not very supportive of lean.

Zargun and Al-Ashaab (2014) identified lean critical success factors for manufacturing organizations in developing countries. Their study was based on an extensive literature review of factors that influence lean adoption process in developed countries and mapping these factors with lean current issues in developing countries to determine successful factors suitable for developing countries. Almomani et al. (2014) integrated a conceptual dynamic framework that consisted of lean assessment using a lean radar score (LRS) and an analytical hierarchy process (AHP) in order to outline the route of lean implementation based on the perspective priorities for improvement. Salem et al. (2016) investigated the level of recognition of lean concepts, principles, tools, and techniques in different manufacturing sectors in Qatar. The study aimed to evaluate lean awareness in industries in Qatar and to understand the perception of industry with respect to lean benefits and lean challenges. Hassanain, Zamakhshary, Farhat, and Al-Badr (2016) evaluated the intervention of lean principles in hospitals across the Kingdom of Saudi Arabia and their influence on the key performance metrics of the operation research such as OR utilization, on-time starts for first cases, room turnover times, overrun cases, and weekly procedure volumes.

2.10 Research Gap Analysis

According to Stone (2012) in his article *Four Decades of Lean: A Systematic Literature Review,* "lean transformations appear to be more successful when strategically aligned throughout the enterprise" (p.121). Moreover, he indicated that in the last four decades of lean,

> the most apparent void within the body of knowledge eschewing from lean literature was the lack of theoretical connections often associated with planned organizational change and human resource development[6] interventions. (p.121)

Sisson (2014) states that "there are several models found in the literature, many focused on Continuous Improvement (CI), quality, TQM, or other topics related to lean rather than specifically on lean itself" (p. 32). Based on a literature review of 102 published studies, Marodin and Saurin (2013) identified future opportunities and research areas of lean production systems implementation. The results of their study indicated that there is

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[6] The definition of Human Resource Development is "a process for developing and unleashing human expertise through organization development and personnel training and development for the purpose of improved performance" (Swanson & Holton, 2001).

a lack of in-depth knowledge regarding company success in their lean efforts, and a lack of effective theories and practices to manage the systemic, human, and organizational dimensions of lean. The following is a summary of the research gaps found in the literature review:

- First, it is apparent from the literature review that there is a need for a comprehensive framework for attaining a successful lean transformation level, and the need is more essential for companies in developing countries.

- Second, the literature review also depicted that while it is crucial to understand an organization's readiness for lean transformation prior to its deployment, there are limited frameworks that focus on lean assessment in developing countries.

- Third, barriers identification is very important in order to have a good starting point for successful lean transformation, and the literature showed that there are various studies which cover the barrier to lean implementation; however, studies that cover developing counties are not yet sufficient. In addition, it is obvious that there is a lack in research for studies that explore the barriers analysis using ISM, which is a soft operation research method.

Table 2-5 is a summary of frameworks for lean implementation in developing countries found in the literature review. It concluded that the there is a lack of comprehensive framework for achieving a successful and sustainable level of lean transformation in developing countries that would consider lean assessment to examine lean transformation level, barriers analysis to achieve a successful lean transformation level using ISM, and involvement of subject-matter experts in lean transformation from the case study of local and multinational companies in a developing country in order to validate the framework.

Table 2-5: Summary of Lean Implementation Models in Developing Countries

Author	Model	Perspective
(Kumar et al., 2006)	Lean Sigma framework, which is an integration of Lean tools (current state map, 5S System, and Total Productive Maintenance [TPM]) within Six Sigma DMAIC methodology.	The model reduced defects occurring in the final product (automobile accessories) manufactured by a die-casting process.
(Sahoo et al., 2008)	Systematic approach for the implementation of lean principles in a forging company in India with a focus on radial forging production flow lines.	Mainly focuses on application of value-stream mapping (VSM), and Taguchi’s method to improve the company’s performance.
(Wee & Wu, 2009)	Based on a case-based approach (CBA), which described lean supply chain (LSC) through value-stream mapping (VSM) using a case study from the Ford Motor Company in Chung Li, Taiwan.	The focus was to address “how Toyota can continuously and consistently achieve its dramatic success through its competences-continuous waste elimination and the objective of long term philosophy” (p. 335) and provide steps for companies regarding problem solving that the Toyota used to do.

Author	Model	Perspective
(Anand & Kodali, 2009)	Conceptual framework included about 65 elements pertaining to LM, which were identified from a detailed literature survey. A case study of automotive components of a supplier company in Maharashtra, India was used for validation.	The framework provided a relationship between the various decision levels of an organization and the elements of LM in addition to the relationship between the various internal stakeholders of the organization. However, the model is too general, which may affect accuracy.
(Al-Tahat, 2010)	Framework that guaranteed an accurate selection of an ideal VSM tool based on a novel formulation of the integrated analytical hierarchy process (AHP) and pre-emptive goal programming (PGP).	The framework aided the decision maker in identifying and reducing all waste in the system, thereby maximizing organizational performance in the shortest timeframe.

Author	Model	Perspective
(Hofer et al., 2011)	An institutional-theoretic framework that explored the interplay among economic, socio-cultural, and regulative forces. The framework was used to measure the current state of implementation of lean production in China as compared to the United States.	The model was good for assessment and addressed the current state rather than just a comprehensive one.
(Roslin et al., 2012)	Reported the critical success factors of lean manufacturing through a case study of an automotive parts manufacturing company in Malaysia that has successfully adopted lean.	A step-by-step procedure for the effective implementation of a lean manufacturing system among Malaysian automotive manufacturing companies.
(Al-Najem et al., 2013)	A measurement framework evaluated the lean readiness level and lean systems within Kuwaiti small- and medium-sized manufacturing industries.	The framework was used to assess the quality practices related to LS (processes, planning and control, human resources, top management and leadership, customer relations, and supplier relations).

Author	Model	Perspective
(J. Jadhav, Mantha, & Rane, 2015)	A roadmap for lean implementation in Indian automotive component manufacturing industry: ISM was compared with an Indian government model.	Both models had six stages and had contributed positively to Indian automotive industry. The framework was exclusive to the Indian manufacturing segment.
(Salem et al., 2016)	Empirical study on lean awareness and potential for lean implementations in Qatar's industries.	Investigated the level of recognition of lean concepts, principles, tools, and techniques in different manufacturing sectors in Qatar.
(Hassanain et al., 2016)	Application of lean methodology to improve operating room efficiency in hospitals across the Kingdom of Saudi Arabia.	Evaluated the intervention of lean principles in hospitals across the Kingdom of Saudi Arabia and its influence on the key performance metrics of operation research such as OR utilization, on-time starts for first cases, room turnover times, overrun cases, and weekly procedure volumes.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Introduction

The methodology chapter describes the research process and addresses the issues of research philosophy. It contains an explanation of research design as well as the choice and implementation of data collection methods. Moreover, this chapter demonstrates an overview of the applied methods and techniques used to achieve the objectives of the study and answer the research questions.

3.2 Research Methodology Diagram

Figure 3-1 presents a diagram which summarizes high-level research methodology. The diagram includes the research idea and literature review, which consists three main objectives: to study the level of lean transformation in developing countries, to determine the barriers of lean transformation in developing countries and seek studies that used ISM for their analysis, and to summarize the previous frameworks for lean transformation in developing countries. Then, using research gap analysis and literature gaps of the basic assessment technique for lean transformation in developing countries was formed, major barriers were identified, and a Structural Self-Interaction Matrix (SSIM) was designed. After that, data collection based on general questions regarding lean in developing countries is profiled along with the basic assessment technique and SSIM. Finally, framework development, validation through case studies, a conclusion, and information on future studies are presented.

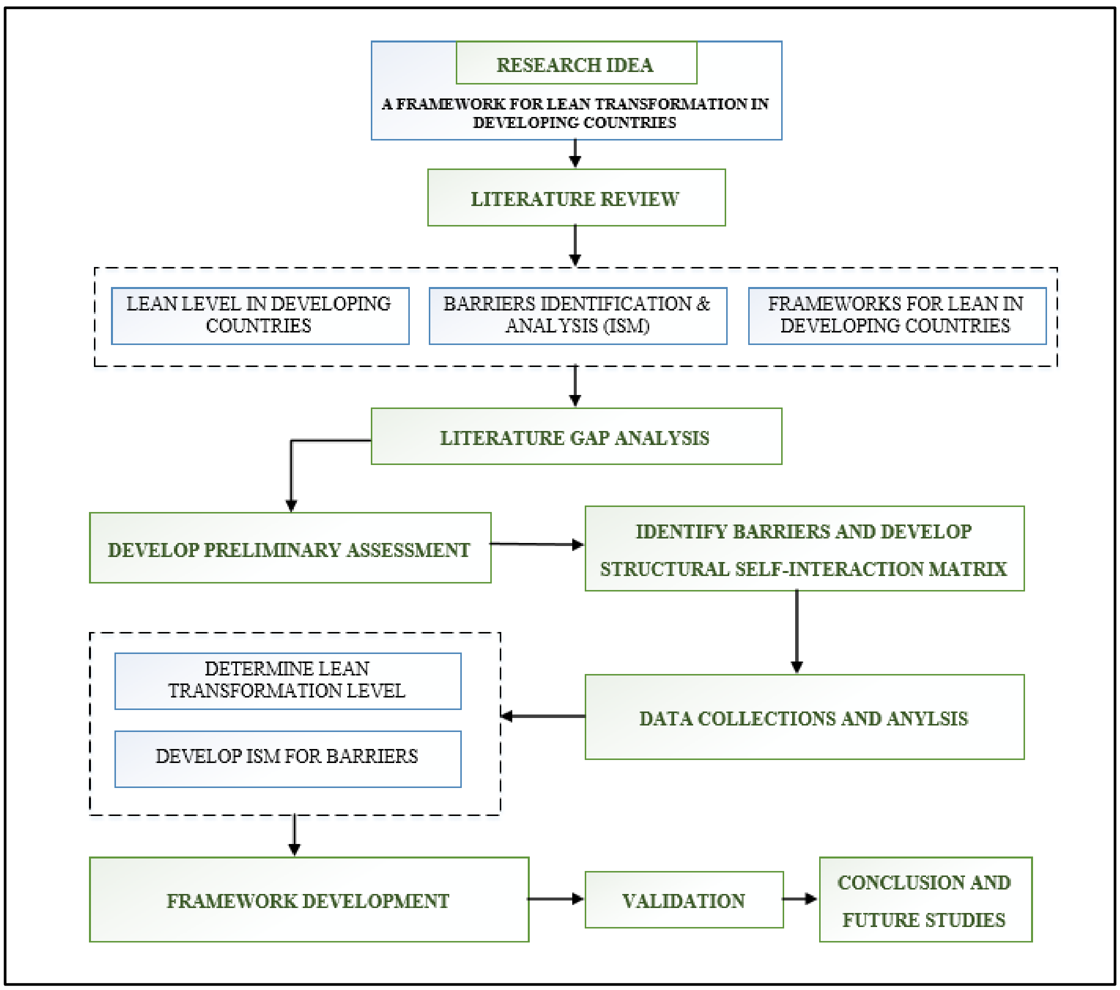

Figure 3-1: Research Methodology Diagram

3.3 Research Idea

Lean and lean thinking is a topic in Industrial Engineering that currently has an intense interest. The trend of spotlighting lean is understandable if the success cases are examined, such as those in the book *Lean Thinking* by Womack and Jones. Weigel (2000) maintains that the sales rank of this book on Amazon has reached a position of 9,708 in an inventory of over hundreds of thousands of books. This widespread awareness of lean was an inspiration to many researchers.

The first step in this research was to understand lean and also look for recent publications in this area. Surprisingly, the success rate of attaining successful lean transformation in the United States and other developed countries, such as the United Kingdom, were low. This evidence was an encouragement to examine lean transformation in developing countries.

3.4 Literature Review

A literature review was then conducted to define to what extent the previous published sources address the research questions and to help in identifying research gaps. This section presents previous studies that relate to lean transformation in developing countries, and includes a historical evolutionary perspective of Toyota Production System (TPS), lean definition, lean benefits, lean implementation, lean implementation in the developing countries, lean assessment, barriers of implementing lean, methods used for barriers analysis, and former frameworks for lean transformation.

3.5 Literature Gap Analysis

This section summarizes the literature review and identifies research gaps, which is the missing component in the existing research literature. There are four major gaps found in the literature. The main gap was the absence of a comprehensive model or roadmap for lean transformation in developing countries. Some frameworks found in the literature were common for developed countries, but do not provide specific actions that should be taken to ensure achievement of successful and sustained lean transformation. Second, previous frameworks that focus on practical ways of evaluating the lean transformation level in developing countries are limited. Some studies that cover the topic of evaluating the level of lean transformation in developing countries concentrate on assessment of a readiness for change or a maturity of the transformation.

Third, there are few studies that identified the barriers to lean transformation in developing countries. Moreover, there is lack of analysis of these barriers using a well-established methodology such as an ISM approach, which examines the relationship between different factors and provides ways of prioritizing them. Fourth, there are a lack of frameworks that consider the involvement of experts in lean from different organizations in developing countries. There are some studies which acknowledge the involvement of experts and are focused on having a successful and sustained lean transformation developed countries; nevertheless, they have not been tested or validated in developing countries such as Saudi Arabia. The following sections focus on developing a bridge to fill these gaps.

3.6 Preliminary Assessment Development

One of the objectives and questions in this study is to examine the level of lean transformation in developing countries. To bridge this gap, a basic assessment method was constructed as follows. First, “Assessment for Lean Manufacturing,” which is also called the “Lean Radar Chart,” was used. This assessment was developed by Strategos, Inc.[7], and has been used by several researchers and consultants in lean assessments. However, the factors for this assessment focus lie more in manufacturing and need to be adjusted for use in assessing lean transformation levels. Thus, the main elements and categories of the assessment were adopted from a framework for a successful, sustained lean transformation proposed by Sisson and Elshennawy (2015), which is illustrated below in Figure 3-2.

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[7] www.strategosinc.com

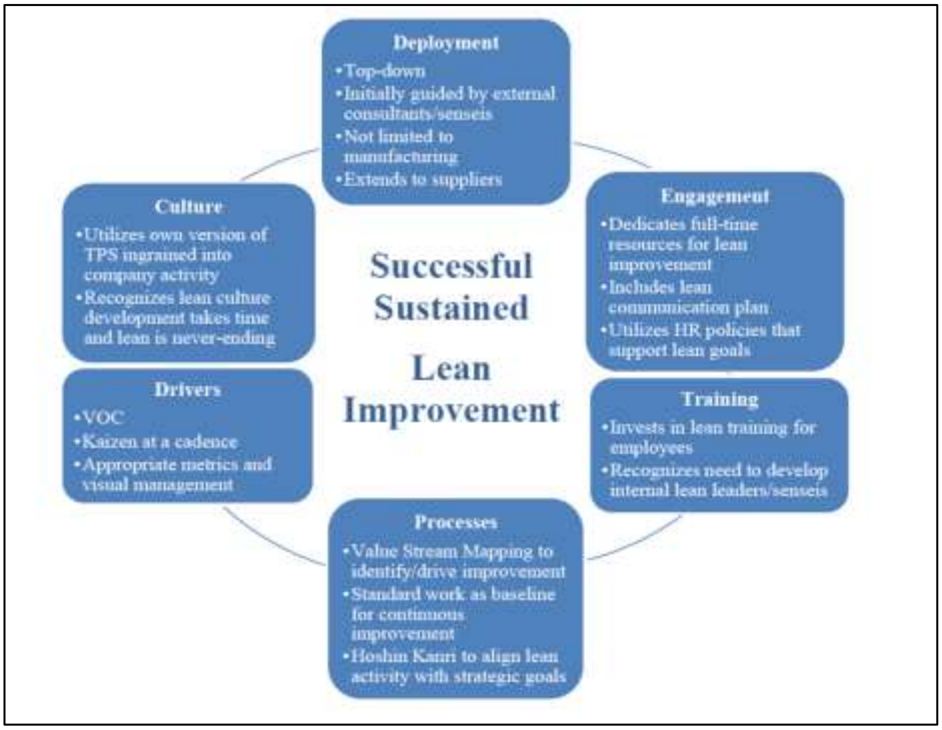

Figure 3-2: Framework for Successful, Sustained Lean Transformation

Second, these elements and categories were used and adjusted in the "Assessment for Lean Manufacturing." Third, a scoring system of the original assessment was also improved to fit the purpose of the assessment, which is to evaluate the current lean transformation level in the Saudi Arabian industry. Figure 3-3 shows a sample of the original "Assessment for Lean Manufacturing," and also the adjusted one.

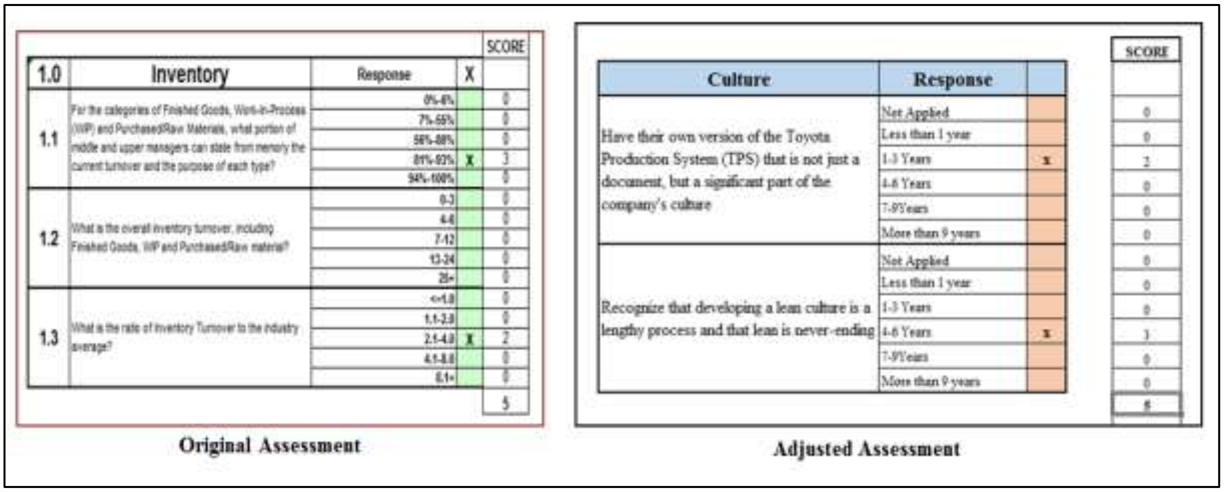

Figure 3-3: Sample of Original and Adjusted Assessment.

Fourth, all scored responses are summarized and the percentage for the lean implementation level for each category is calculated and shown below in

Table 3-1.

Table 3-1: Sample of Score Summary for Lean Assessment.

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	**5**	**2**	**2.50**	**50%**
Deployment	**9**	**4**	**2.25**	**45%**
Engagement	**6**	**3**	**2.00**	**40%**
Training	**5**	**2**	**2.50**	**50%**
Processes	**7**	**3**	**2.33**	**47%**
Drivers	**8**	**3**	**2.67**	**53%**

Five, the percentages of all categories are formed in a radar chart as shown below in Figure 3-4.

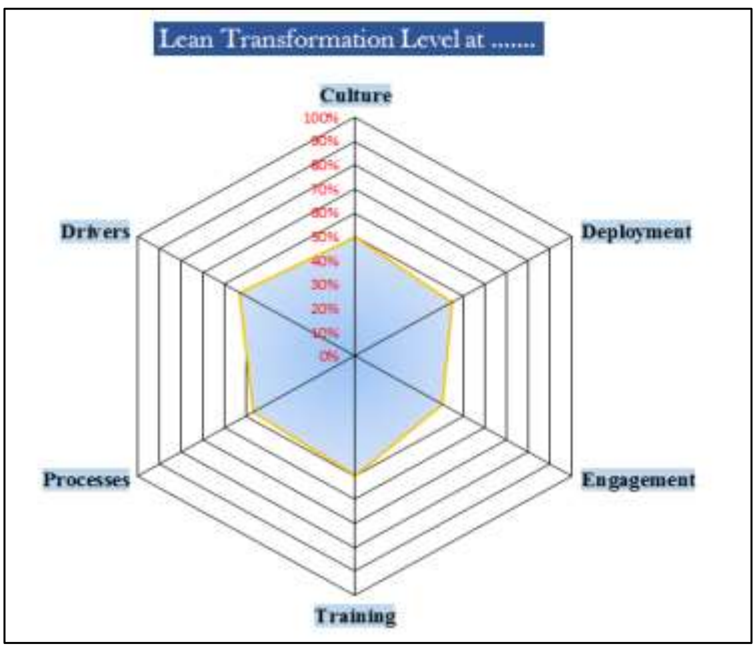

Figure 3-4: Sample of Lean Assessment Radar Chart.

3.7 Barriers Identification and Analysis Using ISM

One of the main parts of this research is to identify, analyze the relationships, and determine the barriers to attaining a sustainable lean transformation in developing countries using Interpretive Structural Modeling (ISM). The major steps of barrier identification and ISM are demonstrated via a flow diagram in Figure 3-5 (Alidrisi, 2015; Janes, 1988; Mathiyazhagan, Govindan, NoorulHaq, & Geng, 2013; Raut, Narkhede, & Gardas, 2017).

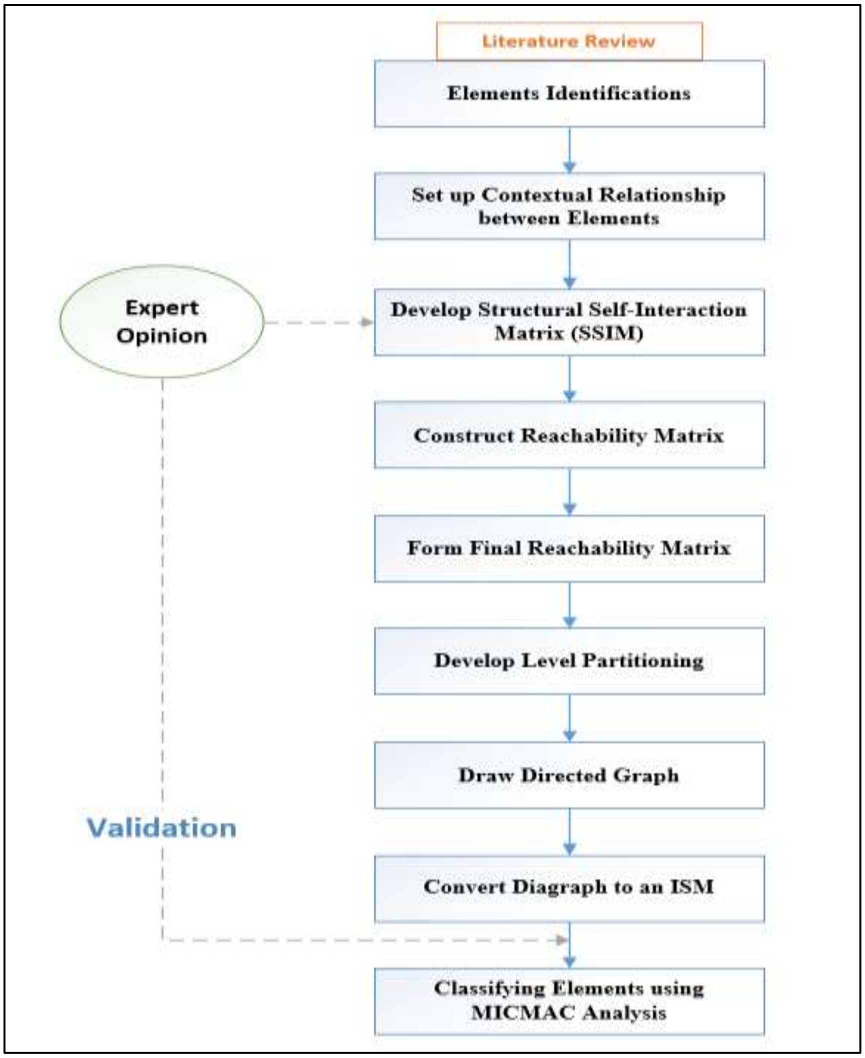

Figure 3-5: Major procedures of ISM.

Developing an ISM starts from an in-depth literature review of the barriers that make transformation to lean challenging. To this end, 21 barriers to lean transformation in developing countries were selected and identified (see Table 2-4). Following the selection, contextual relationships among these barriers were expressed and a Structural

Self-Interaction Matrix (SSIM) was developed. Figure 3-6 shows the four symbols for the contextual relationships and the SSIM.

Please use from the following four symbols to denote the direction of relationship between the barriers:

- V: for the relation from barrier (1) to barrier (2) (i.e., B1 will influence factor B2)
- A: for the relation from barrier (2) to barrier (1) (i.e., B2 will influence factor B1)
- X: for both direction relations (i.e., B1 and B2 will influence each other)
- O: for no relation between the barriers (i.e., B1 and B2 are unrelated).

	B21	B20	B19	B18	B17	B16	B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1
B1																					
B2																					
B3																					
B4																					
B5																					
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B20																					
B21																					

Figure 3-6: SSIM Among Barriers Using Four Symbols (V,O,A,X)

The SSIM was explained to a targeted expert who is a key person in his company, and the SSIM was completed during his interview. Then, an initial reachability matrix was formed. A reachability matrix converts the four symbols for the contextual relationships in the SSIM to a 0 and 1 binary matrix, known as *initial reachability matrix* as shown in Table 3-2 below. The rules for substitution from symbols to (0 and 1) are explained in the following points:

- If the (x, y) input is V, then (x, y) input in the reachability matrix converts to 1 and the (y, x) input converts to 0;
- If the (x, y) input is A, then (x, y) input in the reachability matrix converts to 0 and the (y, x) input converts to 1;
- If the (x, y) input is X, then both (x, y) and (y, x) inputs in the reachability matrix converts to 1; and
- If the (x, y) input is O, then both (x, y) and (y, x) inputs in the reachability matrix converts to 0.

Table 3-2: Sample of the Initial Reachability Matrix

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21
B1	1	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0
B2	1	1	1	1	1	0	1	1	1	0	1	0	0	0	0	1	0	0	0	0	0
B3	1	1	1	1	0	0	0	1	1	1	1	0	1	0	0	1	0	0	0	0	0
B4	0	0	0	1	1	0	1	1	1	1	0	0	1	0	1	0	1	0	0	0	0
B5	0	0	1	1	1	1	1	0	1	0	0	0	1	0	1	1	1	1	1	1	1
B6	0	0	0	1	0	1	1	0	0	0	0	1	0	0	0	1	1	0	0	0	1
B7	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
B8	0	0	0	1	0	0	1	1	1	1	1	0	1	0	0	1	1	1	1	1	0
B9	0	0	0	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	0
B10	0	0	0	1	1	1	1	1	1	1	0	1	1	1	0	0	1	0	0	0	1
B11	0	0	0	0	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0	1	0
B12	0	1	1	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	1	0	0
B13	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0
B14	0	1	1	1	1	0	0	1	1	0	0	0	0	1	0	0	1	0	0	0	0
B15	0	1	0	1	1	1	0	0	1	1	0	1	0	0	1	1	1	1	1	1	0
B16	1	1	1	1	1	0	1	1	1	1	0	1	0	0	1	1	1	0	0	0	1
B17	1	1	0	1	1	1	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0
B18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
B19	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0
B20	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0
B21	0	0	0	1	0	0	0	1	1	1	0	0	1	0	0	1	1	0	0	1	1

The next step was to advance the final reachability matrix, which is to take transitivity logic, a basic assumption made in ISM, into consideration. It maintains that if a Barrier A is related to B and B is related to C, then A is automatically related to C. Accordingly, some ‘‘0’’ entries were converted to ‘‘1’’ and marked by ‘‘1^*’’, as shown in Table 3-3 below. In addition, the ranking powers (driving and dependence powers) were calculated in the final reachability matrix in order to be graphed in the MICMAC analysis.

Table 3-3: Sample of the Final Reachability Matrix

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21	Driving
B1	1	1	1	1*	1*	1*	1	1	1	1*	1*	1*	1*	1*	1*	1*	1	0	0	0	1*	18
B2	1	1	1	1	1	1*	1	1	1	1*	1	1*	1*	1*	1*	1	1*	1*	0	0	1*	19
B3	1	1	1	1	1*	1*	1*	1	1	1	1	1*	1	1*	1*	1	1*	0	0	0	1*	18
B4	1*	1*	1*	1	1	1*	1	1	1	1	1*	1*	1	1*	1	1*	1	0	0	0	1*	18
B5	1*	1*	1	1	1	1	1	1*	1	1*	1*	1*	1	1*	1	1	1	1	1	1	1	21
B6	1*	1*	1*	1	1*	1	1	1*	1*	1*	1*	1	1*	1*	1*	1	1	0	0	0	1	18
B7	1*	1*	1*	1*	1*	1*	1	1*	1*	1*	1*	1*	0	1*	1*	1*	1*	0	0	0	1	17
B8	1*	1*	1*	1	1*	1*	1	1	1	1	1	1*	1	1*	1*	1	1	1	1	1	1*	21
B9	1*	1*	1*	1	1	1	1	1*	1	1	1	1	1	1	1*	1	1	1	1	1	1*	21
B10	1*	1*	1*	1	1	1	1	1	1	1	1*	1	1	1	1*	1*	1	0	0	0	1	18
B11	1*	1*	1*	1*	1	1	1	1	1	1*	1	1	1	1	1*	1*	1*	0	0	1	1*	19
B12	1*	1	1	1	1	1	1	1*	1*	1*	1*	1	1	1	1*	1	1	1	1	0	1*	20
B13	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1	1*	1*	1*	1	1	1*	1*	1*	21
B14	1*	1	1	1	1	1*	0	1	1	1*	1*	1*	1*	1	1*	1*	1	0	0	0	1*	17
B15	0	1	1*	1	1	1	1*	1*	1	1	1*	1	0	1*	1	1	1	1	1	1	1*	19
B16	1	1	1	1	1	1*	1	1	1	1	1*	1	1*	1*	1	1	1	0	0	0	1	18
B17	1	1	1*	1	1	1	1*	1	1	1	1*	1	1	1	1*	1	1	1	1	1	1*	21
B18	1*	1*	1*	1*	1*	1*	0	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1	1	1	1*	20
B19	1*	1*	1*	1*	1*	1*	0	1*	1*	1*	1*	1*	1	1*	1*	1*	1*	1	1	1	1*	20
B20	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1	1*	1*	1*	1*	1	1	1	1*	21
B21	1*	1*	1*	1	1*	1*	1*	1	1	1	1*	1*	1	1*	1*	1	1	0	0	1	1	19
Depeinding	20	21	21	21	21	21	18	21	21	21	21	21	19	21	21	21	21	11	10	11	21	

Level partitioning was the step that is concerned with the removal of a sequential ordering from the final reachability matrix. The final reachability matrix was turned into a table in which rows (i.e., reachability set) and columns (i.e., antecedent set) for each barrier listed, and then intersections between the two sets were addressed as well. Then, leveling procedures were carried out using the highest intersection level for the first iteration and then the second iteration showing the crossed-out barriers resulting from completion of the first iteration as shown in Tables 3-4, 3-5 and 3-6 below to the completion of all iterations, as shown in Table 3-7 below.

Table 3-4: Sample of Levels of Barriers - 1st Iteration

	Reachability Set	Antecedent Set	Intersection Set	Level
B1	1,2,4,5,8,9,10,11,12,14,15,16,17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1,2,4,5,8,9,10,11,12,14,15,16,17	1
B2	1,2,3,4,5,8,9,10,12,14,16,17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	1,2,3,4,5,8,9,10,12,14,16,17	1
B3	1,2,3,4,5,6,7,8,9,10,11,12,14,15,16,17,19,21	2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	2,3,4,5,6,7,8,9,10,11,12,14,15,16,17,19,21	
B4	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,21	1
B5	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,21	
B6	1,2,3,4,5,6,7,8,9,10,12,14,15,16,17,21	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	3,4,5,6,7,8,9,10,12,14,15,16,17,21	
B7	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,21	3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,20,21	3,4,5,6,7,8,9,10,11,12,13,14,16,17,21	
B8	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	
B9	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1
B10	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	
B11	1,2,3,4,6,7,8,9,10,11,12,13,14,15,16,17,18,21	1,3,4,5,7,8,9,10,11,12,13,14,16,17,18,19,20,21	1,3,4,7,8,9,10,11,12,13,14,16,17,18,21	
B12	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,21	1
B13	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	4,5,7,8,9,10,11,12,13,14,16,17,18,19,20	4,5,7,8,9,10,11,12,13,14,16,17,18,19,20	
B14	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1
B15	1,3,4,6,9,12,14,15,16,17,21	1,3,4,5,6,7,8,9,10,11,13,15,16,17,18,19,20,21	1,3,4,6,9,15,16,17,21	
B16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1
B17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1
B18	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	5,8,9,10,11,13,14,15,16,17,18,19,20,21	5,8,9,10,11,13,14,15,16,17,18,19,20,21	
B19	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	3,4,8,9,10,13,14,16,17,18,19,20	3,4,8,9,10,13,14,16,17,18,19,20	
B20	2,3,4,5,6,8,9,10,11,12,13,14,15,16,17,18,19,20,21	8,9,10,12,13,17,18,19,20,21	8,9,10,12,13,17,18,19,20,21	
B21	1,2,3,4,5,6,7,8,9,10,11,12,14,15,16,17,18,20,21	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	3,4,5,6,7,8,9,10,11,12,14,15,16,17,18,20,21	

Table 3-5: Sample of Levels of Barriers – 2nd Iteration

	Reachability Set	Antecedent Set	Intersection Set	Level
~~B1~~	~~1,2,4,5,8,9,10,11,12,14,15,16,17~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1,2,4,5,8,9,10,11,12,14,15,16,17~~	~~1~~
~~B2~~	~~1,2,3,4,5,8,9,10,12,14,16,17~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21~~	~~1,2,3,4,5,8,9,10,12,14,16,17~~	~~1~~
B3	3,5,6,7,8,10,11,15,19,21	3,5,6,7,8,10,11,13,15,18,19,20,21		
~~B4~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,21~~	~~1~~
B5	3,5,6,7,8,10,11,13,15,18,21	3,5,6,7,8,10,13,15,18,19,20,21	3,5,6,7,8,10,13,15,18,21	
B6	3,5,6,7,8,10,15,21	3,5,6,7,8,10,11,13,15,18,19,20,21	3,5,6,7,8,10,15,21	2
B7	3,5,6,7,8,10,11,13,15,21	3,5,6,7,8,10,11,13,18,19,221	3,5,6,7,8,10,11,13,21	
B8	3,5,6,7,8,10,11,13,15,18,19,20,21	3,5,6,7,8,10,11,13,,18,19,20,21	3,5,6,7,8,10,11,13,,18,19,20,21	
~~B9~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1~~
B10	3,5,6,7,8,10,11,13,15,18,19,20,21	3,5,6,7,8,10,11,13,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	
B11	3,,6,7,8,10,11,13,15,18,21	3,5,,7,8,10,11,13, ,18,19,20,21	3,7,8,10,11,13, ,18,19,,21	
~~B12~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,21~~	~~1~~
B13	3,5,6,7,8,10,11,13,15,18,19,20,21	,5,7,8,10,11,13 ,18,19,20,21	,5,7,8,10,11,13 ,18,19,20,21	
~~B14~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1~~
B15	3,6 ,15 ,21	3,5,6,7,8,10,11,13,15,18,19,20,21	3,6 ,15 ,21	2
~~B16~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1~~
~~B17~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1~~
B18	3,5,6,7,8,10,11,13,15,18,19,20,21	,5, ,8,10,11,13, ,18,19,20,21	,5, ,8,10,11,13, ,18,19,20,21	
B19	3,5,6,7,8,10,11,13,15,18,19,20,21	3,,8,10,13, ,18,19,20,	3,,8,10,13, ,18,19,20,	
B20	3,5,6,8,10,11,13,15,18,19,20,21	,8,10 ,13, ,18,19,20,21	,8,10 ,13, ,18,19,20,21	
B21	3,5,6,7,8,10,11, ,15,18 ,20,21	3,5,6,7,8,10,11,13,15,18,19,20,21	3,5,6,7,8,10,11, ,15,18 ,20,21	2

Table 3-6: Sample of Levels of Barriers – 3rd Iteration

	Reachability Set	Antecedent Set	Intersection Set	Level
~~B1~~	~~1,2,4,5,8,9,10,11,12,14,15,16,17~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1,2,4,5,8,9,10,11,12,14,15,16,17~~	~~1~~
~~B2~~	~~1,2,3,4,5,8,9,10,12,14,16,17~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21~~	~~1,2,3,4,5,8,9,10,12,14,16,17~~	~~1~~
B3	3,5,7,8,10,11, , ,19,	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11, , ,19,	3
~~B4~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,21~~	~~1~~
B5	3,5,6,7,8,10,11,13,15,18,	3,5,6,7,8,10,13,15,18,19,20	3,5,6,7,8,10, ,13,15,18,	
~~B6~~	~~3,5,6,7,8,10,15,21~~	~~3,5,6,7,8,10,11,13,15,18,19,20,21~~	~~3,5,6,7,8,10,15,21~~	~~2~~
B7	3,5,7,8,10,11,13	3,5,7,8,10,11,13,18,19,	3,5,7,8,10,11,13	3
B8	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3
~~B9~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1~~
B10	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3
B11	3,7,8,10,11,13,18	3,5,7,8,10,11,13,18,19,20	3,7,8,10,11,13,18	3
~~B12~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,21~~	~~1~~
B13	3,5,7,8,10,11,13,18,19,20	,5,7,8,10,11,13,18,19,20	,5,7,8,10,11,13,18,19,20	
~~B14~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1~~
~~B15~~	~~3,6,15,21~~	~~3,5,6,7,8,10,11,13,15,18,19,20,21~~	~~3,6,15,21~~	~~2~~
~~B16~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1~~
~~B17~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1~~
B18	3,5,7,8,10,11,13,18,19,20	,5,8,10,11,13,18,19,20	,5,8,10,11,13,18,19,20	
B19	3,5,7,8,10,11,13,18,19,20	3,8,10,13,18,19,20	3,8,10,13,18,19,20	
B20	3,5,8,10,11,13,18,19,20	,8,10,13,18,19,20	,8,10,13,18,19,20	
~~B21~~	~~3,5,6,7,8,10,11, ,15,18 ,20,21~~	~~3,5,6,7,8,10,11,13,15,18,19,20,21~~	~~3,5,6,7,8,10,11, ,15,18 ,20,21~~	~~2~~

Table 3-7: Sample of Levels of Barriers – 4th &5th Iteration

	Reachability Set	Antecedent Set	Intersection Set	Level
B1	1,2,4,5,8,9,10,11,12,14,15,16,17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1,2,4,5,8,9,10,11,12,14,15,16,17	1
B2	1,2,3,4,5,8,9,10,12,14,16,17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	1,2,3,4,5,8,9,10,12,14,16,17	1
B4	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17,19,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,1 9,21	1
B9	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,1 8,19,20,21	1
B12	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16, 17,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,2 1	1
B14	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17,18,19,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,1 8,19,21	1
B16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17,18,19,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,1 8,19,21	1
B17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,1 8,19,20,21	1
B21	3,5,6,7,8,10,11, ,15,18 ,20,21	3,5,6,7,8,10,11,13,15,18,19,20,21	3,5,6,7,8,10,11, ,15,18 ,20,21	2
B6	3,5,6,7,8,10,15,21	3,5,6,7,8,10,11,13,15,18,19,20,21	3,5,6,7,8,10,15,21	2
B15	3,6 ,15 ,21	3,5,6,7,8,10,11,13,15,18,19,20,21	3,6 ,15 ,21	2
B3	3,5,7,8,10,11, , ,19,	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11, , ,19,	3
B7	3,5,7,8,10,11,13	3,5,7,8,10,11,13,18,19,	3,5,7,8,10,11,13	3
B8	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3
B10	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3
B11	3,7,8,10,11,13,18	3,5,7,8,10,11,13,18,19,20	3,7,8,10,11,13,18	3
B5	5,13,18	5,13,18,.19.20	5,13,18	4
B13	5,13,18,19,20	5,13,18,19,20	5,13,18,20	4
B18	5,13,18,19,20	5,13,18,19,20	5,13,18,19,20	4
B19	19,20	19,20	19,20	5
B20	19,20	19,20	19,20	5

The following step was to draw the directed digraph and build the ISM-base model. The directed digraph is based on level partitioning in Table 3-7 and the four symbols (V,O,A,X) in the SSIM. V stands for relation directed from B1 to B2, A is for relation directed from B2 to B1, X represents relation directed to both directions, and O for no relation. Then the digraph was converted to ISM and is shown in Figure 3-7 below.

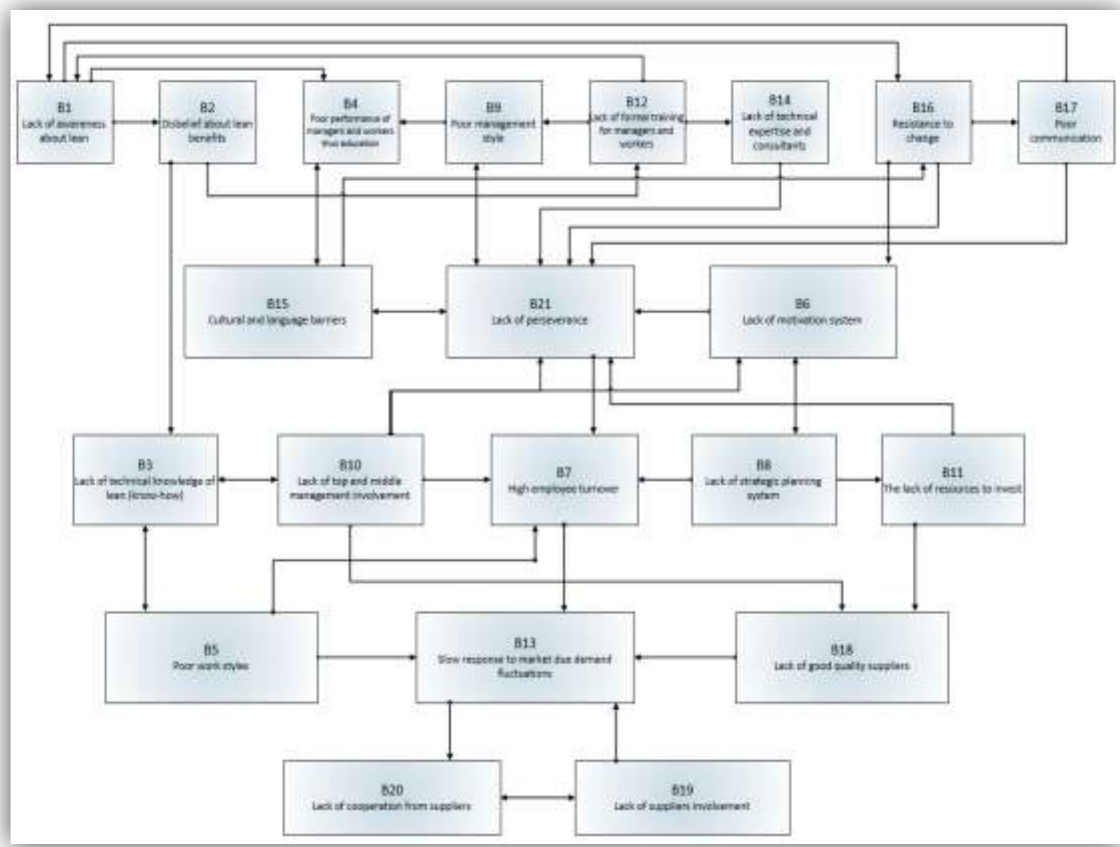

Figure 3-7: Sample of Proposed ISM for Developing Countries

The last part of the ISM is the classification of factors using MICMAC[8] analysis which provides a systematic analysis for complex issues. This step classifies the tested elements based on their driver and dependence power that were calculated in the final reachability matrix, into one of the four categories (clusters). Table 3-8 demonstrates the four clusters for MICMAC analysis (Alidrisi, 2014; Hashmi, 2015; Talib & Rahman, 2015; Tiwari, 2013).

Table 3-8: Description of Four Clusters of MICMAC Analysis

Category	Description
Independent variables	Strong driving power associated with weak dependence power. It is also called drivers or key factors.
Dependent variables	Strong dependence power associated with weak driving power.
Linkage variables	Strong dependence and driving power. Unstable if any action on these factors taken; it will have an effect on others and also a feedback effect on itself.
Autonomous variables	Weak dependence and driving power. Relatively disengaged from the system but has few links, which may be very strong.

[8] MICMAC (Matrice d'Impacts Croises-Multiplication Appliqúe An Classment), is also called (Cross-Impact Matrix Multiplication Applied to Classification)

3.8 Data Collection and Analysis Plan

This part is to apply the previous approaches that included lean assessment and barrier analysis. In addition, is covers the general questions of the interview regarding lean transformation in developing countries, particularly the case studies of Saudi Arabian companies. The following procedures in Figure 3-8 were the major steps for data collection and analysis.

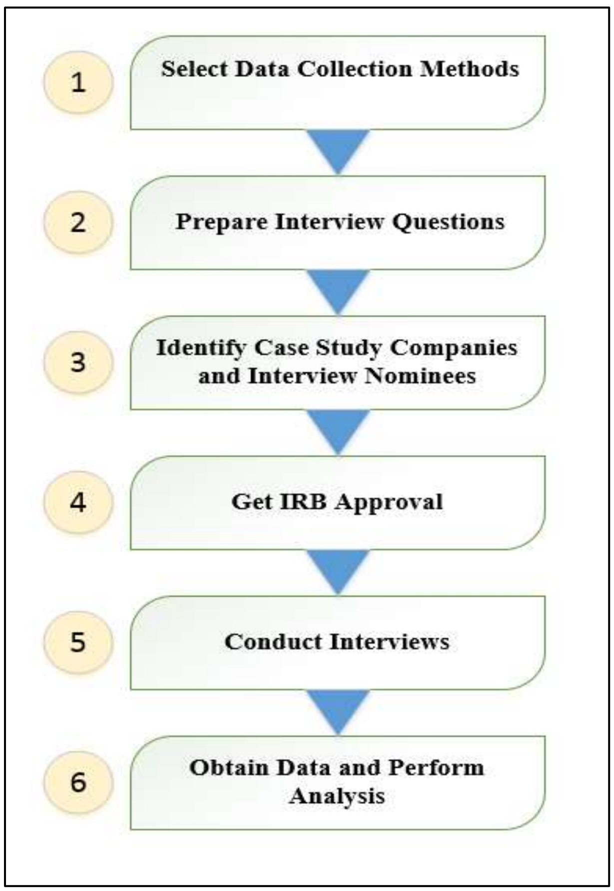

Figure 3-8: Data Collection and Analysis Plan Diagram

3.8.1. Data Collection Methods

Data collection was in the form of interviews as a primary data collection method, and documentations as a secondary data collection method. For interviews, there are three different forms of interviews: unstructured, structured, and semi-structured. In this research, the semi-structured type, which is a combination of the structured and unstructured interviews, was approached. In this type of interview, the interviewer arranges a set of identical questions to be answered by all interviewees. However, additional questions may be asked throughout the interviews to clarify or expand specific concerns (Connaway & Powell, 2010; Dudovskiy, 2015). The interview method was selected due to the small number of informants, the need for detailed information about case studies, direct control over the flow of primary data collection process, to have a chance to recognize specific concerns during the interviews, and to investigate experiences and feelings rather than obtaining more straightforward, factual answers (Denscombe, 2007; Dudovskiy, 2015).

The documents include all reliable data available for each case study and according to Dudovskiy (2015), the "secondary data is a type of data that has already been published in books, newspapers, magazines, journals, online portals etc." (p. 23). In this regard, triangulation methodology was also applied in this research. Triangulation is obtaining more than one method for data collection, such as interviews and documentation which were used in this study (Creswell, 2009; Denscombe, 2007).

3.8.2. Interview Questions

The interview questions were developed based on the literature review and the preliminary interviews with lean professionals in Saudi Arabia, such as consultants and Kaizen and lean system coaches. Then, the first version of the interview questions was reviewed by a panel of subject-matter experts. As a proposal for this study was presented in the 2016 *International Conference on Industry, Engineering, and Management Systems*[9], both the feedback provided by audience professionals as well as comments delivered by the academic advisor and committee members were considered for validation of the questions prior developing the final version of the interview questions.

The interview questions consisted of three parts: general questions about lean transformation in developing countries, questions regarding lean assessment, and questions related to the barrier analysis using ISM. Figures 3-9, 3-10, 3-11, and 3-12 illustrate the three parts of the interview questions.

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[9] IESM conference was March 14-16, 2016 at Cocoa Beach, Florida, USA. Presentation Title *" A Framework for Sustainable Lean Transformation in the Developing Countries"*

A Framework for Lean Transformation in Developing Countries: The Case of Saudi Arabian Industry

Interview Questions

<u>General questions:</u>

1. Do you think organizations in Saudi Arabia are familiar with lean?
2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?
3. How long would you say it took to have a reasonable level of lean implementation in your company?
4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

Figure 3-9: General Questions about Lean Transformation in Developing Countries

Questions for Assessment:

Does your company… (measure)? and for how long?

Measure	Y/N	Duration
Drive lean implementation from the top down.		
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.		
Implement lean in both manufacturing and non-manufacturing areas.		
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers.		
Dedicate full-time resources to lean improvement.		
Seek to provide regular communications on lean throughout the organization.		
Adopt HR policies that support lean goals.		
Invest in training for employees to learn about lean.		
See the value in developing internal lean leaders and Senseis.		
Utilize value stream mapping to identify and drive improvement opportunities.		
Utilize standard work as the baseline for continuous improvement.		
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies.		
Use the Voice of the Customer (VOC) as a driver of improvements.		
Utilize kaizen at a regular cadence to drive continuous improvement.		
Utilize appropriate metrics and visual management to drive lean improvements.		
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture.		
Recognize that developing a lean culture is a lengthy process and that lean is never-ending.		

Figure 3-10: Questions Regarding Lean Assessment.

Questions for Barrier Analysis:

Below are list of barriers that identified from the literature review and a form to prioritize these barriers. Please read the barriers and fill out the form?

B1	Lack of awareness about lean
B2	Disbelief about lean benefits
B3	Lack of technical knowledge of lean (know-how)
B4	Poor performance of managers and workers thus education
B5	Poor work styles
B6	Lack of motivation system
B7	High employee turnover
B8	Lack of strategic planning system
B9	Poor management style
B10	Lack of top and middle management involvement
B11	The lack of resources to invest
B12	Lack of formal training for managers and workers
B13	Slow response to market due demand fluctuations
B14	Lack of technical expertise and consultants
B15	Cultural and language barriers
B16	Resistance to change
B17	Poor communication
B18	Lack of good quality suppliers
B19	Lack of suppliers involvement
B20	Lack of cooperation from suppliers
B21	Lack of perseverance

Figure 3-11: Questions for Barrier Analysis Using ISM (Part 1)

Please use from the following four symbols to denote the direction of relationship between the barriers:

- V: for the relation from barrier (1) to barrier (2) (i.e., B1 will influence factor B2)
- A: for the relation from barrier (2) to barrier (1) (i.e., B2 will influence factor B1)
- X: for both direction relations (i.e., B1 and B2 will influence each other)
- O: for no relation between the barriers (i.e., B1 and B2 are unrelated).

	B21	B20	B19	B18	B17	B16	B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1
B1																					
B2																					
B3																					
B4																					
B5																					
B6																					
B7																					
B8																					
B9																					
B10																					
B11																					
B12																					
B13																					
B14																					
B15																					
B16																					
B17																					
B18																					
B19																					
B20																					
B21																					

Figure 3-12: Questions for Barrier Analysis Using ISM (Part 2)

3.8.3. Case Study Companies and Interview Nominees

Denscombe (2007) states that “one of the strengths of the case study approach is that it allows the researcher to use a variety of sources, a variety of types of data and a variety of research methods as part of the investigation” (p. 54). Yin (2013) maintains that “case studies are the preferred method when (a) "how" or "why" questions are being posed, (b) the investigator has little control over events, and (c) the focus is on a contemporary phenomenon within a real-life context” (p. 1). Based on its design, case study research method consists of three categories: explanatory, descriptive, and exploratory. These categories were considered for the case studies of Saudi Arabian companies due to the following justifications that are related to the research questions: exploratory case studies are use to answer “What” questions, explanatory case studies are used to answer “How” questions, and descriptive case studies focus on describing cultures (Dudovskiy, 2015; Yin, 2013).

The objective of using case studies was to uncover evidence that helped to answer the research questions about lean transformation in developing countries. However, it was crucial to measure the quality of the case study design. There are four critical conditions associated with the quality of designing case study as it is shown in Table 3-9 below (Rowley, 2002; Yin, 2013).

Table 3-9: Conditions of Quality of a Case Study Design

Conditions	Description	Tactics
Construct validity	Defining a sufficient operational set of measures for the research	• perform multiple sources of evidence • review draft report of the case study by interviewees
Internal validity	Forming proper causal relationships when the data analysis part of the case study is performed	• perform pattern matching; • perform explanation building; • identify rival explanations; • use logic models
External validity	Identifying the domain to which a study's findings can be generalized	• use theory in single-case studies • use replication logic in multiple-case studies
Reliability	Investigating that methodology of the case study can be repeated by a different researcher and get the same results	• use a case study protocol • advance a case study database

The desired portion related to the case study was interviewing experts on lean in developing countries using the Saudi Arabian industry as a case study. The selection of expert interviewees was according to different criteria for the companies and the interviewees. For instance, Yin (2013) stated one tips for case selection is that:

> You need sufficient access to, the potential data, whether to interview people, review documents or records, or make-field observations. Given such access to more than a single candidate case, you should choose the case(s) that will most likely illuminate your research questions (p. 26)

The following criteria were considered when selecting case study companies and interviewees:

a) Companies criteria:

- *High reputation in adopting lean*

  Since this research intends to investigate the lean transformation level and the literature review indicated that many companies in developing countries are unfamiliar with lean, it is essential to target the companies which are known for lean adoption. Networking, news, articles, and quality awards were used to choose companies that fulfill this criterion.

- *ISO Certified*

  Since there is an absence of a database of companies that have implemented lean and to avoid selecting companies that do not have a quality system, ISO certification was one of the criteria.

- *Willing to provide data*

  This criterion is important because some companies would prevent any key personnel from being interviewed. Some companies were contacted and provided with a consent form which includes a summary of the research and Institutional Review Board (IRB) approval; but they refused to participate in the study.

b) Interview nominees criteria:

- *Key personnel who are currently in their position, were previously employed or consulted*

  This standard helps to obtain the right person for the interview. Some companies provided candidates who were previously employed to fulfill the following criterion because the candidate was retired, for example.

- *Leader or champion in adopting lean*

  To be more specific and get reliable data, it is crucial to interview one of the leaders who is/was responsible for lean transformation. In addition, this type of candidate has a better awareness of lean terms and techniques, which make the interview more efficient.

- *Minimum of 5 years' experience*

  Experienced candidates have a diversity of skills and a better level knowledge that allows them to provide solid opinions. Furthermore, it is important to have experienced candidates because they were involved in lean implementation and witnessed some or all milestones of the journey.

- *Availability and access to the data*

  According to Yin (2013), it is crucial for selecting candidates for the interview that they have a sufficient access to the potential data. Another important standard is the time availability for the candidates to participate. In some cases, nominees for the interview have refused to participate due to the time constraints, and some showed readiness even though they did not have an appropriate level of commitment to participate in the interview.

3.8.4. Institutional Review Board (IRB)

Once final preparation of the interview questions was completed and the plan to contact the targeted companies was ready, approval from the Institutional Review Board (IRB) was sought. The IRB "consists of a committee established to advocate for the protection of the rights and welfare of human participants involved in research"[10] (para. 1).

A proposal of the research was completed via the Human Research Protocol & Instructions template in addition to other documents, such as the Recruitment Invitation Transcript, the supportive letter from an organization that would be responsible for the researcher, and a Summary Explanation for Exempt Research. These forms were then submitted to the IRB for review and approval. A copy of the IRB approval letter is attached in Appendix B, the Summary Explanation for Exempt Research in Appendix C, and the supportive letter from University of Jeddah in Appendix D.

[10] http://www.research.ucf.edu/Compliance/IRB/About/index.html

3.8.5. Conducting Interviews

The interviews were conducted in English with individual key personnel who were 18 years of age or older and were currently in their position/previously employed at the case study companies in Saudi Arabia, or who acted in a consulting capacity for them. The following procedures were used to conduct the interviews:

1. Contacted key personnel in a top management level, such as a CEO, via a phone call to get permission and obtain the candidates' names and contact information in order to conduct the interview. In some cases, more than one candidate was identified.
2. Provided via email the consent form (Summary Explanation for Exempt Research), the letter of support, and the interview questions, if requested.
3. Each interview was set for one hour and was conducted via Skype or phone.

3.8.6. Data Analysis Plan

This section describes the procedures for analysis of the obtained data, taking in consideration the four critical conditions mentioned in Section 3.8.4, which were associated with the quality of designing the case study. Data were obtained from interviewing key personnel in 10 local and eight multinational Saudi Arabian companies, and also from supported documents related to each case. Accordingly, an analysis was performed on each part of the interview questions for each company, and then for all companies per category. This means that each multinational company was examined and then all multinational companies together were tested. The following procedures were performed for the data analysis of multinational and local Saudi Arabian companies:

a) Analysis for the general questions section:

1. Develop a database for each question
2. Summarize the responses of each company
3. Compare data using pattern matching
4. Perform explanation building
5. Summarize findings, and
6. Drive conclusion

b) Analysis for the lean assessment section: (*detailed steps were previously explained in Section 3.6)*

1. Enter the data of each company into the adopted lean assessment model
2. Compare data using pattern matching
3. Perform explanation building
4. Perform statistical analysis
5. Summarize findings, and
6. Drive conclusion

c) Analysis for barriers analysis using ISM section: (*detailed steps were previously explained in Section 3.7)*

1. Utilize database for responses of the Structural Self-Interaction Matrix (SSIM)
2. Combine responses of all multinational companies and all local companies and develop one SSIM for each category.
3. Build the ISM for each category
4. Compare data using pattern matching
5. Perform explanation building
6. Summarize findings, and
7. Drive conclusion

3.9 Framework Development

The framework was developed by conducting a thorough literature review analysis and interviewing key personnel in 10 local and eight multinational Saudi Arabian companies. The framework reacted to general data about lean transformation in developing countries, assessed a lean transformation level, and constructed barriers to Interpretive Structure Molding (ISM) in achieving a successful lean transformation. Description of the framework components are discussed in Chapter 5.

3.10 Framework Validation

The first of four key measures in designing the case study mentioned in Section 3.8.4 is construct validity, which includes performing multiple sources of evidence and a review draft report of the case study by interviewees (Yin, 2013). Accordingly, a validation of the framework was completed through multiple case study analysis of 10 local and eight multinational Saudi Arabian companies. In addition, a subject-matter expert was recruited to validate the assessment, ISM, and the proposed framework. In addition, examining supporting documents that were provided by the case study companies was another step in the validation process.

The interview candidates from the case study companies were selected as experts for validation. Two experts from the multinational companies and two from the local companies were involved. Each expert was provided a draft report of his company, the overall findings of lean assessment, ISM for barriers, and the proposed framework. Furthermore, he was provided a validation form as shown below in Figure 3-13.

Validation Form

- Company:
- Position:
- Lean Role:
- Work Experience:

Lean Transformation Level

Category	Feedback	Corrective Action
Lean Transformation Level at your company		
Overall all Lean Transformation Level Multinational Companies		
Overall all Lean Transformation Level Local Companies		

Barriers Analysis

Category	Feedback	Corrective Action
Barriers List		
ISM for multinational companies		
ISM for local companies		

Framework for Lean Transformation

Category	Feedback	Corrective Action
Framework Components		
Phase 0 (Foundation)		
Phase I		
Phase II		
Phase III (Excellence)		
Duration for multinational		
Duration for local		

Figure 3-13: Expert Feedback Form for Validation

In addition, two experts in ISM were contacted in order to validate the steps and the ISM-base models for the multinational and local companies. The criteria of selecting experts for the ISM validation were:

- Works in the academic field

- ➢ Has at least two publications in the subject of ISM
- ➢ Willing and available to participate

Each expert was provided a report that included the entire procedure for developing ISM and validation for as shown in Figure 3-14.

Validation Feedback Form

- **Institute:**
- **Position:**
- **Recent Publications:**

Barriers Identification and Analysis (ISM)

Category	Feedback	Corrective Action
Barriers Contents		
Structural Self-Interaction Matrix		
Initial Reachability Matrix		
Final Reachability Matrix		
Level Partitions		
ISM for multinational companies		
ISM for local companies		

Figure 3-14: Expert Feedback form for ISM Validation

3.11 Conclusion and Future Research

This part included a summary of all case study findings as well as final conclusions and recommendations based on the framework for lean transformation in developing countries. In addition, some potential ideas for future research related to lean transformation in developing countries were recommended.

CHAPTER 4 DATA COLLECTION AND ANALYSIS

4.1 Introduction

The data collection and analysis chapter considers the outcomes of the interview data collection and analysis related to the general information about lean transformation in developing countries, lean assessment, and barriers analysis using ISM for the case study companies. The nominated companies included eight multinational and ten local Saudi Arabian companies. Moreover, it reviews the supported documents data collection and analysis for each case study.

Non-probability snowball sampling and expert sampling techniques were approached. Snowball sampling is to choose candidates who fulfill the requirements for the research, and who are able to suggest other candidates with the level of knowledge or even better. Snowball sampling is mostly practical when the study is struggling to reach populations that are unobtainable or a difficult to find, or when it involves studying relationships among mutual population members. Expert sampling gathers data from a sample of individuals who have an eligible level of knowledge and proficiency in some area (Gu, Hu, & Liu, 2000; Marcus, Weigelt, Hergert, Gurt, & Gelléri, 2016; Trochim, 2001). Furthermore, a pattern-matching technique was used in the analysis to compare the outcomes of the companies. Yin (2013) states that pattern-matching technique is used to compare "an empirically based pattern with a predicted one or with several alternative predictions… If the empirical and predicted patterns appear to be similar, the results can help a case study to strengthen its internal validity" (p.143).

In the data collection and analysis, some assumptions were considered. These assumptions include that the six categories (culture, deployment, engagement, drivers, training, process) used in the lean assessment have an equivalent importance or weight. In addition, there are a wide variety of types of companies in Saudi Arabia, for example: pure manufacturing companies, pure service companies, private companies, companies that owned totally or partially by government, etc. A delimitation method, which identifies the boundaries and scope of the study, was approached. It was assumed that all case-study Saudi Arabian companies are from the private sector and offer manufacturing and services areas.

4.2 Data collection and analysis for Multinational Companies

This section contains detail descriptions of interviews and supported documented information for each company. However, the barrier analysis using ISM is described in two groups: ISM-base model for the entire multinational companies and ISM-base model for the entire local companies.

4.2.1. Toyota Saudi Arabia (Part of Abdul Latif Jameel Group)

1. Company Background:

Abdul Latif Jameel was established in 1945, and currently has operations in over 30 countries employing approximately 17,500 people from more than 40 nationalities. The company's core values include respect, improvement, pioneering, and empowering. These values are very supportive to TPS and it helps to have a sufficient leadership whose focus is to sustain lean transformation at the company. Toyota Saudi Arabia has achieved ISO 9001:2008 certification for best practice standards.

2. Interviewee Background:

With his MBA in Executive Leadership and engineering background, he developed strategic plans in embedding the Kaizen culture across the ALJ organization. He had several Kaizen accomplishments and attained more than a $70,000 cost savings in his division alone. He has had the opportunity to work in Japan at the head company Toyota Motor Corporation; accordingly, he gained valuable experience that helped him in transferring the knowledge to his ALJ associates. He created the ALJ's warehouse manual, which lead to a $4 million cost savings for the company. He participates as a sensei for ALJ's executives and middle management in Hoshin Kanri (Policy Deployment), Toyota Business Practices program, and in its on-the-job development program.

3. General Questions Responses:

<u>1. Do you think organizations in Saudi Arabia are familiar with lean?</u>

"I think companies in Saudi Arabia and other developing countries are not yet familiar with lean. Honestly speaking lean implementation level is weak. However, the case is different in very specific cases such as in Toyota, Abdul Latif Jameel because the concept of lean was initiated in Toyota as what it called by Toyota Production System."

Then, he was asked to give a percentage for lean implementation level in Saudi Arabian local and multinational companies, he responded:

"Not including Toyota, in my own opinion in multinational companies it is maybe around 50% and in local companies it is less than 30%"

<u>2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?</u>

"The most obvious factor is top management believe which can influence the transformation of lean in any company to achieve significant results and sustain for longer time. An example of this in Toyota when I was in one of the training program in Japan I have noticed that every two month the warehouse have different improvements and this because management of Toyota is very supportive to continuous improvement. Also, the factors that shown below in the assessment can play important role to make the transformation successful. For example, Kaizen, Hoshin Kanri and training which are utilized in our Toyota way culture".

<u>3. How long would you say it took to have a reasonable level of lean implementation in your company?</u>

"It depends if we consider small size companies which have less the 50 employees, reasonable level of lean would be reached between 3-6 months. In mid-size companies which have 50 to 300 employees, it would take 2 years. In companies that have more than 300 employees, it would attained in 5 years"

<u>4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?</u>

"Organizations are not very interested in lean when they have high demand and making good profit or lean contribution would not be appearing. However, companies would ask for lean during their rescission. Nowadays, companies in Saudi Arabia must implement lean because of the impact of oil price change. In addition, companies should be aware of the Saudi Arabia's Vision 2030. One of the vision 2030 goals is the National Transformation Program 2020 which includes fiscal balance program and performance measurement program."

4. Lean Transformation Level at Toyota Saudi Arabia:

Table 4-1 shows the responses regarding lean assessment at Toyota Saudi Arabia. The interviewee was asked to provide examples for each measure that is implemented in his company. For Toyota Saudi Arabia, the investigator was invited to visit the head center of the company and attend short presentation about Toyota Global Contents, which included details about TPS that been deployed in their departments. As a result, the company has attained a perfect level of lean transformation, as shown below. Table 4-2 and Figure 4-1 show that Toyota Saudi Arabia has level of implementation of 90% in most of the lean transformation categories, except in deployment and engagement; this level is at 75%.

Table 4-1: Interview Responses for Lean Assessment at Toyota Saudi Arabia

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	

Table 4-2: Scores Summary for Lean Transformation at Toyota Saudi Arabia

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	9	2	4.50	90%
Deployment	15	4	3.75	75%
Engagement	11	3	3.67	73%
Training	9	2	4.50	90%
Processes	13	3	4.33	87%
Drivers	14	3	4.67	93%

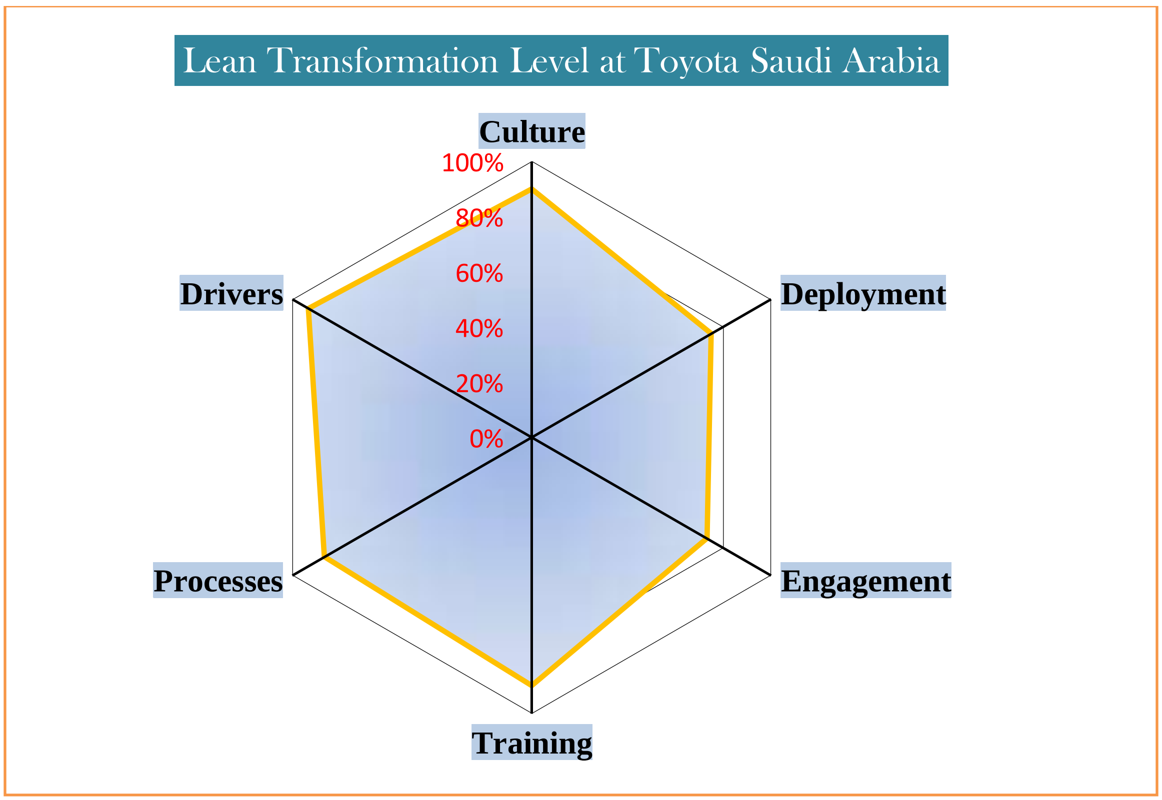


Figure 4-1: Lean Transformation Level at Toyota Saudi Arabia

5. Supported Documents:

The investigator asked for supported examples to be documented and to explain how the above measures in the assessment were accomplished. The only provided examples for Toyota Saudi Arabia include Toyota Global Contents, which is shown in Figure 4-2 and Toyota Way Culture and Mindset at ALJ, which is shown in Figure 4-3. These two figures are evident for the level of lean transformation at Toyota Saudi Arabia.

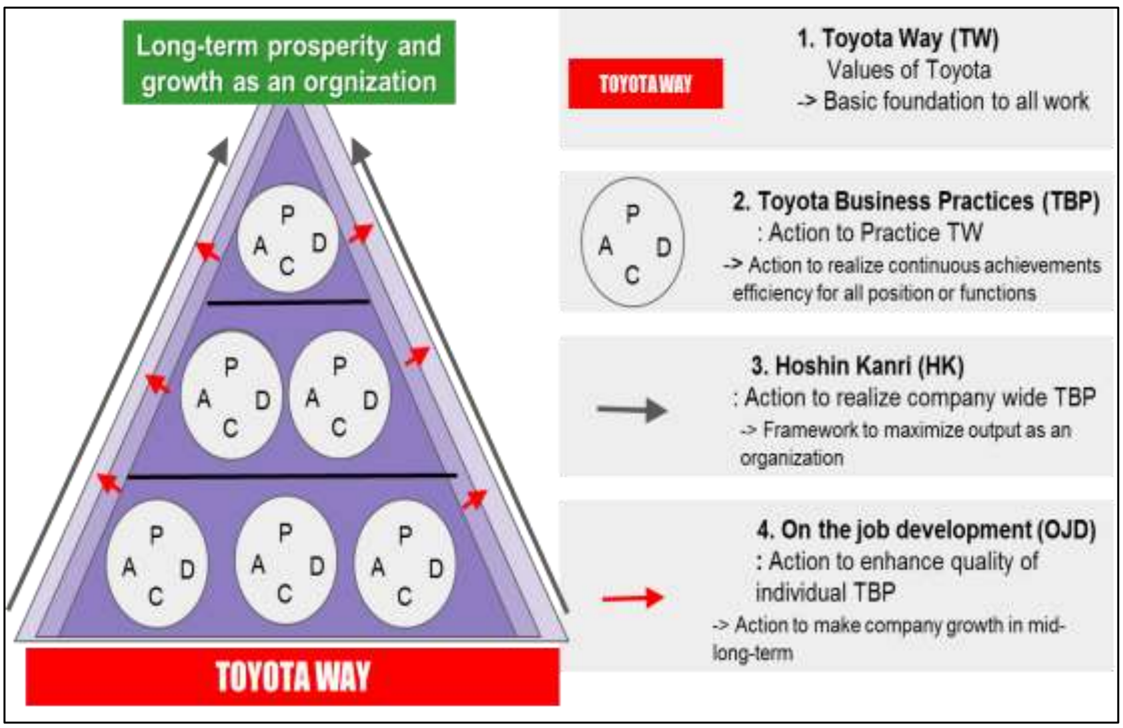


Figure 4-2: Toyota Global Contents

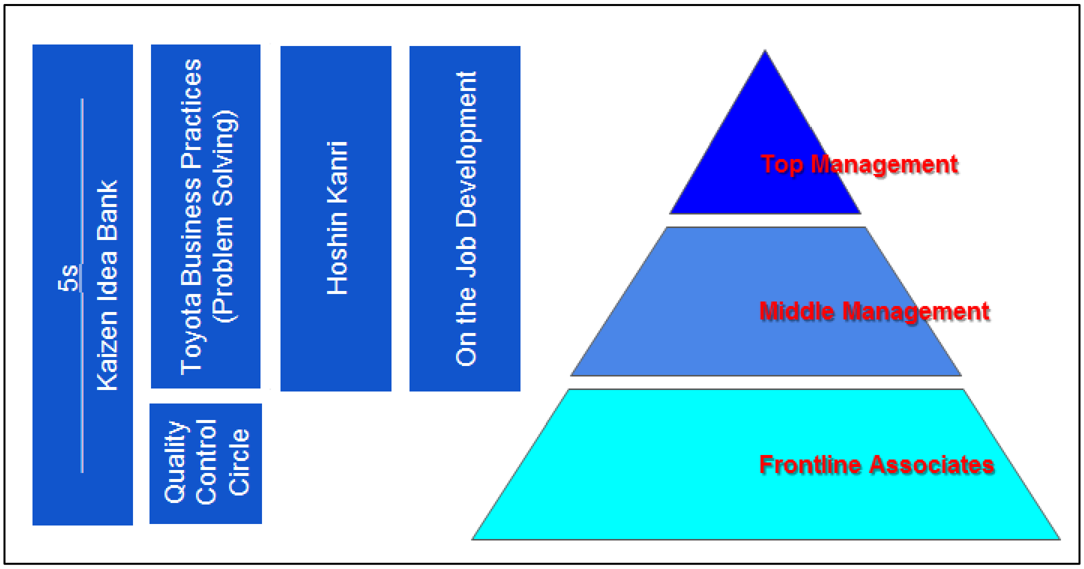


Figure 4-3: Toyota Way Culture and Mindset at ALJ

6. References:

- http://www.alj.com/en/about-us
- https://www.linkedin.com/company-beta/17866/
- http://vision2030.gov.sa/en/ntp
- http://www.alj.com/en/businesses/automotive/expanded-vehicle-services

4.2.2. Procter & Gamble

1. Company Background:

Procter & Gamble (P & G) was started in Saudi Arabia in 1961 with a Tide plant, which was called Modern Industries Company. It was then expanded to a total of four plants in Saudi Arabia. The numbers show that P&G has 65 leadership brands, employees from 150 different nationalities, operations in 70 countries, provide 10 billion liters of clean water, and sells its product in more than 180 countries and territories. P&G Saudi Arabia is following all ISO and Saudi FDA requirements such as it has obtained ISO 14001.

P&G values include integrity, leadership, ownership, passion for winning, and trust. The company principles covers show respect for all individuals, the interests of the company and the individual are insuperable, strategically focused in work, innovation is the cornerstone of the success, seek to be the best, externally focused by understanding consumers and their needs, and mutual interdependency is a way of life for the company.

2. Interviewee Background:

A senior manager with nine years of manufacturing experience in one of the most prestigious FMCG companies, Procter & Gamble. With a strong technical & academic background, he has competitive analytical capabilities and unique problem-solving approaches. He is known as a results-oriented leader with effective organizational skills. He is also known as a passionate leader who builds up his own capabilities by moving out his comfort zones.

3. General Questions Responses:

1. Do you think organizations in Saudi Arabia are familiar with lean?

"The terminology of lean is not known by many people including multinational companies. Multinational companies have the methodology but with different names. They might do some practices that related to lean but they don't know if these called lean. In general, only less than 10% of Saudi Arabian companies are familiar with lean"

Then, he was asked is this percentage for local and multinational companies, he responded:

"I would say it is for local companies and for multinational companies I would say it is between 20- 30%"

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

"The first factor is to educate your employee about the concepts of (Power of Zero which is to make the employee to believe that the loss can be dropped to zero, or is to have zero loss mentality) and (Power of 100 which is to have 100% of your employee participate, engaged, and capable to achieve good results in implementing lean). For example, in a large size companies that have non-manufacturing departments such as supply chain, marketing, sales if you wouldn't have these department 100% involve in lean transformation you will not have a successful transformation to lean. The second factor is to build the culture of loss identification and quantification capabilities. Employees should be trained on how to find loss in the company's processes and operations. In addition, they have to be capable to measure the improvement that done to get rid of the identified loss. They should know how to use before and after measurement tools. Third factor in my opinion is coaching. Don't expect from your employee if they take training classes today they can do the job tomorrow. Also, I had seen this in the next part of the interview about the senseis which is to have a coach. For example, coach can help to drive lean from top down. In fact, coaching is one of the main critical factors once the employees take the theoretical knowledge it is important to participate with them on the floor. Additionally, coaching is a good method to confirm that the theoretical knowledges are transferred to execution level. The previous factors are not enough unless we add a forth factor to them and that is to have a regular review techniques. You have to have specific milestones daily, monthly, quarterly to review your lean program. This factor is related to the second factor that is loss identification and quantification capabilities because you cannot do a good job here if you don't have these capabilities. Indeed, all factors have strongly linked to each other you cannot do one of them alone. The fifth factor for this question is investment in technical capabilities. In my personal opinion companies in Saudi Arabia are far away from this factor and this is killing me."

<u>3. How long would you say it took to have a reasonable level of lean implementation in your company?</u>

"There is no specific answer it could take from one to two years or maybe from 9-10 years; all it depends about the critical success factors mentioned in the previous question. If you have the ability to build and sustain these factors; for example, you invest in technical capabilities for two years and then stopped so you didn't sustain this factor.

Certainly, this will affect the duration of the transformation; so, don't expect you will get result in the same time frame. Let tell you an example about P&G Saudi Arabia. We have system for lean implementation called Integrated Work System (IWS) which is similar to TPS in Toyota and it was started in the 90's. IWS consist of 4 phases P&G Saudi Arabia was the fastest branch in allover P&G branches in the world that completed the first phase within less than two years. However, same branch with the same majority of people took longer time to move from phase 1 to phase 2 around 9 years. This indicates that there is no specific number you can say about this question. Another example is in Egypt one of the P&G factories called Six of October. This factory has completed the 4 phases very quickly in comparison to the other factories we have in other countries. The main reason is that they started correctly taking in consideration the five mentioned factors."

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

"As I said in personal opinion, I would like to add another factor which is diversity. This factor is very essential. When I started in P&G Saudi Arabia in 2008 there were around 13 nationalities in the factory. We had technicians from USA, Germany, Arteria, Somalia, and other countries that you would be surprised to see good capabilities from these countries. Indeed, there was a very good level of diversity. Diversity that existed included male and female in the company. Again in my opinion diversity of different combinations of backgrounds in education, ages, genders, and positions from different countries is a must to have successful lean transformation. As an example that once the diversity in our factory declined we had a drop in our company."

4. Lean Transformation Level at P&G Saudi Arabia:

Table 4-3 shows the responses regarding lean assessment at P&G Saudi Arabia. The interviewee was asked to provide examples for each measure that is implemented in his company. As result, the company has attained a perfect level of lean transformation as shown below. Table 4-4 and figure 4-4 show that P&G Saudi Arabia has a level of implementation of 100% in culture, process, and training. These highest numbers in culture, process, and training confirm that P&G has a high employee turnover because the company invests on them and they will be sought after by many other companies. However, the company has 53% in the driver's category, 75% in deployment, and 67% in engagement.

Table 4-3: Interview Responses for Lean Assessment at P&G Saudi Arabia

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Adopt HR policies that support lean goals	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Table 4-4: Scores Summary for Lean Transformation at P&G Saudi Arabia

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	10	2	5.00	100%
Deployment	15	4	3.75	75%
Engagement	10	3	3.33	67%
Training	10	2	5.00	100%
Processes	15	3	5.00	100%
Drivers	8	3	2.67	53%

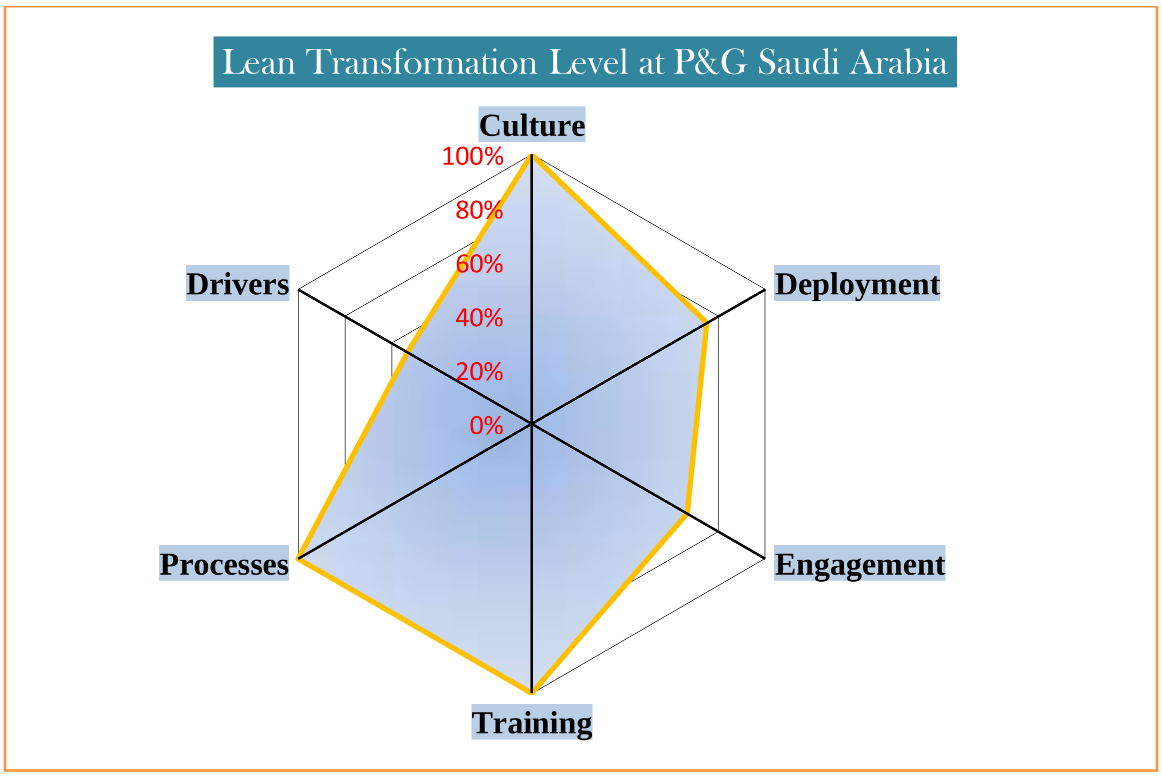


Figure 4-4: Lean Transformation Level at P&G Saudi Arabia

5. Supported Documents:

The figures below are some supported documents that cover portions of the responses for lean transformation assessment at P&G Saudi Arabia. By analyzing these documents and integrating them with responses of the interview, it can be concluded that the company has a successful transformation to lean. Moreover, the written purpose of P&G Saudi Arabia as shown on their website supports that the company deploys VOC to drive the company's improvement. Also, positive values of the company are evident that confirm a perfect lean implementation level that P&G Saudi Arabia has attained.

6. References:

- http://saudiarabia.pgcareers.com/
- http://us.pg.com/who-we-are/our-approach/purpose-values-principles
- https://twitter.com/pgsaudi/media?lang=en

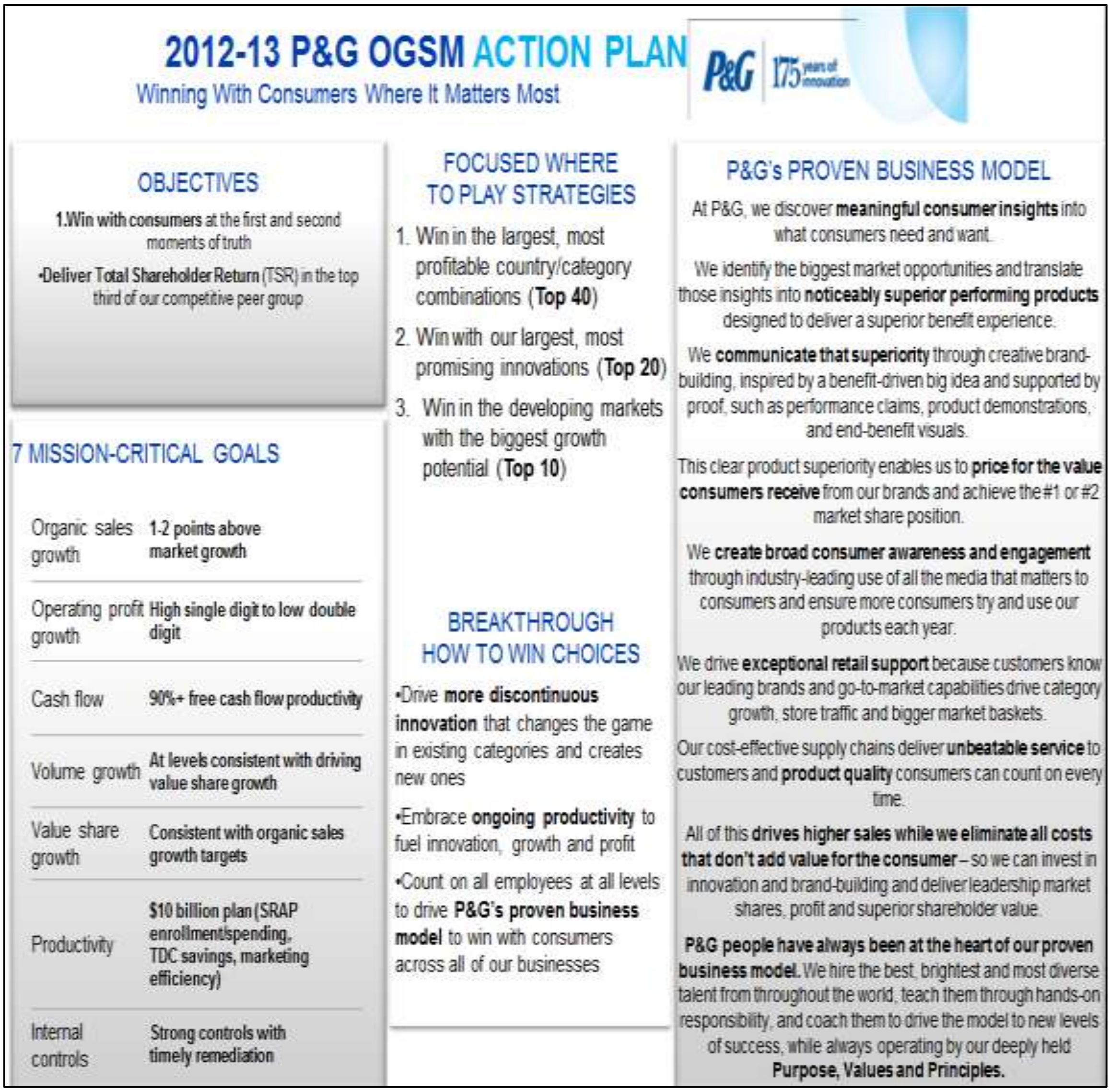


Figure 4-5: Sample of OGSM Action Plan at P&G Saudi Arabia

Figure 4-6: Sample of Product Supply (PS) 2020 Organization Design

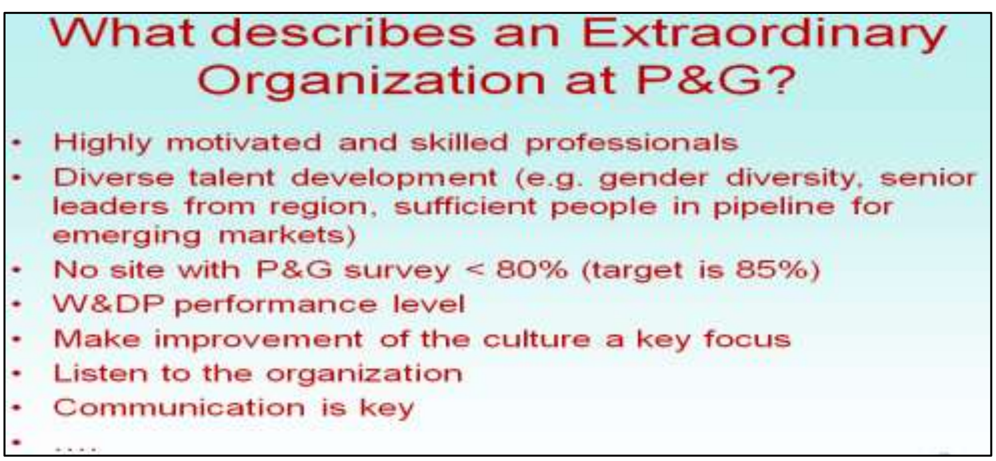


Figure 4-7: Extraordinary Organization - P&G Saudi Arabia

4.2.3. Al Salem Johnson Controls

1. Company Background:

Established in 1991, Al Salem Group of Companies in Saudi Arabia joined arms with YORK's mother company Johnson Controls, a leading multi-industrial company in Saudi Arabia and Lebanon. It is one of the first companies in Saudi Arabia that provides sustainable solutions through products and services that not only optimize energy use, but also improve comfort and security levels. They are the biggest supplier of air conditioners in the region. The company has more than 2,000 employees. Al Salem Johnson Controls is ISO 9001:2015, ISO 14001:2004 and OSHAS 18001 certified. The company values include integrity, employee engagement, sustainability, customer satisfaction, and innovation.

2. Interviewee Background:

The interviewee for this company is certified by the American Society of Quality as a Certified Manager of Quality/Organizational Excellence, and holds a Six Sigma Black Belt. He has more than 14 years of experience in varies fields of Air-Conditioning Equipment, Manufacturing, Team Leadership, Continuous Improvement, and Training Management. He has the capabilities that make him eligible to obtain the Johnson Controls Merit Award for 10-Year Marker Excellence 2014, 3rd Best Idea Award for Idea Generation Competition 2013, Top Performers Award 2011, and the Johnson

Controls Merit Award for Customer Satisfaction and Employee Ingenuity in 2009.

3. General Questions Responses:

The interviewee preferred to respond with written answers to this section of the interview as shown below.

1. Do you think organizations in Saudi Arabia are familiar with lean?

"Yes, but very limited exposure due to insufficient local expertise."

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

"Top Management commitment and incentive programs which are based on solid evidence of Lean deployment results, e.g., annual bonus for managers which depends on their efforts in implementing Lean)."

3. How long would you say it took to have a reasonable level of lean implementation in your company?

"3 years"

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

"Lean deployment is a Top-Down process. It cannot be sustained unless it is supported by stable workforce, preferably local and not expat-dependent."

4. Lean Transformation Level at Al Salem Johnson Controls:

Table 4-5 shows the responses regarding lean assessment at P&G Saudi Arabia. The interviewee was asked to provide examples for each measure that is implemented in his company. As result, the company has attained an average level of lean transformation as shown below. Table 4-6 and figure 4-8 show that Al Salem Johnson Controls has an above-average level of implementation of 70% in training, an average level in drivers 60%, and in culture, 50%. The company is very weak in deployment; it has attained only 25%, which indicates that they need to work more to increase the level of deployment.

Table 4-5: Interview Responses for Lean Assessment at Al Salem Johnson Controls

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Table 4-6: Scores Summary for Lean Transformation at Al Salem Johnson Controls

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	5	2	2.50	50%
Deployment	5	4	1.25	25%
Engagement	7	3	2.33	47%
Training	7	2	3.50	70%
Processes	7	3	2.33	47%
Drivers	9	3	3.00	60%

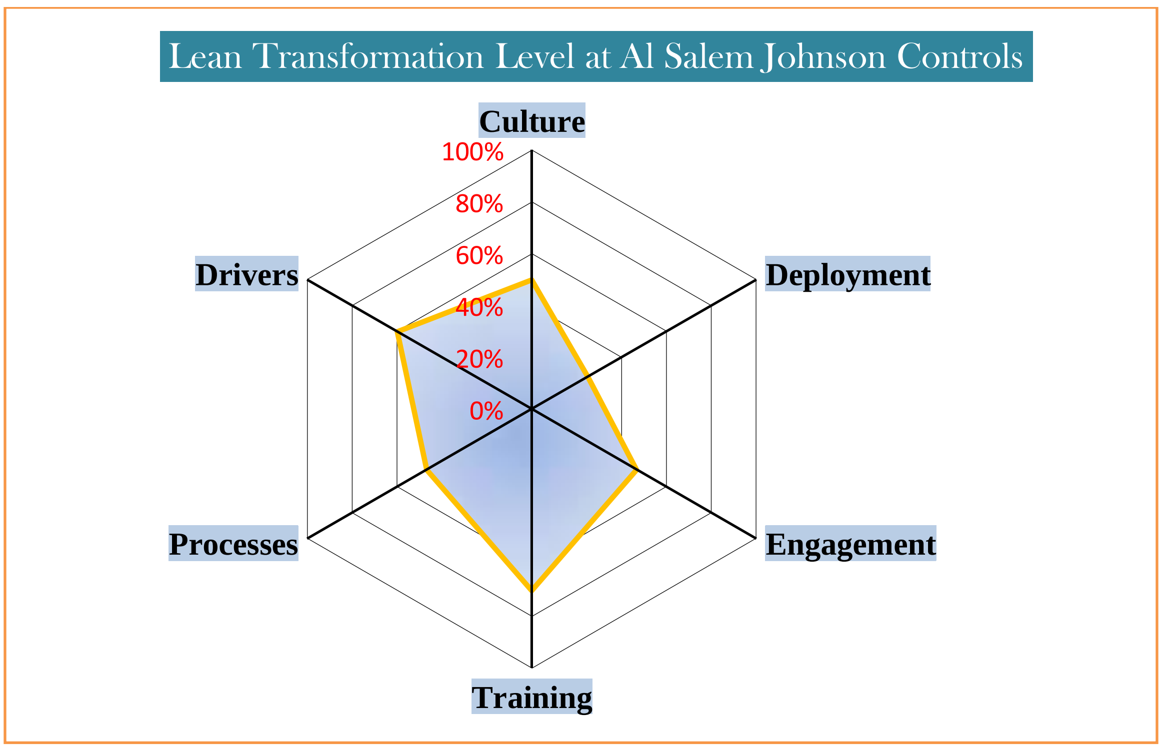
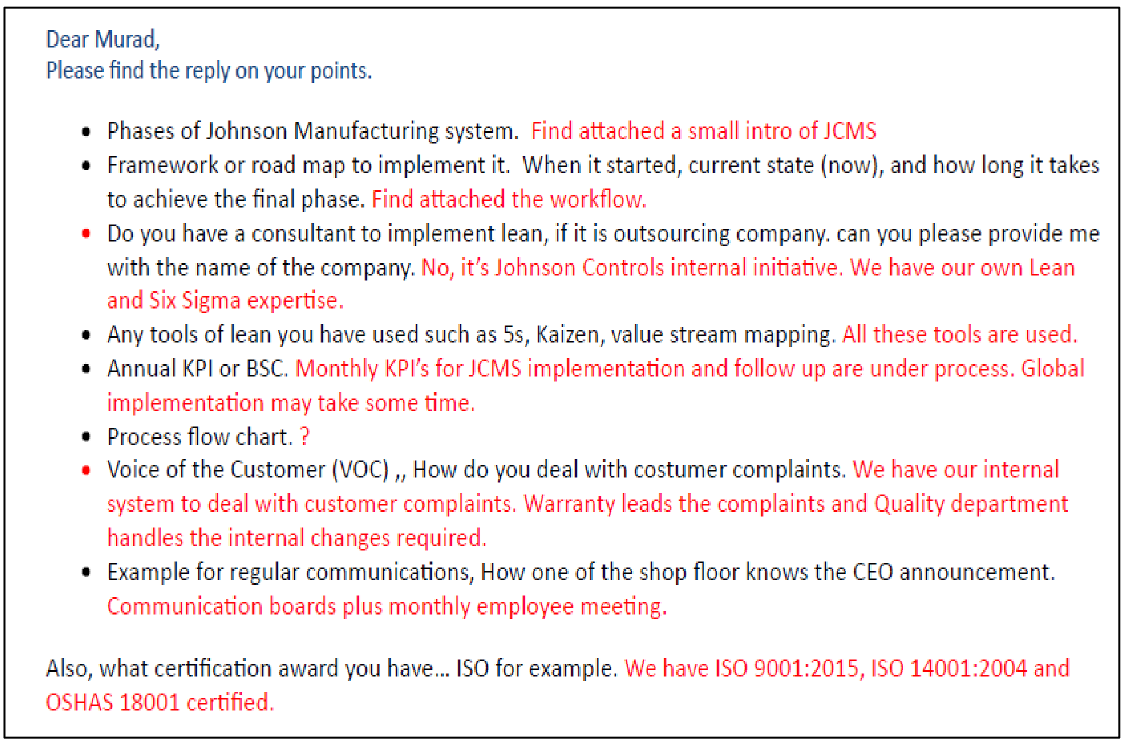


Figure 4-8: Lean Transformation Level at Al Salem Johnson Controls

5. Supported Documents:

The figures below were provided as supported documents of the lean transformation level at Al Salem Johnson Controls. In addition, examples for some lean methods that were applied are shown below. After analyzing these documents, it can be concluded that the company has a good start toward achieving a successful transformation to lean. The only missing part is to consider and involve suppliers. This issue is very critical and might hinder them to attain the desired level.



Dear Murad,
Please find the reply on your points.

- Phases of Johnson Manufacturing system. Find attached a small intro of JCMS
- Framework or road map to implement it. When it started, current state (now), and how long it takes to achieve the final phase. Find attached the workflow.
- Do you have a consultant to implement lean, if it is outsourcing company. can you please provide me with the name of the company. No, it's Johnson Controls internal initiative. We have our own Lean and Six Sigma expertise.
- Any tools of lean you have used such as 5s, Kaizen, value stream mapping. All these tools are used.
- Annual KPI or BSC. Monthly KPI's for JCMS implementation and follow up are under process. Global implementation may take some time.
- Process flow chart. ?
- Voice of the Customer (VOC) ,, How do you deal with costumer complaints. We have our internal system to deal with customer complaints. Warranty leads the complaints and Quality department handles the internal changes required.
- Example for regular communications, How one of the shop floor knows the CEO announcement. Communication boards plus monthly employee meeting.

Also, what certification award you have... ISO for example. We have ISO 9001:2015, ISO 14001:2004 and OSHAS 18001 certified.

Figure 4-9: Additional Responses about Lean at Al Salem Johnson Controls

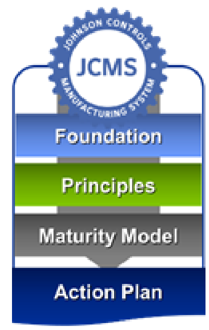
Implementation of Next Generation JCMS in Jeddah Factory

Jeddah factory is currently undergoing implementation of Next generation Johnson Controls Manufacturing system. It's a global Johnson Controls' initiative to engage employees, drive operational excellence and grow our business.

WHAT IS NEXT GENERATION JCMS?

Next generation Johnson Controls Manufacturing System, or JCMS, is the one Johnson Controls way of manufacturing to attain world-class performance. JCMS is built on the following building blocks:

- Four Foundations
- Nine Principles
- The Maturity Model
- The Action Plan



FOUR FOUNDATIONS

Customer Focus

Put the customer first and work to continuously exceed their increasing expectations.

Stable Production Environment

Standardization, consistency, predictability and repeatability are fundamental. Problems are instabilities that must be surfaced quickly and solved permanently.

Zero Tolerance for Waste

Manufacturing activities that do not add value or fundamentally change the nature of the product or service - as defined by the customer - should be avoided and eliminated.

Organize Around Pull

A product should only be manufactured in response to specific demand signals and request from a customer; materials and resources should be advanced only when downstream processes request them.

NINE PRINCIPLES

The nine principles provides a comprehensive model for managing each manufacturing facility. These principles have a set of manufacturing practices that provide a path for maturingg a team's capability level. There are also a common set of metrics for each principle. And there is a set of required standards every single plant must meet over time.

Figure 4-10: Phases of Johnson Manufacturing System (part 1)

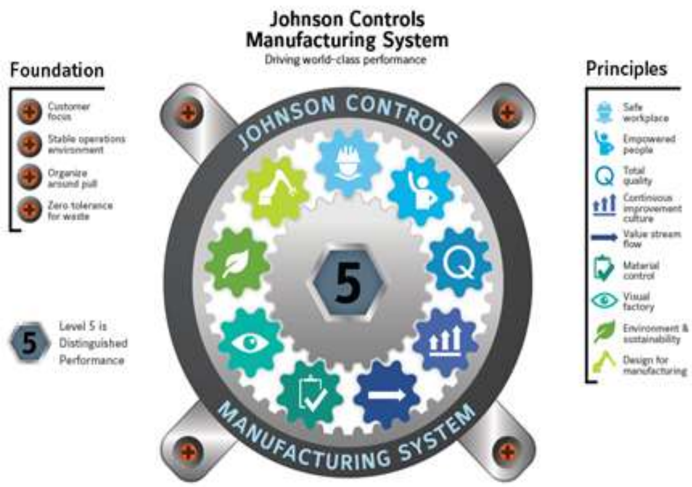
MATURITY MODEL

It all comes together in an assessment tool that can be used to determine each plant's unique maturity level. The Maturity Model contains a common set of manufacturing practices and governing behaviors. It will be used by each plant to assess itself and determine its maturity level for each Principle.
In all there are five maturity levels: 1 through 5

ACTION PLAN

Based on their score, the system will help plant managers develop and author their own unique plant action plan. This action plan provides a path for capability and performance improvement. Action plans include:

- One-to-four year roadmap
- The vision and the means to move forward
- Collaborative development
- Clear deliverables



- Ownership and accountability
- The "Plan, Do, Check, Act" cycle

Figure 4-11: Phases of Johnson Manufacturing System (part 2)

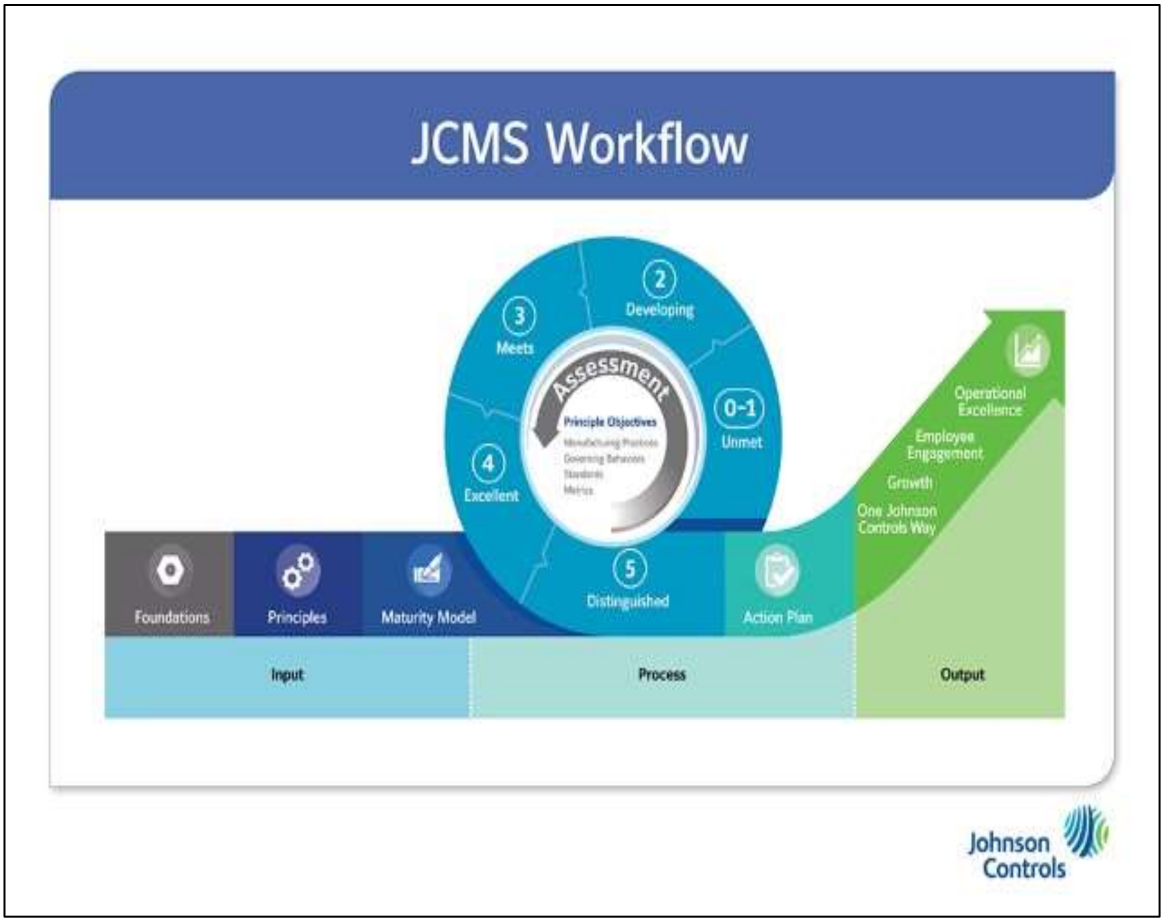


Figure 4-12: Johnson Manufacturing System Workflow

Figure 4-13: Sample of 5S technique at Al Salem Johnson Controls

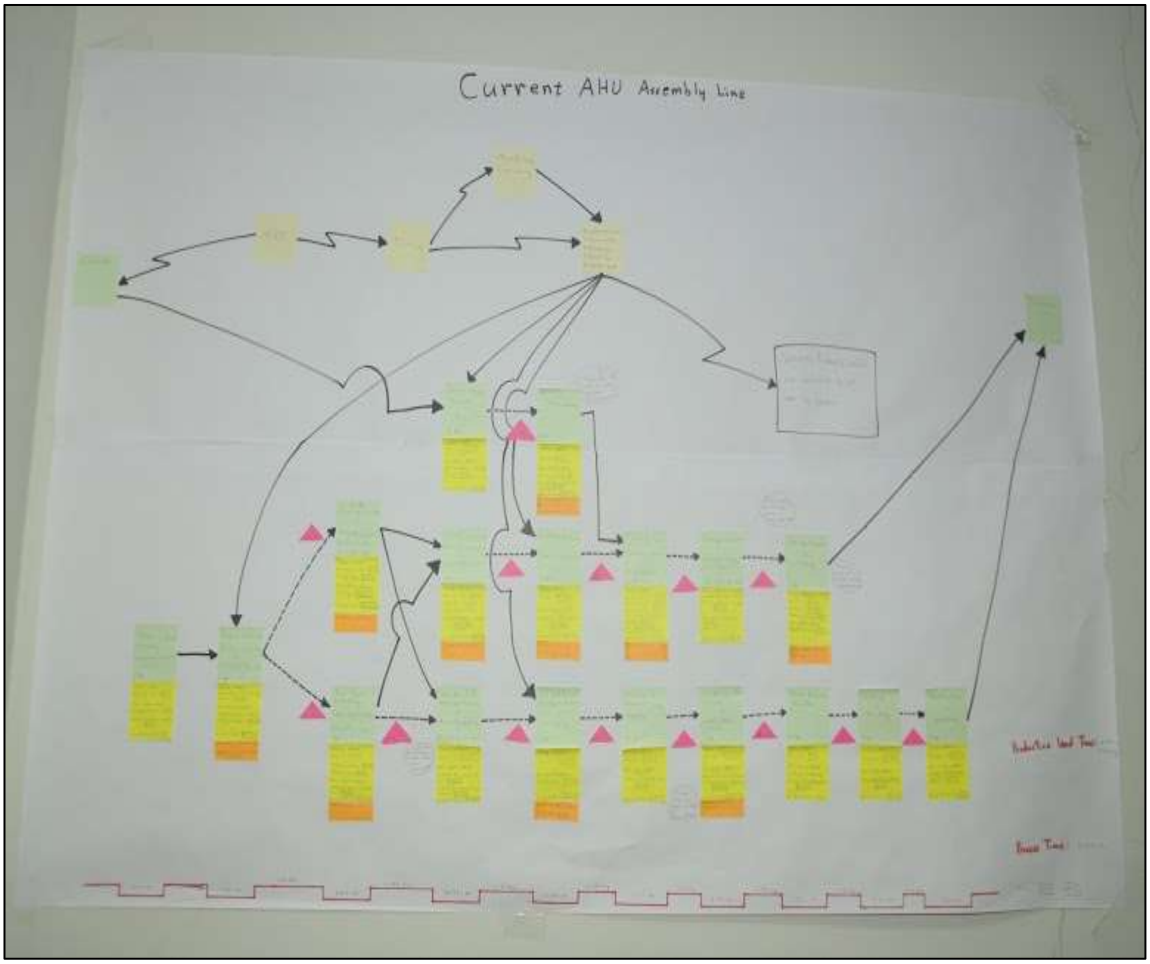
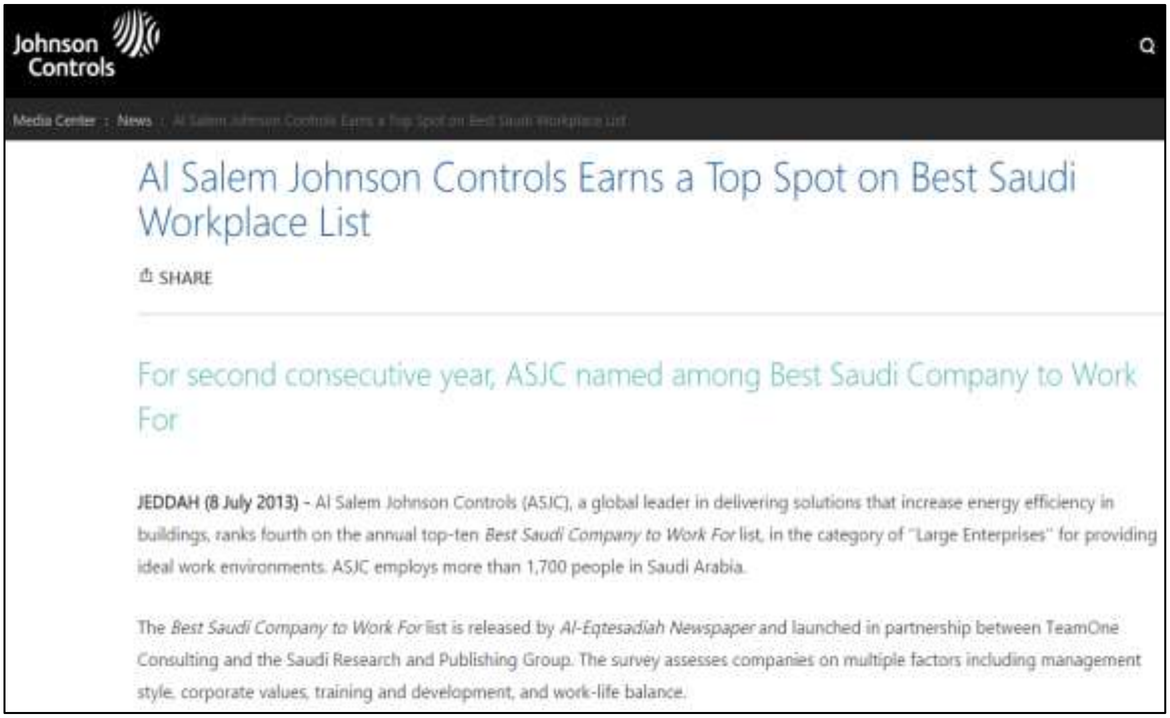


Figure 4-14: Sample of VSM at Al Salem Johnson Controls


Johnson Controls

Media Center : News

Al Salem Johnson Controls Earns a Top Spot on Best Saudi Workplace List

SHARE

For second consecutive year, ASJC named among Best Saudi Company to Work For

JEDDAH (8 July 2013) - Al Salem Johnson Controls (ASJC), a global leader in delivering solutions that increase energy efficiency in buildings, ranks fourth on the annual top-ten *Best Saudi Company to Work For* list, in the category of "Large Enterprises" for providing ideal work environments. ASJC employs more than 1,700 people in Saudi Arabia.

The *Best Saudi Company to Work For* list is released by *Al-Eqtesadiah Newspaper* and launched in partnership between TeamOne Consulting and the Saudi Research and Publishing Group. The survey assesses companies on multiple factors including management style, corporate values, training and development, and work-life balance.

Figure 4-15: Second Time Award for Best Workplace among Saudi companies

6. References:

- https://www.linkedin.com/company-beta/10607516/
- http://www.york.com.sa/en/

4.2.4. Saudi Industrial Projects Company (Pepsi Cola)

1. Company Background:

Saudi Industrial Projects Company (SIPCO) is the Pepsi bottling company for the western region in Saudi Arabia. SIPCO has 17 distribution centers, covering the western region of Saudi Arabia. SIPCO is the biggest and one of the strongest Pepsi-Cola franchises in the Middle East. It has six main branches and 11 satellite branches in three regions, 89% market share, three manufacturing plants, and over $500 million in revenue. The company fulfills the food safety and quality management systems such as AIBI, ISO 9001 and ISO 22000, FSSC 22000.

2. Interviewee Background:

He is currently a manufacturing manager at one of the plants of SIPCO. He has 13 years of experience: three years as a manufacturing manager and 10 years as a quality control and quality assurance manager in SIPCO and AFIA international company. He has an Executive Master of Business Administration, and a bachelor's degree in Industrial Engineering.

3. General Questions Responses:

<u>1. Do you think organizations in Saudi Arabia are familiar with lean?</u>

"No, companies in Saudi Arabia and other developing countries are not familiar with lean. In local companies lean implementation level is very weak and even is not exist in governmental companies."

Then, he was asked to give a percentage for lean implementation level in Saudi Arabian local and multinational companies; he responded:

"I think in multinational companies it is maybe around 10% and in local companies it is around 5%"

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

"Awareness about lean benefits would be the most important factor. If the people aware and believe in lean benefits such as improving quality and productivity, and reducing wastes in the process they would buy it. Because it will affect cost and reduce the cost and increase the benefits."

3. How long would you say it took to have a reasonable level of lean implementation in your company?

"I would say to have reasonable level but not the optimum is 3 years. In our company we have a framework for lean transformation and it is mentored by the head company. This system called Manufacturing and Warehouse System (M&W). It consist of 4 stages, the first stage is *stage 0* which include data collection and preparing the performance measurements. *Stage 1* includes two parts 1A which is measuring and 1B which is improving performance. *Stage 2* is visualizing the factory, and *Stage 3* is changing the work. To reach stage 2 and see some result you need 3years"

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

"The other factor that is linked to the first one is top management commitment. Lean transformation in developing countries has to be from top to down. I would also say the companies have to be ready for the National Transformation Program 2020 which is under the umbrella of the Saudi Arabia's Vision 2030."

4. Lean Transformation Level at SIPCO (Pepsi Cola)

Table 4-7 shows the responses regarding lean assessment at SIPCO. The interviewee was asked to provide examples for each measure that is implemented in his company. As result, the company has attained above the average level of lean transformation as it will be shown below. Table 4-8 and figure 4-16 show that SIPCO has level of implementation of 70% in culture, process, and training. However, the company has 53% in the drivers category, 55% in deployment, and 47% in engagement.

Table 4-7: Interview Responses for Lean Assessment at SIPCO (Pepsi Cola)

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Table 4-8: Scores Summary for Lean Transformation at SIPCO (Pepsi Cola)

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	7	2	3.50	70%
Deployment	11	4	2.75	55%
Engagement	7	3	2.33	47%
Training	7	2	3.50	70%
Processes	10	3	3.33	67%
Drivers	8	3	2.67	53%

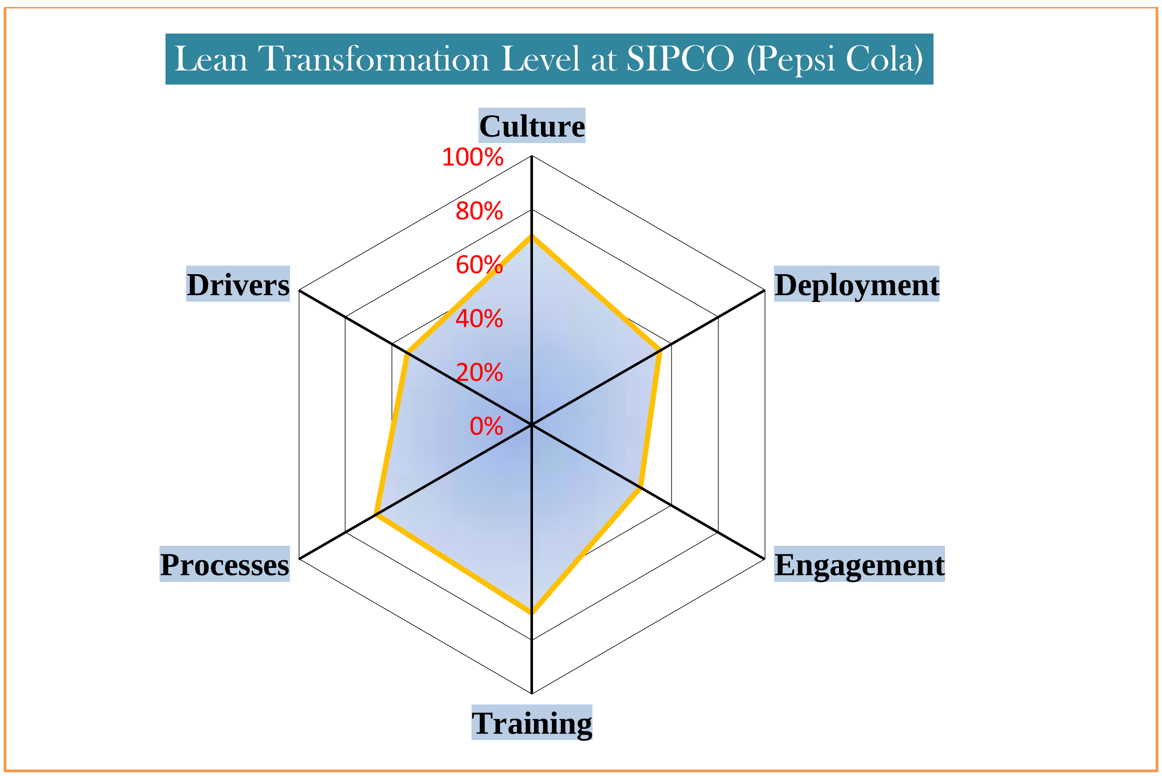


Figure 4-16: Lean Transformation Level at SIPCO (Pepsi Cola)

5. Supported Documents:

The figures below were provided as supported documents for the lean transformation level at SIPCO. In addition, examples for some lean methods that were applied are shown below. After analyzing these documents, it can be concluded that the company has a good start toward achieving a successful transformation to lean. The only missing part is to consider and involve suppliers. This issue is very critical and might hinder them in attaining the desired level.

Figure 4-17: M&W of PepsiCo International Company

Figure 4-18: M&W of PepsiCo International Company Stages 0-3

Figure 4-19: M&W of PepsiCo International Company Benefits

Figure 4-20: Sample of Scoreboard at SIPCO

DATA PREPARATION SHEET

FORM 1

SITE MANGER	Betty Candoit	SITE	Center City	YEAR	2002	DATE	Oct-1- 01

ACCOUNTABILITY	MEASURES	UOM	BASELINE	BENCHMARK	BUSINESS OPPTY	VALUE TO BUSINESS (FINANCIAL)	VALUE TO BUSINESS (NON-FINANCIAL)
SAFETY	INJURY FREQUENCY	#	500	0	500	$ 25,000	
	LOST TIME	#	20	0	20	$ 250,000	
QUALITY	BRIX	%	90	100	10		
	CO2	%	98	100	2		
	TA	%	99	100	1		
	YEAST	%	30	0	30		
	IQA	Level	Bronze	Gold	2 Levels		BUSINESS STRATEGY
PRODUCT AVAILABILITY	FORECAST ACCURACY	%	70	90	20	$ 15,000	
	% GOOD	%	40	70	30	$ 7,500	
	MATERIAL AVAILABILITY	%	90	100	10	$ 3,000	
	SCHEDULE COMPLIANCE	%	65	90	25	$ 20,000	
	CNAL	#	30,000	0	30,000	$ 30,000	
WASTE	PKG LOSS	$	$ 30,000	$ 25,000	$ 5,000	$ 5,000	
	ING LOSS	$	$ 140,000	$ 25,000	$ 115,000	$ 115,000	
	PRODN BREAKAGE	$	$ 100,000	$ 25,000	$ 75,000	$ 75,000	
	WHSE BREAKAGE	$	$ 10,000	$ 12,500	$ (2,500)	$ -	
	SHRINKAGE	$	$ 5,000	$ 12,500	$ (7,500)	$ -	
	TOTAL PLANT WASTE	$	$ 300,000	$ 100,000	$ 200,000	$ 200,000	
PRODUCTIVITY	FILLER DOWNTIME	%	25	10	15	$ 90,000	
	NET EFFICIENCY	Cs/LnHr	1000	1500	500	$ 200,000	
	PRODN PRODUCTIVITY	Cs/EEHr	45	198	153	$ 164,000	
	WHSE PRODUCTIVITY	Cs/EEHr	250	1000	750	$ 94,000	
	PLANT PRODUCTIVITY	Cs/EEHr	10	100	90	$ 2,000,000	

Figure 4-21: Sample of Data Preparation Sheet at SIPCO

6. References:

- https://www.naukrigulf.com/about-sipco
- http://www.sipco.net.sa/index.html
- https://www.linkedin.com/company-beta/845293/?pathWildcard=845293

4.2.5. Philips Lighting Saudi Arabia

1. Company Background:

The company's mission is to improve people's lives through meaningful innovations; combining advanced technologies, market understanding, and local industrial capabilities to provide Saudi Arabia with the latest LED solutions. The company supports Saudi Arabia's Vision 2030 to improve energy efficiency, stimulating local innovation and manufacturing to enhance sustainability for future generations. Philips Lighting aims to deliver solutions that will help to fulfill this vision by creating a positive impact on people's lives, and adding sustainable value today and tomorrow. The company has obtained ISO 9001, ISO 14001, and OHSAS 18001 certifications.

2. Interviewee Background:

He is a professional with more than 20 years of experience in business transformation, operations, and integrated management systems. His specialties include international experience with Multinational Organizations in Canada, Saudi Arabia and Egypt.

3. General Questions Responses:

<u>1. Do you think organizations in Saudi Arabia are familiar with lean?</u>

"No, companies in Saudi Arabia are not familiar with lean. People have misunderstanding about lean concept. I think they have conflict between the lean concept and cost reduction or optimization. The true definition of lean as a sustainable solution is unknown. In fact many people do not know lean and when I do the training I used to give an example. The example is that when someone goes to the supermarket to buy ground beef he will find 3 types: ground beef, lean ground beef, and extra lean ground beef. Lean ground beef means less fat, the fat here is the waste."

Then, he was asked when he said "no," is that also applicable multinational companies, and could he please give a percentage for lean implementation level in Saudi Arabian local and multinational companies? He responded:

"No, I was talking about the local companies since I am dealing with many of them. However, the situation in multinational companies is better because the plan comes from outside of Saudi Arabia from the head of the companies. If I want to give percentages, I would say less than 60% of local companies are familiar with lean. For multinational companies I think the percentage would be around 90%"

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

"First factor is top management to buy the idea and support the transformation to lean. Second factor the see impact of lean which means lean should be done seriously and if it doesn't show result it means it wasn't done seriously. The impact can be financial impact or customer satisfaction. Third factor in my opinion is showoff for the company. This can be a driver to have a successful lean implementation. For example, the company can use the lean program in its campaign by saying we are deploying lean to have best quality with reasonable cost”

3. How long would you say it took to have a reasonable level of lean implementation in your company?

“At least one year in manufacturing area and to have solid base in I would say not less than five years. I said one year in manufacturing area is good based on experience of our company because we had good background about lean. However, if you start from scratch definitely it would take more than one year in manufacturing area”

Then, he was asked if we have framework that have 5 phases in which phase you will consider your company.

“I would say Phase 2 to 3. You know that to implement lean in manufacturing is faster and easy to measure it. But, in non-manufacturing is challenging. Thus, we started our lean program from manufacturing by implementing 6S technique to the three plants we have in Saudi Arabia. Then, we applied Hoshin planning and then Kaizen in different areas. The implementation in manufacturing took around one year. After that when we felt that lean was popular in the company and the culture is ready we started the implementation to non-manufacturing departments such as finance, supply chain, quality, etc. ”

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

“I think the main driver of lean transformation in Saudi Arabia or any other developing countries is the finical issues. Lean will reduce cost, shorten time, and reduce the utilized areas. Additionally, I would say that companies have to think and consider the Saudi Arabia's Vision 2030 and the National Transformation Program 2020 in their strategy. In our company we started to involve the key factors of the National Transformation Program 2020 in our strategy. For instance, we started to match the goals of the transformation to our strategy in energy conservation and Saudization programs which is to offer more opportunities of job by replacing non-Saudis employees by Saudis."

4. Lean Transformation Level at Philips Lighting Saudi Arabia

Table 4-9 shows the responses regarding lean assessment at Philips Lighting Saudi Arabia. The interviewee was asked to provide examples for each measure that is implemented in his company. As result, table 4-10 and figure 4-22 show that the company has attained perfect level of lean implementation in process 93% and in training 90%. The documents analysis in the next section also confirms these good levels that the company has. Moreover, the company has 73% the drivers' category, 60% in engagement, 55% in deployment, and 50% in culture.

Table 4-9: Interview Responses for Lean Assessment at Philips Lighting Saudi Arabia

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	

Table 4-10: Scores Summary for Lean Transformation at Philips Lighting Saudi Arabia

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	5	2	2.50	50%
Deployment	11	4	2.75	55%
Engagement	9	3	3.00	60%
Training	9	2	4.50	90%
Processes	14	3	4.67	93%
Drivers	11	3	3.67	73%

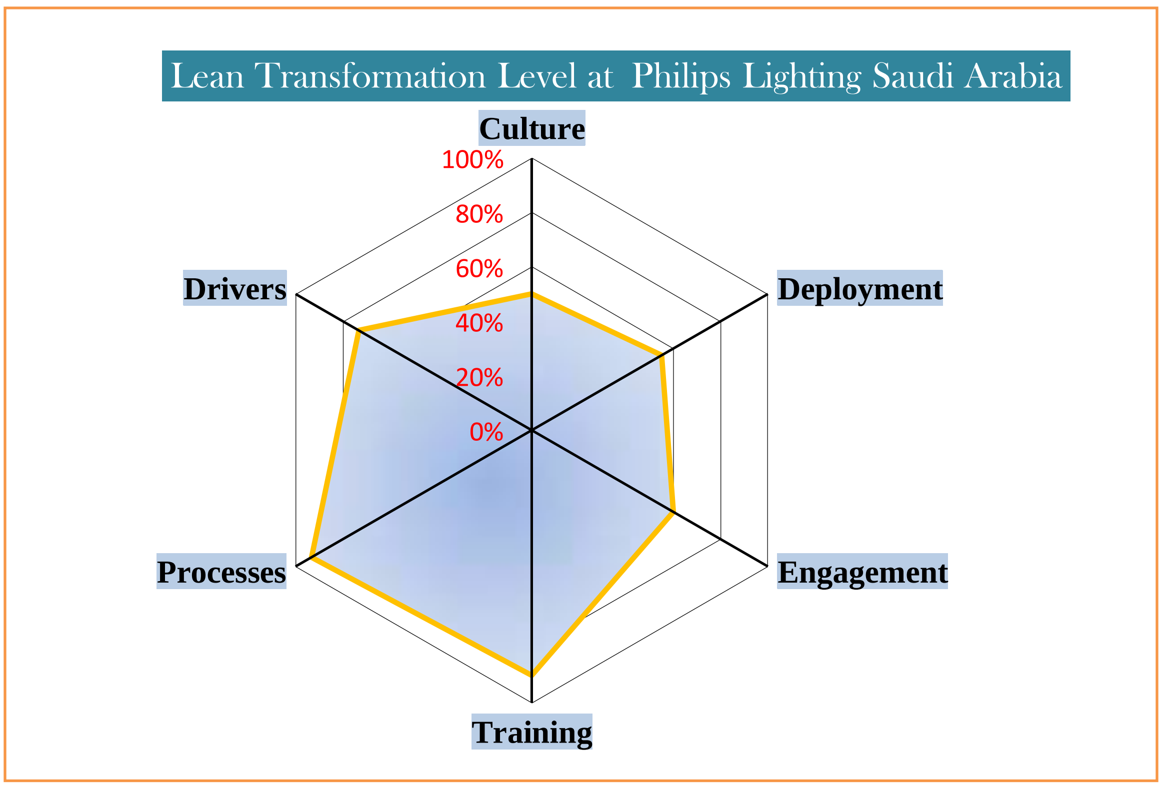


Figure 4-22: Lean Transformation Level at Philips Lighting Saudi Arabia

5. Supported Documents:

The figures below were provided as supported documents for the lean transformation level at Philips Lighting Saudi Arabia. In addition, examples for some lean methods that were applied are shown below. After analyzing these documents, it can be concluded that the company has attained a perfect level of lean implementation in process 93% and in training 90%. However, the company in the other categories is at the above-average level. The only missing part is to consider and involve suppliers. This issue is very critical and might hinder them in attaining the desired level.

Figure 4-23: Sample of 6S Lean Technique at Philips Lighting Saudi Arabia

6. References:

- ➢ https://www.linkedin.com/company-beta/1484179/?pathWildcard=1484179
- ➢ http://www.philips-slc.com

Hoshin Kanri

Lean Transformation Team applies Hoshin method in order to ensure that the strategic goals and projects of the company will drive progress and action at every level. High level of employee identifies some areas for improvement and also in some areas there are chronicle problems which can be solved by choosing a suitable lean projects / Kaizen events. In Hoshin plan, different level of employee work together to achieve the goals and the objective of each Kaizen or lean project. Each project has its own leader, source, date, area, and potential sponsor. All Kaizen event or lean project leader should be selected from a list of employees who attend green belt training or Lean Foundation training. Kaizen event and Lean project are evaluated based on "weightage score" in order to make a priority list.

- There are around 31 people who have green belt training.
- There are around 22 people who have Lean Foundation training.
- The total Kaizen event and Lean project are more than 20.

Figure 4-24: Hoshin Kanri at Philips Lighting Saudi Arabia

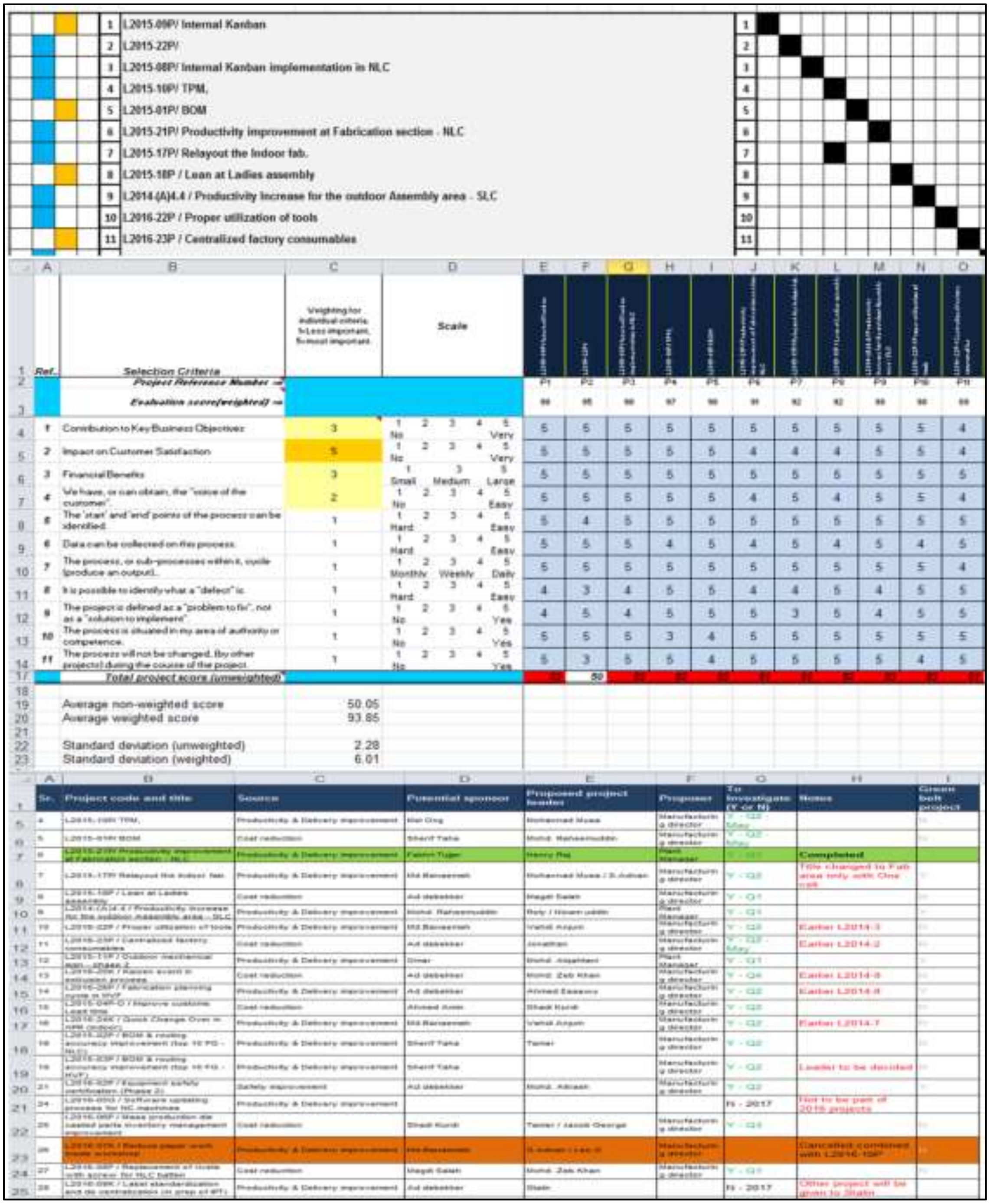


Figure 4-25: Sample of Planning - Hoshin X Matrix at Philips Lighting Saudi Arabia

Figure 4-26: Sample of Achievements for Lean Transformation Program at Philips Lighting Saudi Arabia

Lean Corner

Introduction

Lean Corner have been created for the first time in PLSA, located in INARA PLAZA 3rd Floor. Lean Corner provides all facilities for launching Kaizen events, also it provides books, lectures and Team building games. Providing Lean Foundation Training for several departments employees.

Material

Books

Lean corner provides a different variety of books that can help and guide employees to do better in their work style and in order to increase the awareness of lean transformation. Employees can come over and borrow any book they like, also E-books are provided.

Project and Kaizen Posters:

There are some Kaizen are posted showing the status before and after, processes, cause& effect, SIPOC, and result.

Team building games:

Lean corner provides different games such as Gutter ball activity, Marble Tubes, Teamplay Tubes. Teamplay give opportunity to employees to learn some skills that could be applied into day to day work. They can learn problem solving & communication exercise, simplify processes, or reduce wasting time.

Kaizen Event Facilities and Coffee Corner:

Lean corner provide all tools that to applied Kaizen event, increase awareness of Lean concept, and training, also some helpful videos and articles are provided. In the coffee corner we are updating out plan, project celebration or birthday celebration.

Figure 4-27: Description about Lean Corner at Philips Lighting Saudi Arabia

Figure 4-28: Samples of Lean Corner Materials at Philips Lighting Saudi Arabia

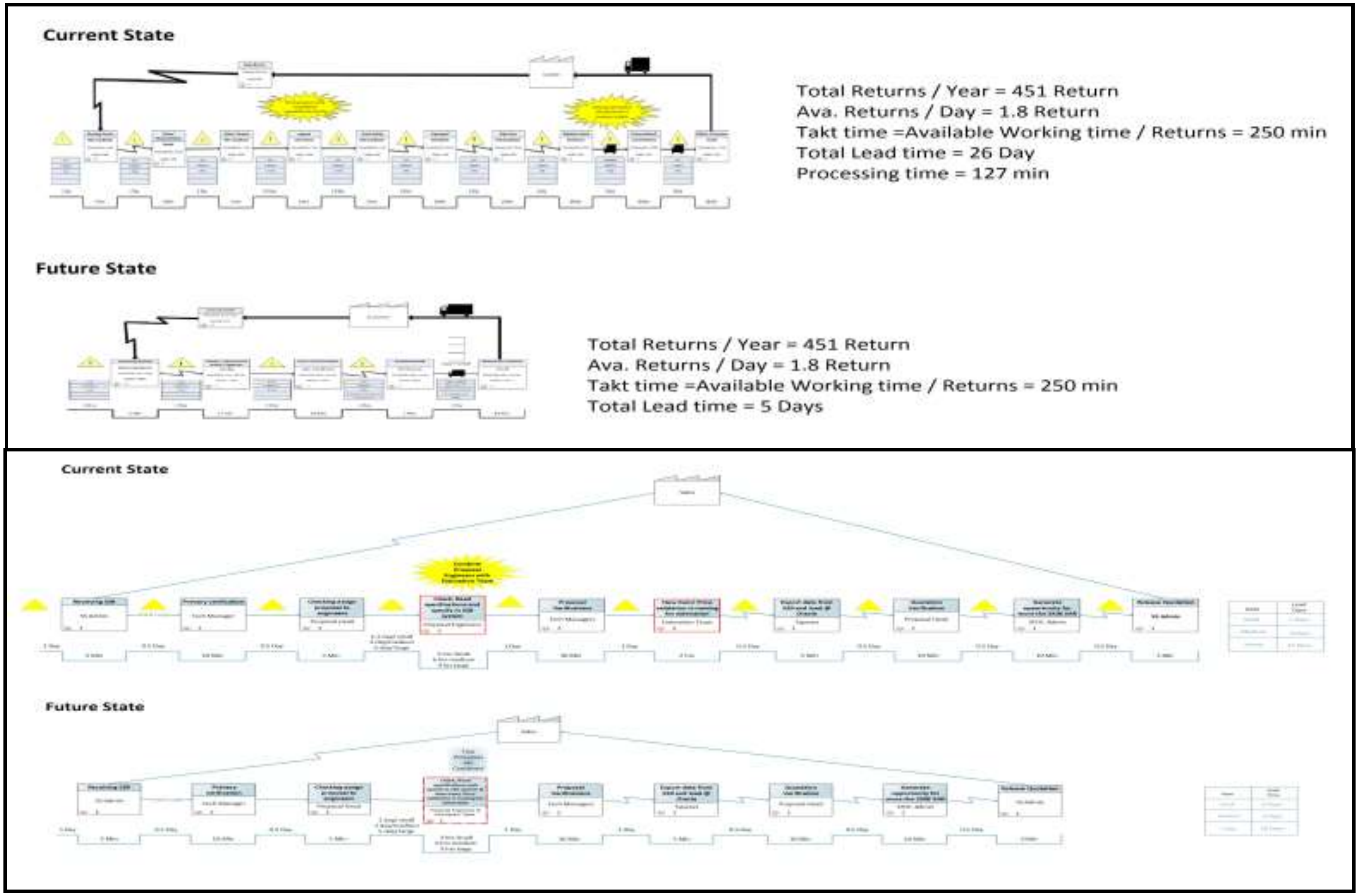


Figure 4-29: Samples of VSM at Philips Lighting Saudi Arabia

4.2.6. Jotun Saudia Company

1. Company Background:

The company was founded in 1984 and owns and operates paint factories and manufactures and markets decorative paints, marine coatings, and protective coatings. Jotun Saudia is part of the Jotun Group, which is a matrix organization divided into seven regions responsible for the sale of decorative paints and performance coatings (Marine, Protective, and Powder Coatings). Jotun group has 37 production facilities in 21 countries, 63 companies in 45 countries, and is represented in over 100 countries around the world. Jotun Group is certified by Quality Management (ISO 9001), Environmental Management (ISO 14001), and Occupational Health and Safety (OHSAS 18001).

2. Interviewee Background:

The interviewee for Jotun Saudia Company has 11 years of experience as a production manager and continuous improvement executive. He is currently a production manager at one of Jotun Middle East, India, and Africa plants. He has Mechanical Engineering background, and was in a development training in strategic planning at the British American Academy for Management Development, as well as Integrated Business Processes with SAP ERP training program at University of Duisburg-Essen.

3. General Questions Responses:

1. Do you think organizations in Saudi Arabia are familiar with lean?

"For this question of course I don't have a specific study that can indicate accurate numbers about lean in Saudi Arabia. However, in my personal perspective you cannot say that companies in Saudi Arabia are familiar with lean. If there are companies that familiar with lean it would be very limited. I think nowadays companies start looking for lean and they understand the importance of its benefits to organization. This was for local companies which has very low level of implementation. For multinational I think they should be familiar since they gain the knowledge from the corporate. Worker in multinational company are more trained about best practices of lean and the have diversity of capabilities that makes them aware about lean"

Then, he was asked to give a percentage for lean implementation level in Saudi Arabian local and multinational companies, and he responded:

"The number that I would tell you is an estimate from what I believe. In local companies it is less than 40% and this percentage is for large size companies that have good recourses. In multinational companies the percentage is higher and it would reach to 60% or 70%"

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

"For this question I would choose the factors from the assessment table below. First factor is drive lean implementation from the top down. The second point is to understand that developing a lean culture take long time and that lean is never-ending. Some people may feel it waste of time because they don't recognize this factor. Third is to follow up and measure the improvement. For example, by applying Key Performance Indicator (KPI) method to measure where you are and where you have to be."

3. How long would you say it took to have a reasonable level of lean implementation in your company?

"Our lean program took about five or six years, and in the last two years there was more focus on the program because its result started to show up. Lean is a long term investment; you invest in training and transferring know-how. It is very difficult to see the result immediately. I know that in some cases you would see some good results but overall it takes minimum of five years"

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

"Belief about lean benefits would be another important factor that I would like to add. Also, it is crucial to have a motivation system."

4. Lean Transformation Level at Jotun Saudia Company

Table 4-11 shows the responses regarding lean assessment at Jotun Saudia Company. The interviewee was asked to provide examples for each measure that is implemented in his company. As result, the company has attained an average level of lean transformation as it will be shown below. Table 4-12 and figure 4-30 show that Jotun Saudia has level of implementation of 70% in training, 60% in culture, and 53% in process. However, it has less than 50% in drivers, engagement, and deployment categories.

Table 4-11: Interview Responses for Lean Assessment at Jotun Saudia Company

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Table 4-12: Scores Summary for Lean Transformation at Jotun Saudia Company

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	6	2	3.00	60%
Deployment	8	4	2.00	40%
Engagement	5	3	1.67	33%
Training	7	2	3.50	70%
Processes	8	3	2.67	53%
Drivers	7	3	2.33	47%

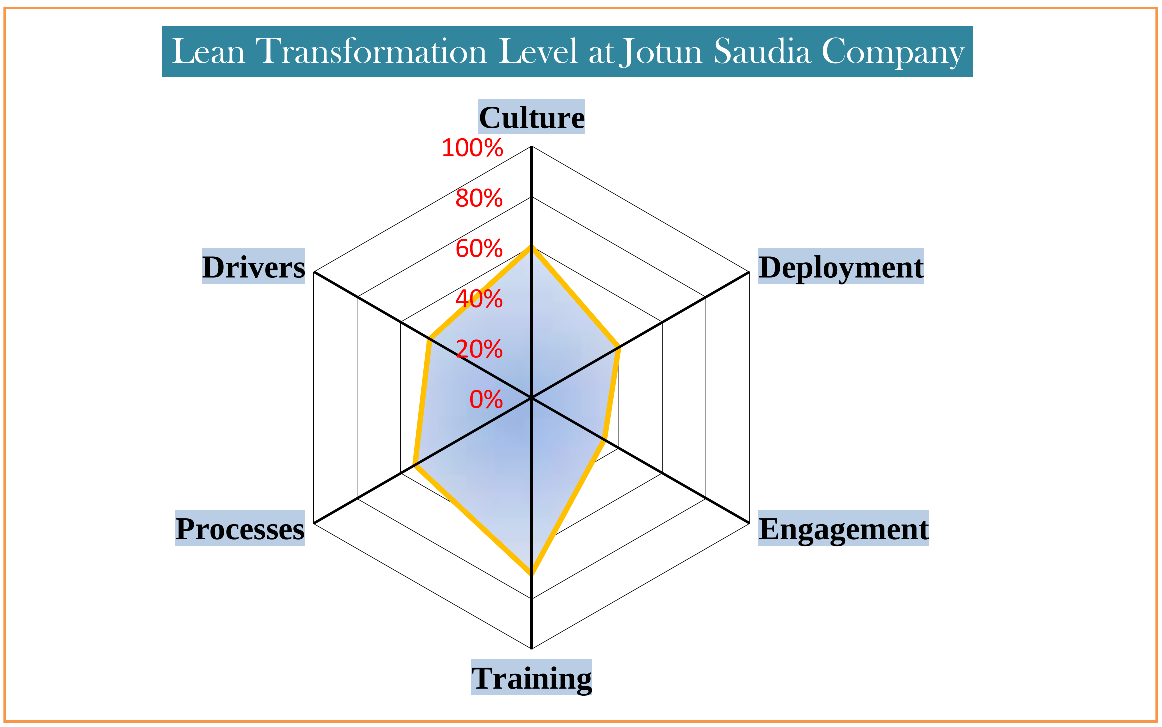


Figure 4-30: Lean transformation level at Jotun Saudia Company

5. Supported Documents:

Figures below were provided as supported documents for the lean transformation level at Jotun Saudia Company. In addition, examples for some lean methods that were applied are shown below. After analyzing these documents, it can be concluded that the company has a good start toward achieving a successful transformation to lean. They need to focus more on increasing the level of drivers, engagement, and deployment categories. In addition, to work hard for the missing part which is to consider and involve suppliers. This issue is very critical and might hinder them to attain the desired level.

6. References:

- http://www.jotun.com/sa/en/corporate/about-jotun/index.aspx
- http://www.bloomberg.com/research/stocks/private/snapshot.asp?privcapId=47057605

Figure 4-31: Jotun Operating System

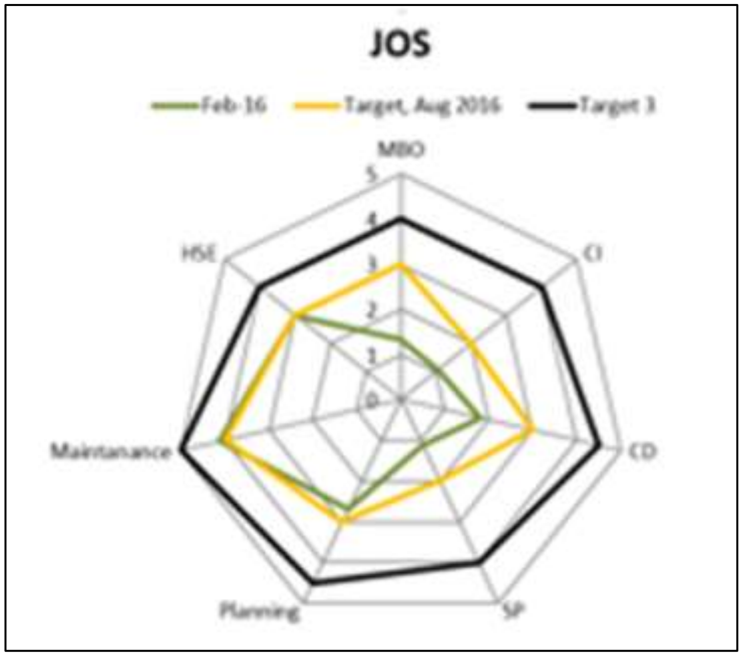


Figure 4-32: Sample of Lean Radar Chart for Jotun Operating System

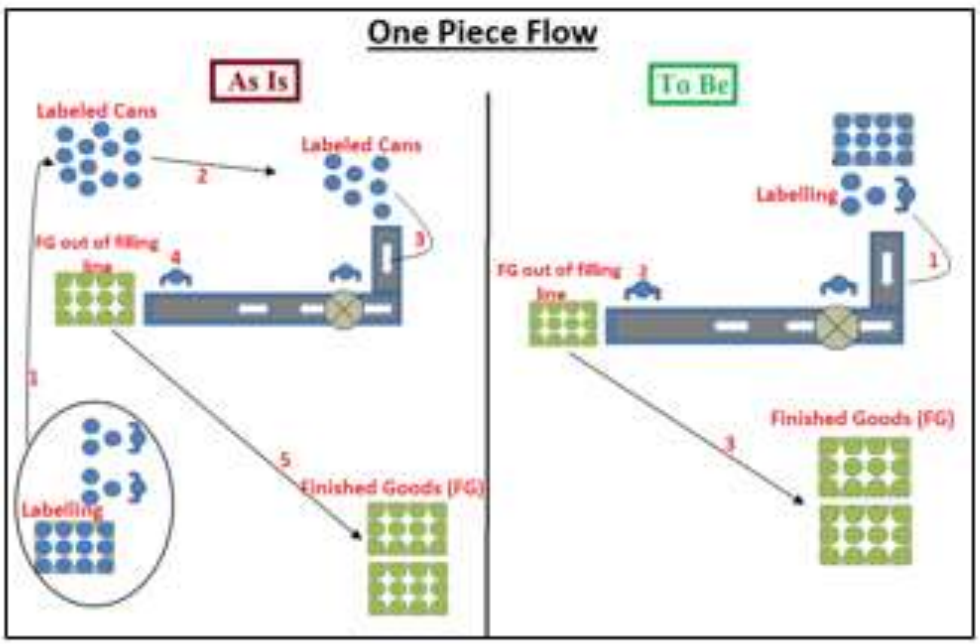


Figure 4-33: Sample of Mapping Process at Jotun Saudia

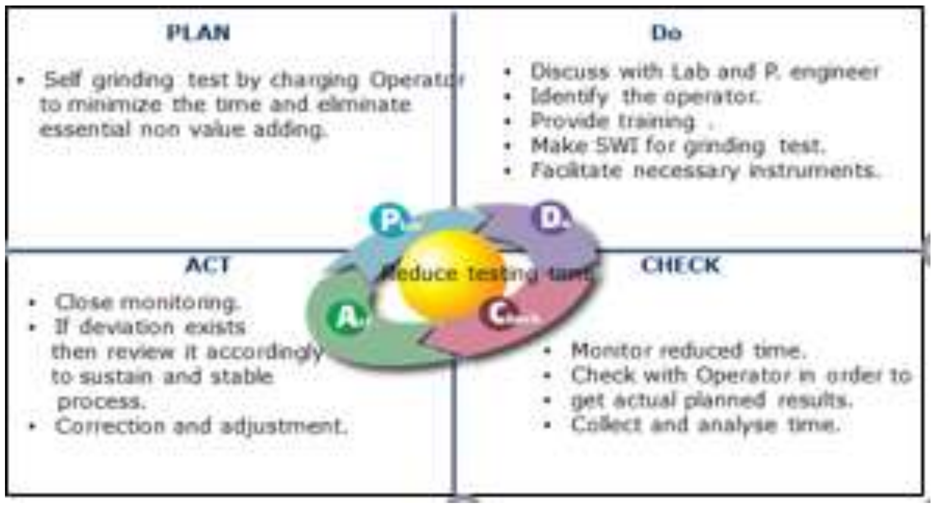


Figure 4-34: Sample of PDAC at Jotun Saudia

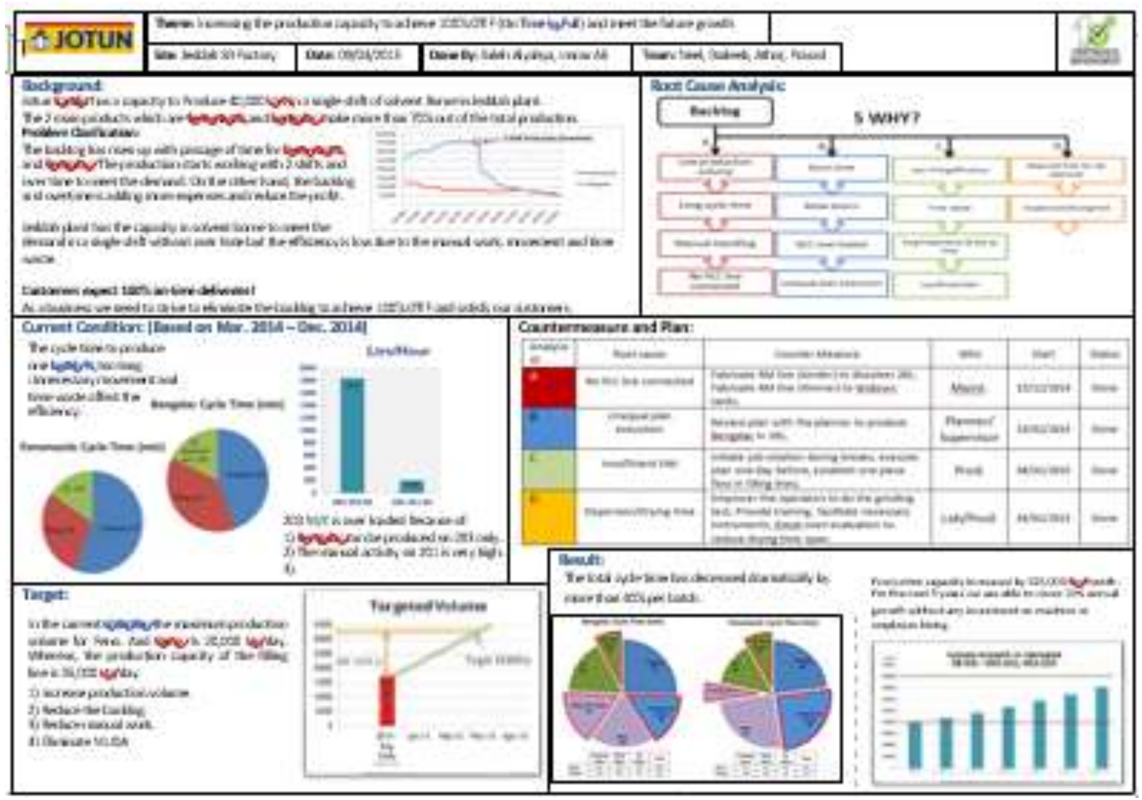


Figure 4-35: Sample of A3 tool at Jotun Saudia

Figure 4-36: Sample of 5S board at Jotun Saudia

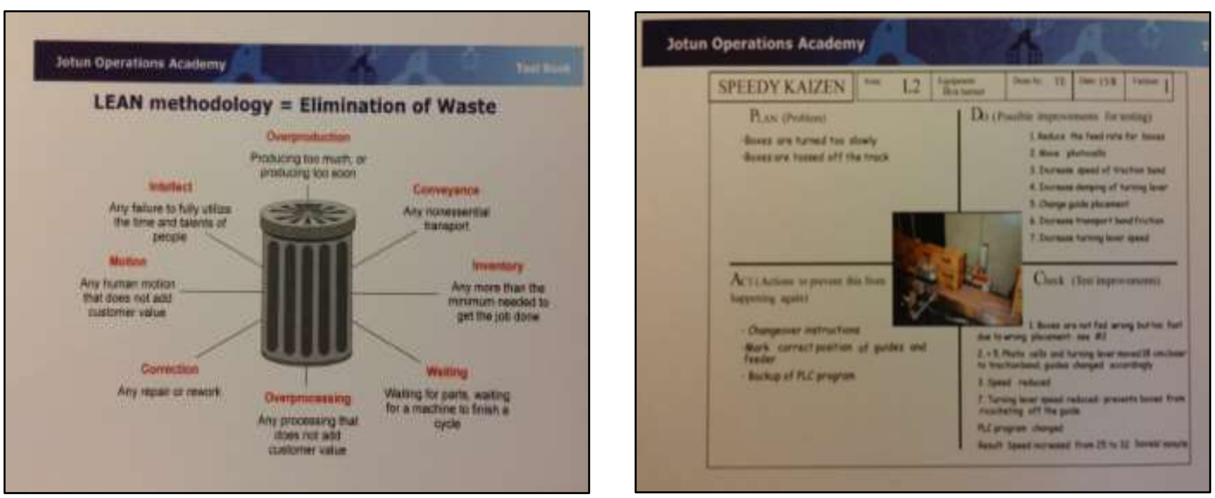


Figure 4-37: Sample of Process Manual at Jotun Saudia

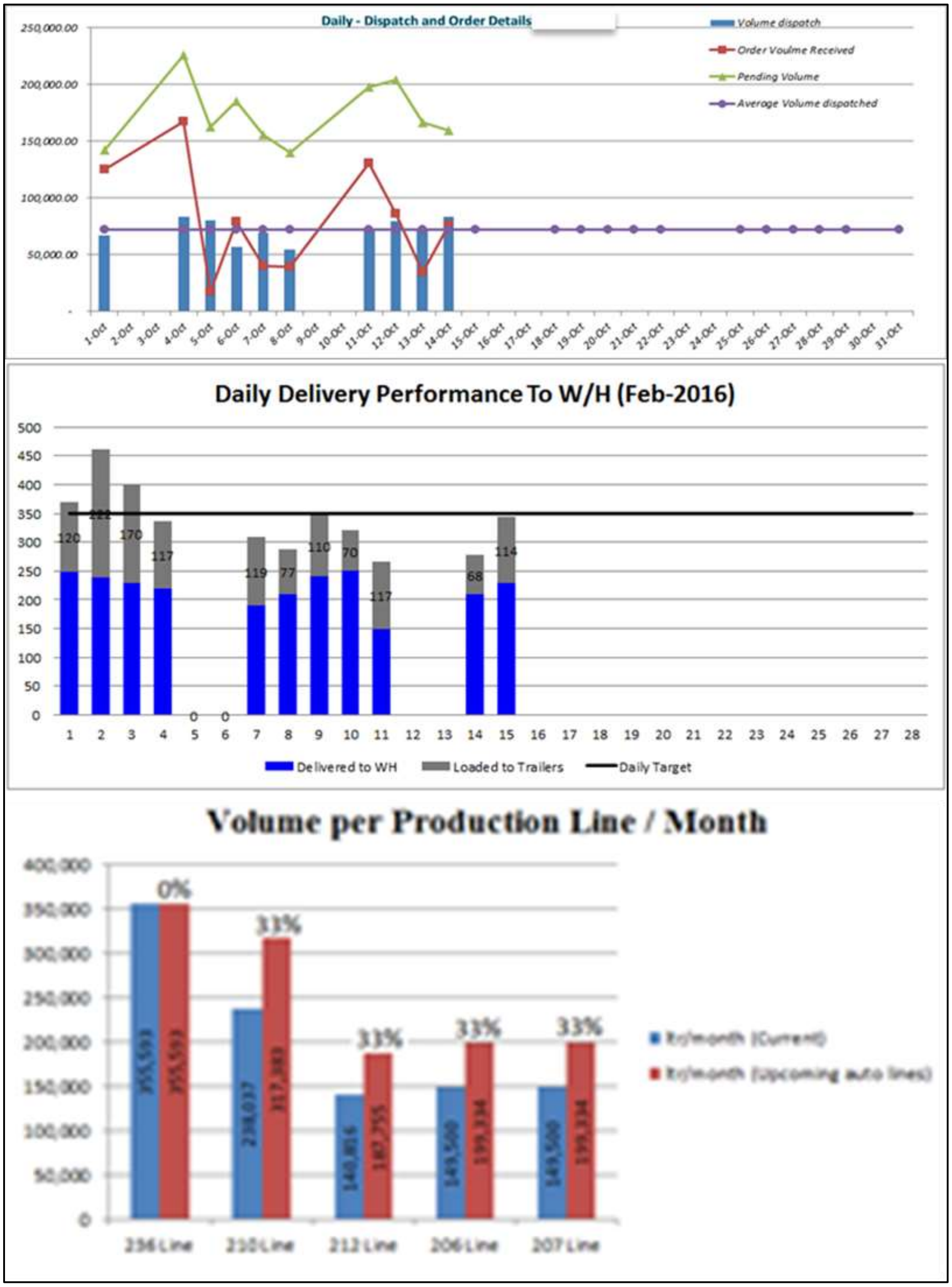


Figure 4-38: Sample of KPI's at Jotun Saudia

4.2.7. Nestlé Saudi Arabia

1. Company Background:

Nestlé signed its first agency contract in Saudi Arabia in 1955. It was then part of Nestlé Middle East which started in 1997 and since that has invested in the region more than $ 400 million, operates17 factories and 37 offices, and employs more than 7,000 people. Nestlé Saudi Arabia in 2012 has developed the first Nestlé Center of Excellence, which is for recent university graduate students to do training programs that acquire their skills to excel in the corporate world. Company's principles are driven by passion and guided by trust. In addition, they believe to build trust among themselves, products, with customers over the long term, all actions have to be in line with the company's values of respect, transparency, integrity, and quality. The company has obtained ISO 22000 certification in addition to ISO 14001.

2. Interviewee Background:

The interviewee is one of the Nestle Continuous Excellence Champions. He works for 15 years at Nestle and was leading the sales in the company. The interviewee stated that the answers of the interview were discussed in a group of four executives at Nestlé Saudi Arabia and members of Nestle Middle East Leadership Team. One of them was the Head of General Services at the company with more than 11 years of managerial and technical experience.

3. General Questions Responses:

The interviewee preferred to respond with written answers to this section of the interview as it shown below.

1. Do you think organizations in Saudi Arabia are familiar with lean?

“Yes, in some and to specific level of organization types.”

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

“To link lean transformation to providing top line and bottom line benefits for the organization Saudi Arabia.

Leadership involvement in driving lean transformation in the organization in Saudi Arabia.”

3. How long would you say it took to have a reasonable level of lean implementation in your company?

“Lean implementation generally starts to deliver business results in 18 months from initiation. We need to remember that lean transformation is based on continuous improvement, which doesn’t have an end.”

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

“Lean transformation should be driven in pragmatic manner”

4. Lean Transformation Level at Nestlé Saudi Arabia

Table 4-13 shows the responses regarding lean assessment at Nestlé Saudi Arabia. The interviewee was asked to provide examples for each measure that is implemented in his company. As result, the company has attained below average level of lean transformation as it will be shown below. Table 4-14 and figure 4-39 show that the have attained level of implementation of 60% in culture, 47% in process and 40% and less in the other categories. The company is very weak in deployment; it has attained only 25% and in training with only 20% which indicated that they need to work more to increase these levels. Nestlé Saudi Arabia has a good baseline for lean transformation that covers most of the critical success factors to achieve successful lean transformation.

Table 4-13: Interview Responses for Lean Assessment at Nestlé Saudi Arabia

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	
	Less than 1 year	x
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Table 4-14: Scores Summary for Lean Transformation at Nestlé Saudi Arabia

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	**6**	**2**	**3.00**	**60%**
Deployment	**5**	**4**	**1.25**	**25%**
Engagement	**6**	**3**	**2.00**	**40%**
Training	**2**	**2**	**1.00**	**20%**
Processes	**7**	**3**	**2.33**	**47%**
Drivers	**6**	**3**	**2.00**	**40%**

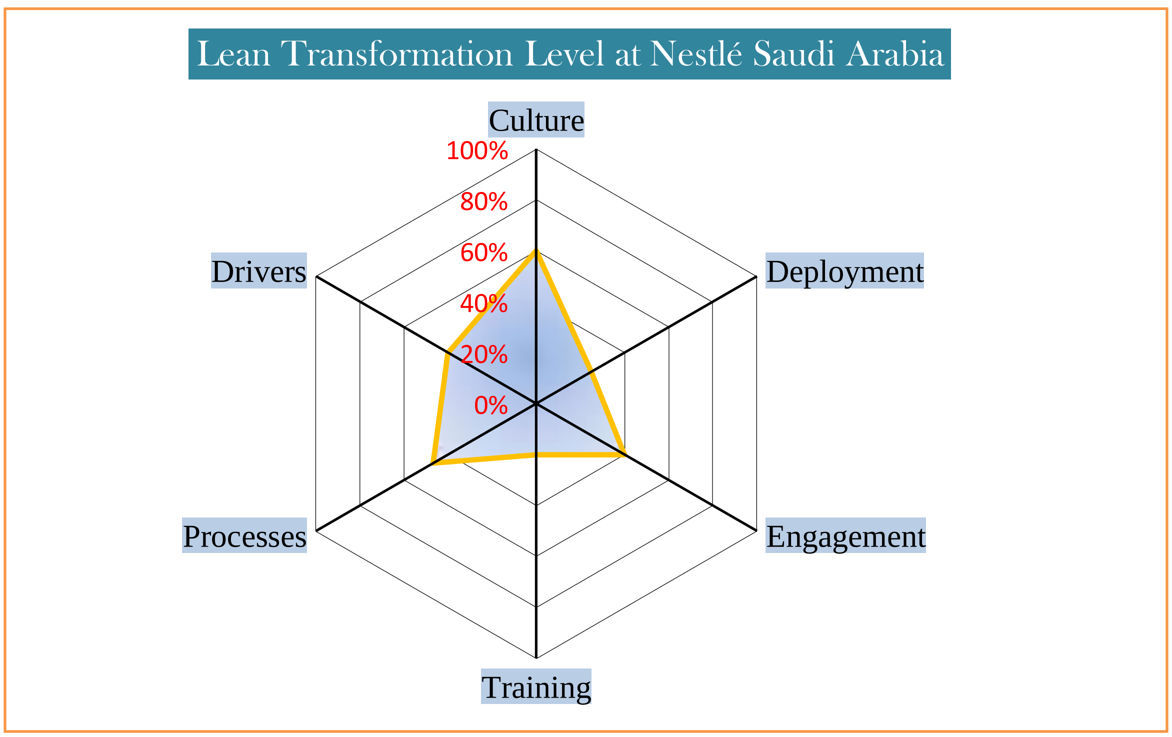


Figure 4-39: Lean Transformation Level at Nestlé Saudi Arabia

5. Supported Documents:

Figures below were provided as supported documents lean transformation level at Jotun Saudia Company. In addition, examples for some lean methods that were applied are shown below. For example, figure 4-40 below gives an overview for the 10 Nestlé corporate business principles and what they want to achieve through them which can be evident to support the lean transformation level in the company. After analyzing these documents, it can be concluded that the company has a good start toward achieving a successful transformation to lean. They need to focus more on increasing the level of training and deployment categories. In addition, to work hard for the missing part which is to consider and involve suppliers. This issue is very critical and might hinder them to attain the desired level.

6. References:

- www.nestle-me.com
- www.nestle-me.com/en/csv
- http://www.nestle.com/Media/NewsAndFeatures/Saudi-Arabia-HQ

Consumers	1	Nutrition, health and wellness	We aim to enhance the quality of consumers' lives by offering tastier, healthier food and drinks and encouraging a healthy lifestyle.
	2	Quality assurance and product safety	We want to ensure that, everywhere in the world, the Nestlé name represents the highest levels of product safety and quality.
	3	Consumer communication	We are committed to responsible, reliable communication that informs consumers, promotes healthier diets and respects consumer privacy.
Human rights and labour practices	4	Human rights in our business activities	We fully support the UNGC's principles on human rights and labour, and aim to set an example of good human rights and labour practices throughout our business activities.
Our people	5	Leadership and personal responsibility	While fostering a culture of respect and dignity, we provide our people with equal opportunities for development, protect their privacy and do not tolerate any form of harassment or discrimination against them. At the same time, we expect our employees to be responsible, motivated, and to live up to our values.
	6	Safety and health at work	We are committed to preventing work-related accidents, injuries and illnesses, and to protecting employees, contractors and others involved along the value chain.
Suppliers and customers	7	Supplier and customer relations	We require our suppliers, agents, subcontractors and their employees to demonstrate honesty, integrity and fairness, and to adhere to our non-negotiable standards.
	8	Agriculture and rural development	We aim to help rural communities become more environmentally sustainable by contributing in a range of areas, including agricultural production and the social and economic status of farmers.
The environment	9	Environmental sustainability	We are committed to environmentally sustainable business practices and strive to use natural resources efficiently, achieve zero waste and use sustainably managed renewable resources.
	10	Water	The world faces a growing water challenge, and we are committed to using water sustainably and improving our water management.

Figure 4-40: Nestlé Corporate Business Principles

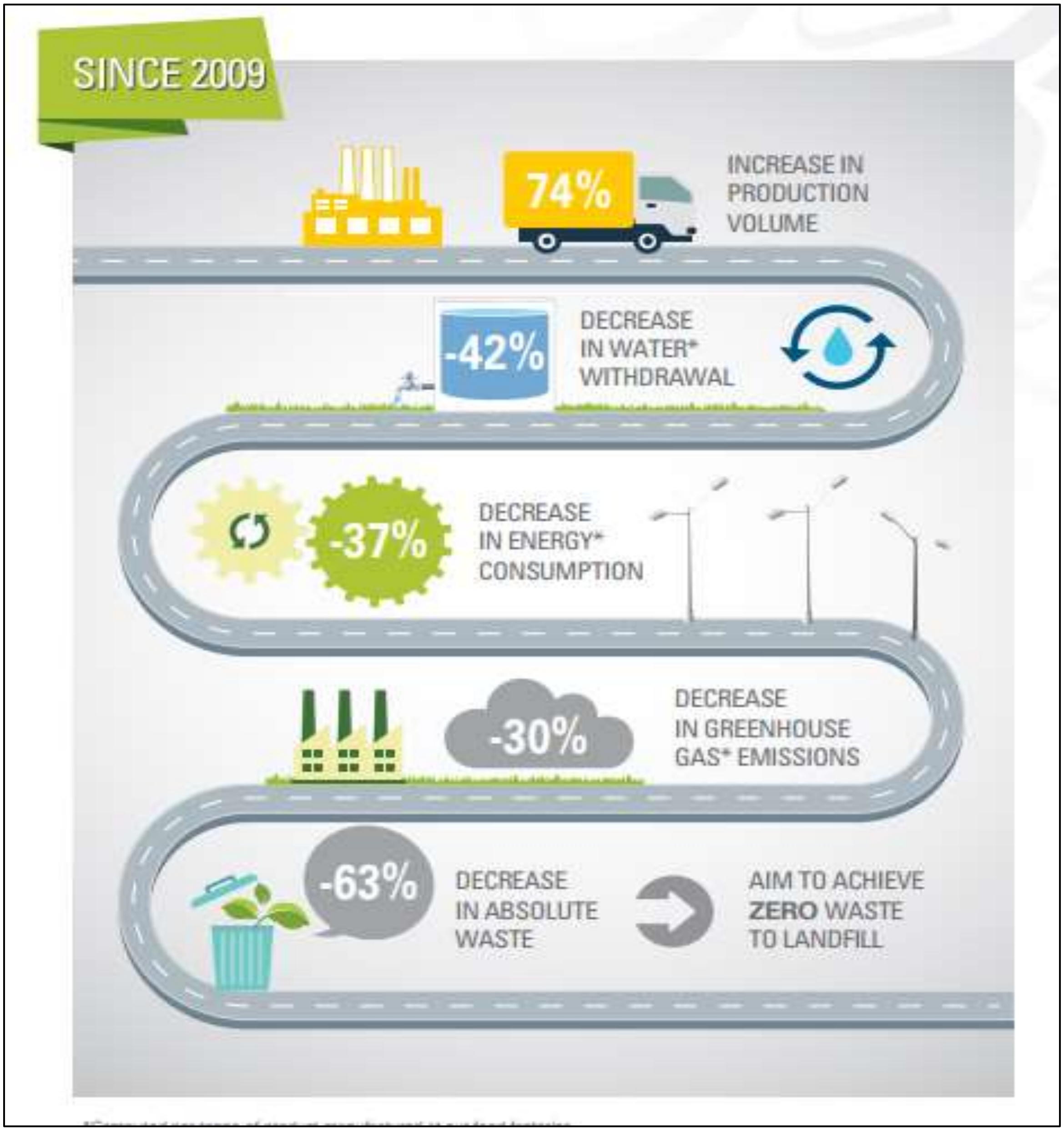
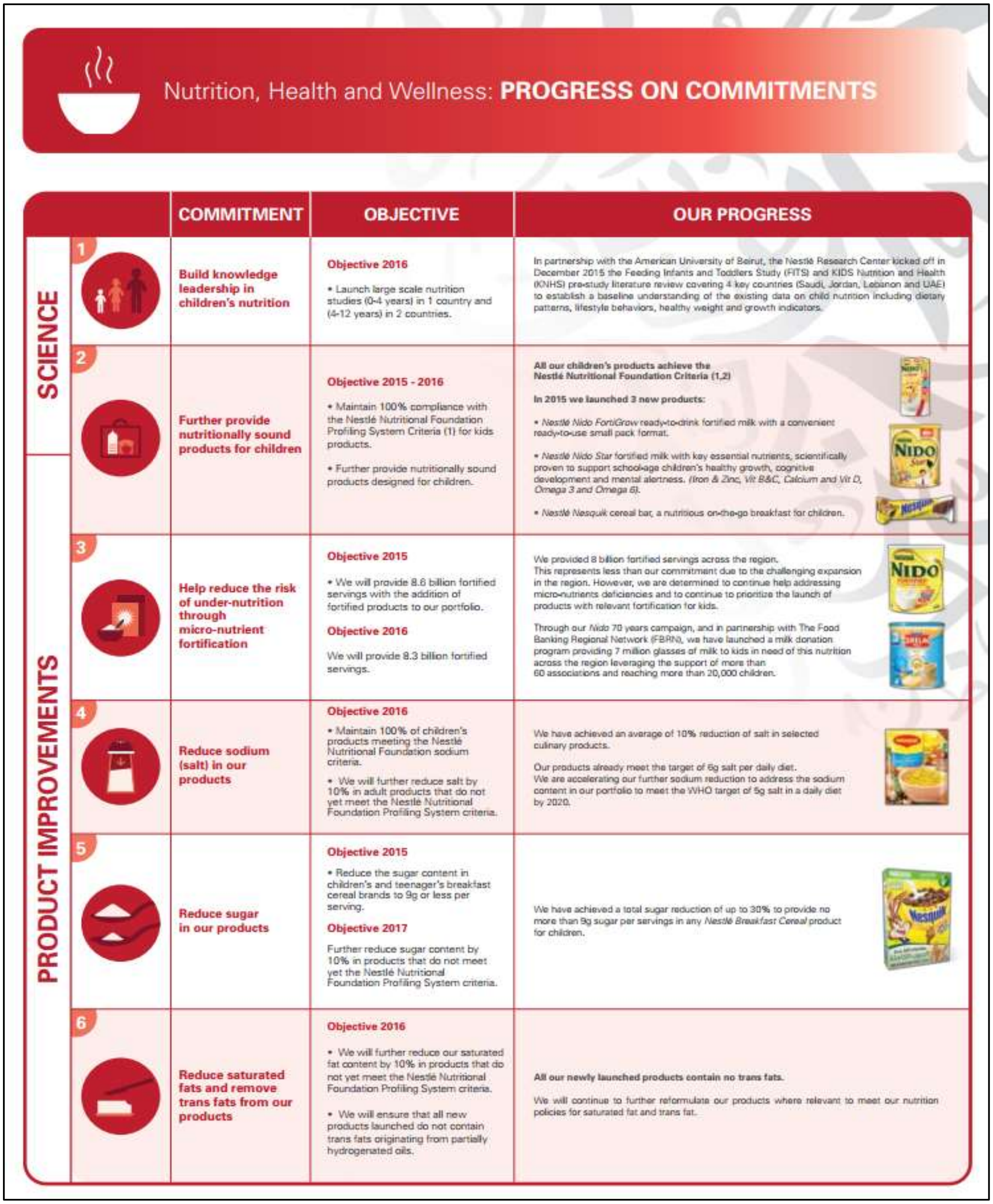


Figure 4-41: Progress on Creating Shared Value Commitments for Water and Environmental Sustainability at Nestlé



Nutrition, Health and Wellness: **PROGRESS ON COMMITMENTS**

		COMMITMENT	OBJECTIVE	OUR PROGRESS
SCIENCE	1	**Build knowledge leadership in children's nutrition**	**Objective 2016** • Launch large scale nutrition studies (0-4 years) in 1 country and (4-12 years) in 2 countries.	In partnership with the American University of Beirut, the Nestlé Research Center kicked off in December 2015 the Feeding Infants and Toddlers Study (FITS) and KIDS Nutrition and Health (KNHS) pre-study literature review covering 4 key countries (Saudi, Jordan, Lebanon and UAE) to establish a baseline understanding of the existing data on child nutrition including dietary patterns, lifestyle behaviors, healthy weight and growth indicators.
SCIENCE	2	**Further provide nutritionally sound products for children**	**Objective 2015 - 2016** • Maintain 100% compliance with the Nestlé Nutritional Foundation Profiling System Criteria (1) for kids products. • Further provide nutritionally sound products designed for children.	**All our children's products achieve the Nestlé Nutritional Foundation Criteria (1,2)** **In 2015 we launched 3 new products:** • *Nestlé Nido FortiGrow* ready-to-drink fortified milk with a convenient ready-to-use small pack format. • *Nestlé Nido Star* fortified milk with key essential nutrients, scientifically proven to support school-age children's healthy growth, cognitive development and mental alertness. *(Iron & Zinc, Vit B&C, Calcium and Vit D, Omega 3 and Omega 6).* • *Nestlé Nesquik* cereal bar, a nutritious on-the-go breakfast for children.
PRODUCT IMPROVEMENTS	3	**Help reduce the risk of under-nutrition through micro-nutrient fortification**	**Objective 2015** • We will provide 8.6 billion fortified servings with the addition of fortified products to our portfolio. **Objective 2016** We will provide 8.3 billion fortified servings.	We provided 8 billion fortified servings across the region. This represents less than our commitment due to the challenging expansion in the region. However, we are determined to continue help addressing micro-nutrients deficiencies and to continue to prioritize the launch of products with relevant fortification for kids. Through our *Nido* 70 years campaign, and in partnership with The Food Banking Regional Network (FBRN), we have launched a milk donation program providing 7 million glasses of milk to kids in need of this nutrition across the region leveraging the support of more than 60 associations and reaching more than 20,000 children.
PRODUCT IMPROVEMENTS	4	**Reduce sodium (salt) in our products**	**Objective 2016** • Maintain 100% of children's products meeting the Nestlé Nutritional Foundation sodium criteria. • We will further reduce salt by 10% in adult products that do not yet meet the Nestlé Nutritional Foundation Profiling System criteria.	We have achieved an average of 10% reduction of salt in selected culinary products. Our products already meet the target of 6g salt per daily diet. We are accelerating our further sodium reduction to address the sodium content in our portfolio to meet the WHO target of 5g salt in a daily diet by 2020.
PRODUCT IMPROVEMENTS	5	**Reduce sugar in our products**	**Objective 2015** • Reduce the sugar content in children's and teenager's breakfast cereal brands to 9g or less per serving. **Objective 2017** Further reduce sugar content by 10% in products that do not meet yet the Nestlé Nutritional Foundation Profiling System criteria.	We have achieved a total sugar reduction of up to 30% to provide no more than 9g sugar per servings in any *Nestlé Breakfast Cereal* product for children.
PRODUCT IMPROVEMENTS	6	**Reduce saturated fats and remove trans fats from our products**	**Objective 2016** • We will further reduce our saturated fat content by 10% in products that do not yet meet the Nestlé Nutritional Foundation Profiling System criteria. • We will ensure that all new products launched do not contain trans fats originating from partially hydrogenated oils.	**All our newly launched products contain no trans fats.** We will continue to further reformulate our products where relevant to meet our nutrition policies for saturated fat and trans fat.

Figure 4-42: Sample of Progress on Commitments Measurement at Nestlé

4.2.8. AFIA International Company (part of Savola Group)

1. Company Background:

AFIA International Company is a core part of Savola Group Company, which is a Saudi Joint Stock. It first started production in 1979, and currently manages a wide range of market-leading brands in 30 countries. The company long-term goal is to provide superior autonomy to the Savola Foods Company so that it can invest in marketing, branding and in improving its range. With that in mind, they have developed a strategy that includes four key fundamentals: defend, extend, build, and incubate. The company's values are: self-nourishment, interactive nourishment (teamwork dynamics), and released nourishment (organizational culture). The AFIA International Company was certified by several global organizations in quality such as EMS ISO 14001:2004, FS ISO 22000:2005, and ISO 9001:2008.

2. Interviewee Background:

The interview for AFIA International Company was conducted with two interviewees. The first is senior department manager quality control with 30 years professional and management experiences. His background is in chemistry and has a master degree in Organic and Industrial Chemistry. The second interviewee is a department manager of Total Productive Manufacturing (TPM) at the company with 15 years of experience as a process manager, maintenance team manager, and TPM manager. His background is in Mechanical Engineering, and he has a master degree in Engineering Management.

3. General Questions Responses:

The interviewee preferred to respond with written answers to this section of the interview, as shown below.

<u>1. Do you think organizations in Saudi Arabia are familiar with lean?</u>

"Somewhat."

<u>2. What are main success factors for lean transformation in Saudi Arabia?</u>

"In my opinion the following are important factors:

- To develop road MAP
- Flexibility
- Full skill knowledge's about systems, processing and products
- Awareness
- Ownership
- Motivation
- Team development
- Involvement from all circles within the organization
- Experience and expertise
- Knowledge for change on business and customer voice
- Skill
- Loyalty
- Discipline

- Attitude and culture
- Job security
- To upgrade knowledge
- Communication; download business strategy
- No time limits; it is a continuous improvements unless reaching to set target and target always changeable

Can you please provide me with some examples?

"e.g., change, empowerment, Kaizen, multiskilling development"

3. How long would you say it took to have a reasonable level of lean implementation in your company?

"It depends, about five years."

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

"Other factors:

- Invest on human development,
- Functional on job training,
- Space for continues improvements,
- Investment on R& D,
- Full knowledge's about processing and products
- Knowledge development center,
- To upgrade knowledge
- Efficient Communication across the business
- Cope with situation, not a rigid but flexible culture

- Job security
- No time limits; it is a continuous improvement unless reach to set target and target is changeable & it depend on company business and market strategy."

4. Lean Transformation Level at AFIA International Company

Table 4-15 shows the responses regarding lean assessment at AFIA International Company. The interviewee was asked to provide examples for each measure that is implemented in his company. As result, the company has attained low level of lean transformation as it will be shown below. Table 4-16 and figure 4-43 show that the highest level of implementation at AFIA International Company is 50% in the culture category. Meanwhile the company has low level in the other categories. There are several areas of "opportunity of improvement" that can develop the lean transformation level in the company.

Table 4-15: Interview Responses for Lean Assessment at AFIA International Company

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Table 4-16: Scores Summary for Lean Transformation at AFIA International Company

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	**5**	**2**	**2.50**	**50%**
Deployment	**6**	**4**	**1.50**	**30%**
Engagement	**4**	**3**	**1.33**	**27%**
Training	**2**	**2**	**1.00**	**20%**
Processes	**6**	**3**	**2.00**	**40%**
Drivers	**6**	**3**	**2.00**	**40%**

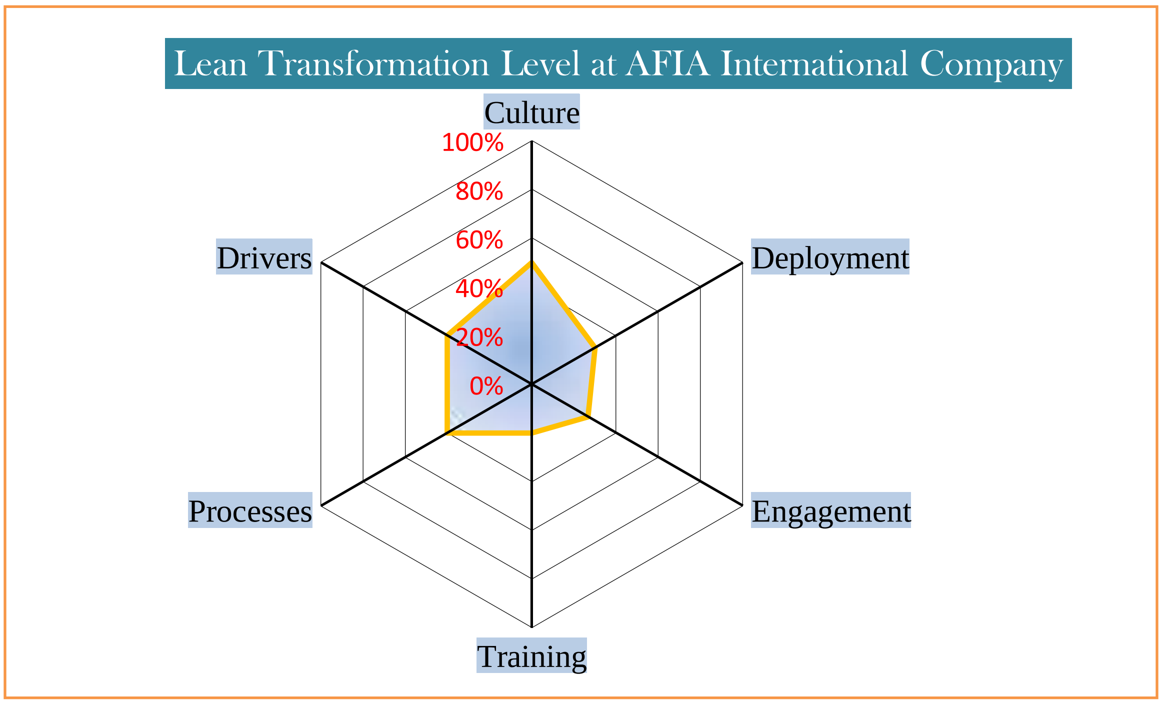


Figure 4-43: Lean Transformation Level at AFIA International Company

5. Supported Documents:

The figures below were provided as supported documents for lean transformation level at AFIA International Company. In addition, examples for some lean methods that were applied are shown below. After analyzing these documents, it can be concluded that the company has a good start toward achieving a successful transformation to lean. The only missing part is to consider and involve suppliers. This issue is very critical and might hinder them in attaining the desired level.

6. References:

- https://www.savola.com/en/about-us/savola/history
- https://www.universalhunt.com/company/afia-international-company

Productivity	Monthly Target	Quality	Monthly Target	Cost	Yearly Target	Delivery	Monthly Target	Safety	Monthly Target	Morale	Monthly Target
OEE	75%	QDI	4.0	CC	260 SR/MT	Adherance to Audit schedule (TW, 5S, VPM, AM)	80%	Safety Audit	80%		
Adherence to PM	95%			ITQAN	15.0 MSR	Adherance to Training schedule	80%			Kaizen submission	60%
Audit Score (TW, 5S, VPM, AM)	75%										

Figure 4-44: Sample of AFIA KPI's with Target

Figure 4-45: AFIA's TPM World Class Excellence Framework

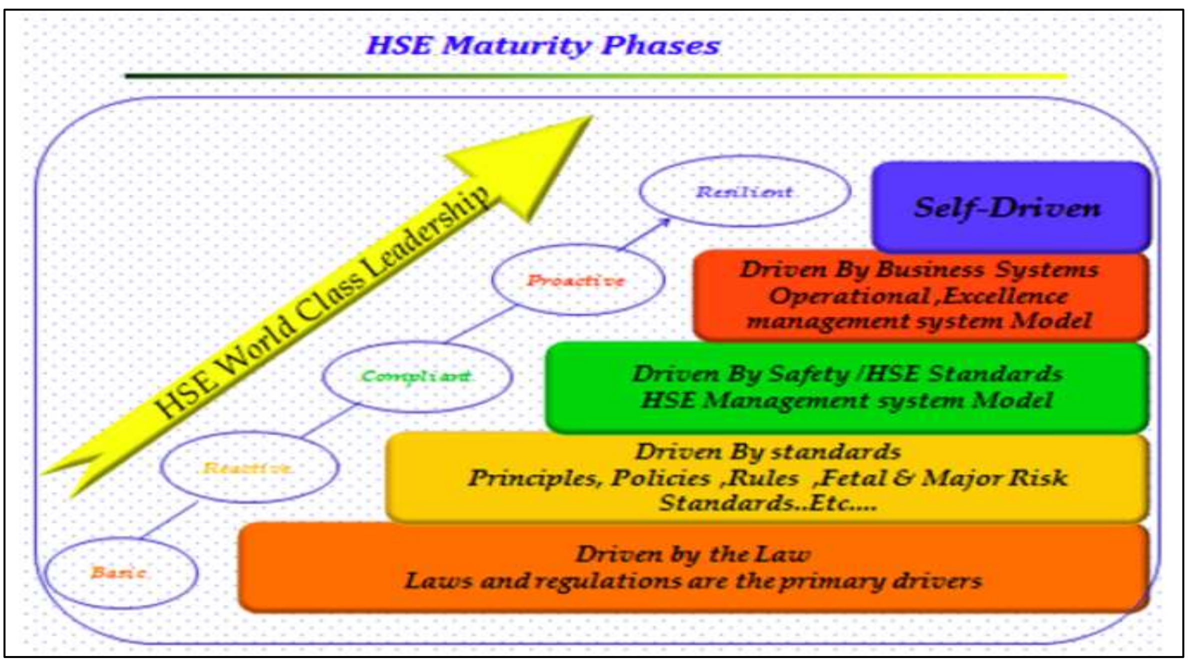


Figure 4-46: Health and Safety Executive (HSE) Maturity Model at AFIA

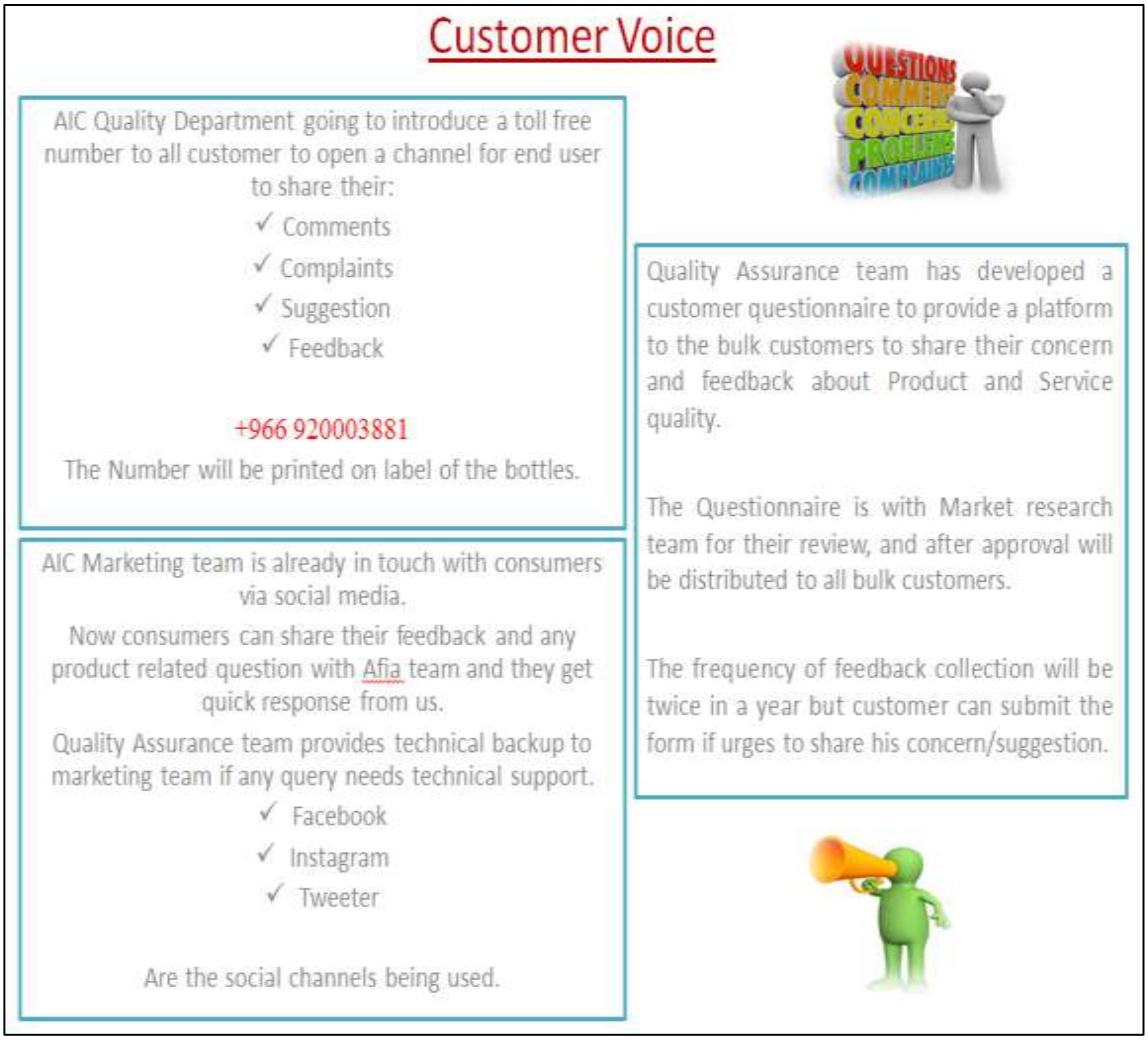


Figure 4-47: Sample of AFIA's Voice of Customer Scheme

4.3 Summary for All Multinational Companies

Table 4-17 summarizes the scores of the assessment for lean transformation level in Saudi Arabian multinational companies. In addition, the mean, median, and standard deviation were calculated for all multinational companies. The presented standard deviation of each category is high, which shows high variation of each company from the calculated mean. Figure 4-48 shows the lean radar chart for all multinational companies and it can indicated that these companies have an average of 66.8% in process category and 66.3% in both culture and training categories. These results reflect that Saudi Arabian multinational companies have a good level of lean implementation for these category and some companies like Toyota an P&G have a 100% implementation for these categories.

Table 4-17: Scores and Statistical Summary for Multinational Companies

Category	AFIA	JOHNSON CONTROLS	JOTUN	Nestlé	P&G	PEPSI	PHILIPS	TOYOTA	Mean	Median	STDEV
Culture	50	50	60	60	100	70	50	90	66.3	60	18.0
Deployment	30	25	40	25	75	55	55	75	47.5	47.5	19.4
Engagement	27	47	33	40	67	47	60	74	49.4	47	15.4
Training	20	70	70	20	100	70	90	90	66.3	70	28.7
Processes	40	47	53	47	100	67	93	87	66.8	60	22.0
Drivers	40	60	47	40	53	53	73	93	57.4	53	16.8

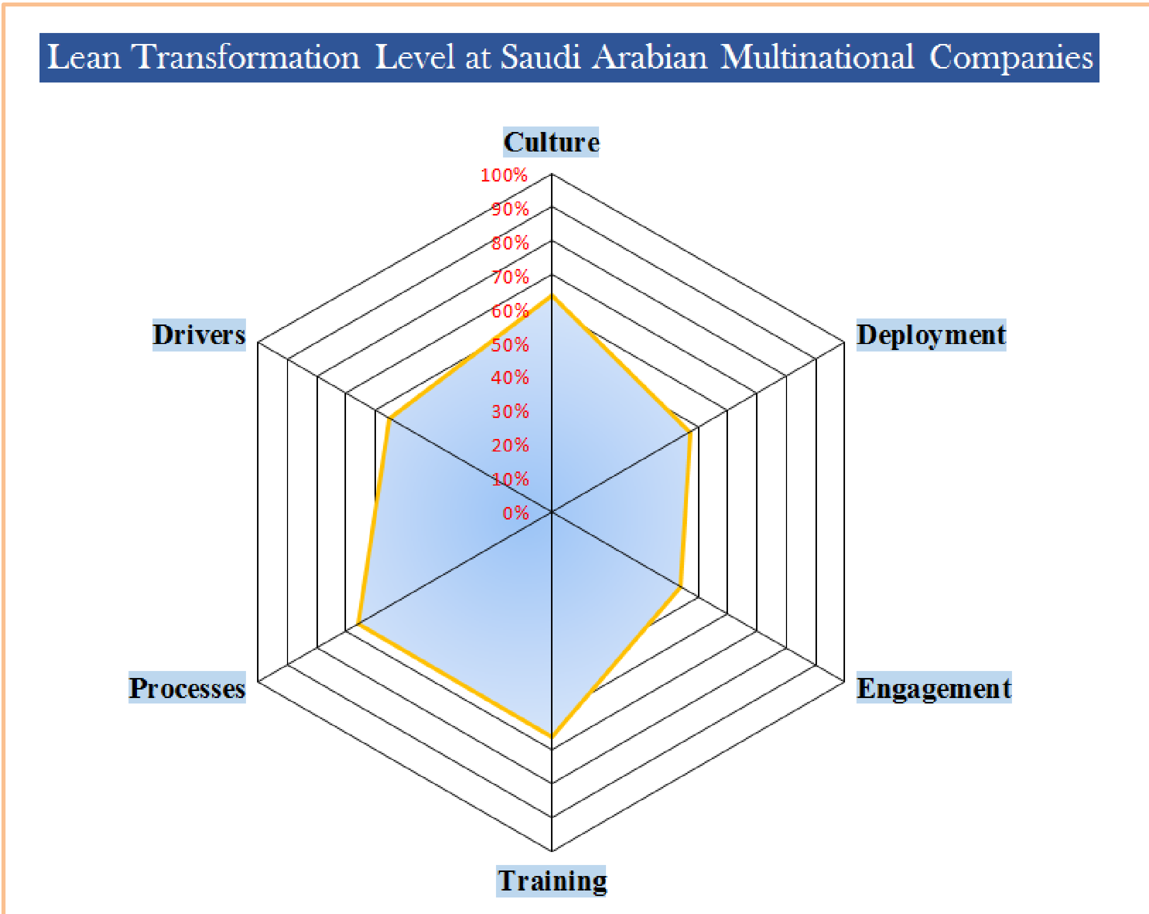


Figure 4-48: Lean Transformation Level at Saudi Arabian Multinational Companies

4.4 Data collection and analysis for Local Companies

4.4.1. Obeikan Investment Group

1. Company Background

The Obeikan Investment Group was established in 1982 and specializes in offering integrated solutions including Business to Business (B2B), Business to Consumer (B2C), and Business to Government (B2G) in Middle East and Africa in specific industries: paper and board, plastic, liquid packaging, education and e-learning, float glass, and real estate. Currently, Obeikan Investment Group exports to more than 75 countries and has 7,500 employees. The group values include respect, integrity, and fairness. In addition, its affiliated companies have obtained ISO 9001, ISO 18001 and ISO 1400.

2. Interviewee Background:

The interviewee is a General Manager at one of the Obeikan Investment Group companies. He is also the Business Excellence General Manager at Obeikan Investment Group. His work experience is 18 years: four years at Obeikan Investment Group, and nine years at P&G which is one a multinational company. He is a proficient in lean manufacturing, continuous improvement, production planning, supply chain management, strategic planning, and operation excellence business strategy. He has a master’s degree in Chemical engineering.

3. General Questions Responses:

1. Do you think organizations in Saudi Arabia are familiar with lean?

"Before answering I would like to give a brief about my background. I worked in in Saudi Arabia in two companies P&G Saudi Arabia for 10 years and Obeikan. In addition, I have very strong connection with many companies in Saudi Arabia like our suppliers. My feedback is that I have noticed that there is a vertical trend in Saudi Arabian companies in starting using the journey of lean. Despite that some companies are not doing it right, it is the time for lean not only to compete in the market but to survive currently in the market. So for lean yes companies with different scale started the journey and to there are many consultation firms in the floor which proving that how much the market is growing here in Middle East in terms of lean."

Then, he was asked to give a percentage for lean implementation level in Saudi Arabian local and multinational companies; he responded:

"Local companies can be divided to three categories: small, medium, big or group like Obeikan. For companies like us I consider it one of the moderate companies not very big like ARAMCO, I would say not more than 60%. Small companies have no thing and didn't start lean, and more than 80% of the big companies are familiar with lean. On the other hand, multinational companies there are working like hill on lean because they are driven outside that the experience are validated and proven how much return back to business; so, 100% of them are familiar with lean"

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

"Here I will reply base on my experience at Obeikan and I won't consider the multinational companies. The first thing I would consider it as a factor is commitment from top management. If there is no commitment from top management, it will never happen, why? Lean transformation is not something easy and we know at the beginning that there will be a lot of pain due to the culture change you are moving the whole business to a different directions. Top management like CEOs have to feel the pain and overcome with that pain and then cascade it to down until everyone believe in lean, otherwise it will never success. Thus, commitment is the first factor. The second factor I would say long term vision, we need to know where to go, how we track this and how we will assess our movements to have the right intervention on time. The long term vision helps to engage everyone in the company, and to have the right calibration and prioritization across whole organization. So, long term vision is the second main success factor. Third is mainly involvement of the whole levels in organization. This involvement at the beginning should be transferred as an ownership, otherwise, it will not success and be like two forces that going in different directions which will collapse the organization."

3. How long would you say it took to have a reasonable level of lean implementation in your company?

"Not less than five years because it is a journey and it doesn't end. Actually, in each phase you will have values but the right values that followed global standards and to do so you need more than 5 years."

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

"I would add working on organization's behavior and culture in parallel to all lean transformation which is consisting of building systems and capabilities. It is a key to deliver sustainable transformation because otherwise it won't be efficient and effective. Moreover, I would say one of the enabling tools for Saudi Arabian companies is to consider Saudi Arabia's Vision 2030. In Obeikan we are working very fast to match our strategy to the new strategies in Saudi Arabia. For example, the Saudi Arabia's Vision 2030 engaged us to start working as a partner with General Electric to build a new management system that is to develop a digitalization framework for lean transformation to help companies to have a ready product to use for lean transformation in their organization."

4. Lean Transformation Level at Obeikan Investment Group

Table 4-18 shows the responses regarding lean assessment at Obeikan Investment Group. The interviewee was asked to provide examples for each measure that is implemented in his company. As result, the company has attained average level of lean transformation as it will be shown below. Table 4-19 and figure 4-49 show that the highest level of implementation at Obeikan Investment Group is 60% in the training category, then 55% for deployment and 50% for culture. However, the company has low level in engagement category as 40%.

Table 4-18: Interview Responses for Lean Assessment at Obeikan Investment Group

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Table 4-19: Scores Summary for Lean Transformation at Obeikan Investment Group

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	5	2	2.50	50%
Deployment	11	4	2.75	55%
Engagement	6	3	2.00	40%
Training	6	2	3.00	60%
Processes	7	3	2.33	47%
Drivers	7	3	2.33	47%

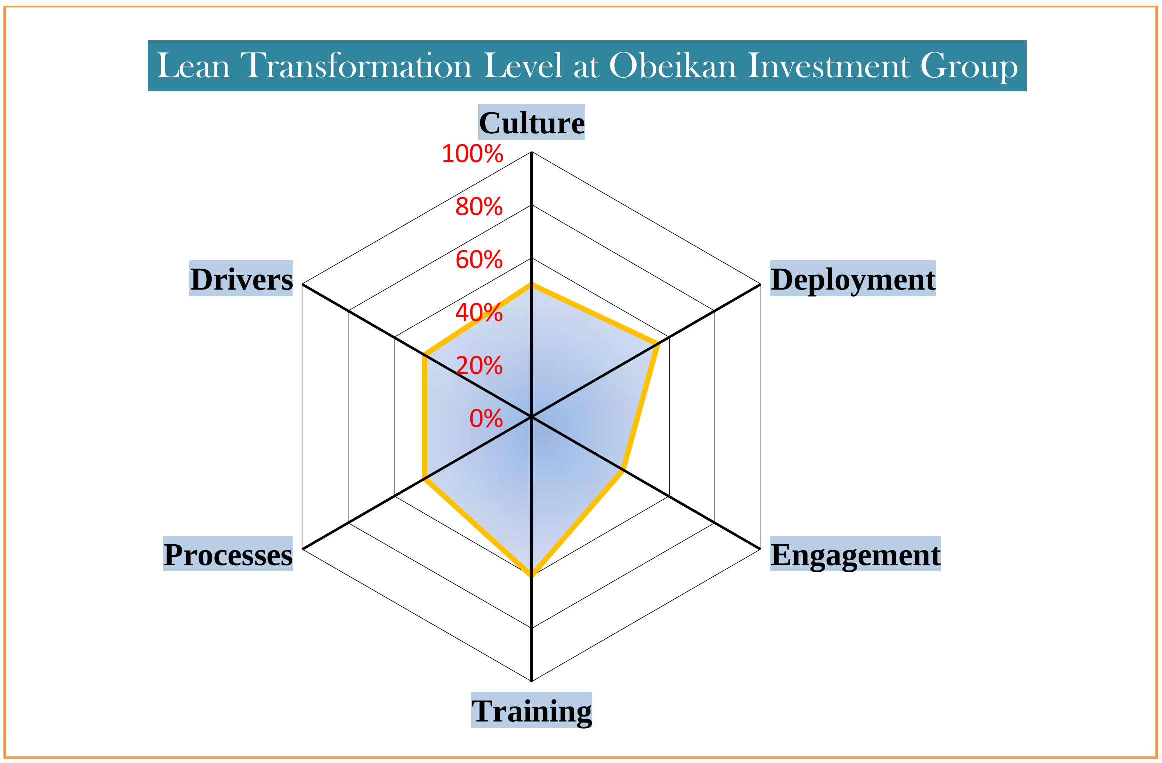


Figure 4-49: Lean Transformation Level at Obeikan Investment Group

5. Supported Documents:

The figures below were provided as supported documents for lean transformation level Obeikan Investment Group. In addition, examples for some lean methods that were applied are shown below. After analyzing these documents, it can be concluded that the company has a good start toward achieving a successful transformation to lean. Moreover, top management at Obeikan Investment Group is very supportive to lean transformation as it is noticed in their leadership system and strategic plans.

6. References:

- http://www.obeikan.com.sa/
- https://www.linkedin.com/company-beta/2307165/?pathWildcard=2307165

Obeikan Quality Pillar

What is the progressive quality pillar mission?

The aim of PQ is to develop and support the **Zero defect system**.

1. The system is often unable to detect and dynamically eradicate problems.
   1.1 The quality culture generally stems from a certification system (Process and product
   1.2 But it is often confined to an anomaly recording procedure and fire fighting action implementation
   1.3 The re-occurrence of anomalies is due to the inability of the system to detect and prevent them
   1.4 This system does not fit with various daily events (unplanned events, new process and product, labor turnover................)

2. The Progressive Quality Pillar drives us into the systematic process of loss eradication.
2
   2.1 Identifies, deploys and quantifies the off-quality cost's sources
   2.2 Develops the Know-How and support teams in eradicating the losses through an approach suited for the level of losses.
   2.3 Switches mindset from product quality control to process control and then to an efficient conditions management system to hold the gains.

3. The PQ Pillar combines the relevant pillars for eradication.
   3.3 internal quality e.g..process scrap, quality loss, material yield, overusage, rework, downgrade, second quality, selling price cut, obsolete products, overproduction, unsold products
   3.2 Inspection "QC" e.g... tests, samples, control operators, measurement system tools, Product SPC
   3.3 Prevention "Quality Achievement" e.g... standardization and SPECS, Poka-Yoke, Inspection operators, Process SPECS, Quality system and training.
   3.4 External Quality "Off-Quality" e.g..... Claims, Complaint, returns, Replacement
   3.4.1 External Quality "satisfaction measurement, e.g.... finished product audit and customer satisfaction score

Figure 4-50: Obeikan Quality Pillars

The progressive quality pillar develops the know-how and support teams in eradicating the quality related loss thru 3 phases:

Phase 1 Restore

- Understand the situation and select the topics “track the # of defects and defect modes”
- Restore and maintain the process condition

Phase 2 Improve

- Repetitive defects analysis and elimination
- A single defect analysis

Phase 3 Innovate

- Analysis & elimination of chronic & potential defects

Obeikan Progressive Quality pillar route goes thru 6 steps:

1 Analyze claims and waste and define targets and vision
2 Reduce claims and waste through restoration of the quality system
3 Reduce claims and waste through restoration of known conditions
4 Reduce claims and waste through process improvement
5 Reduce claims and waste through advanced problem solving
6 Introduce and manage the Zero waste system

Figure 4-51: Obeikan Quality Pillars Route

Figure 4-52: Obeikan Production System Pillar

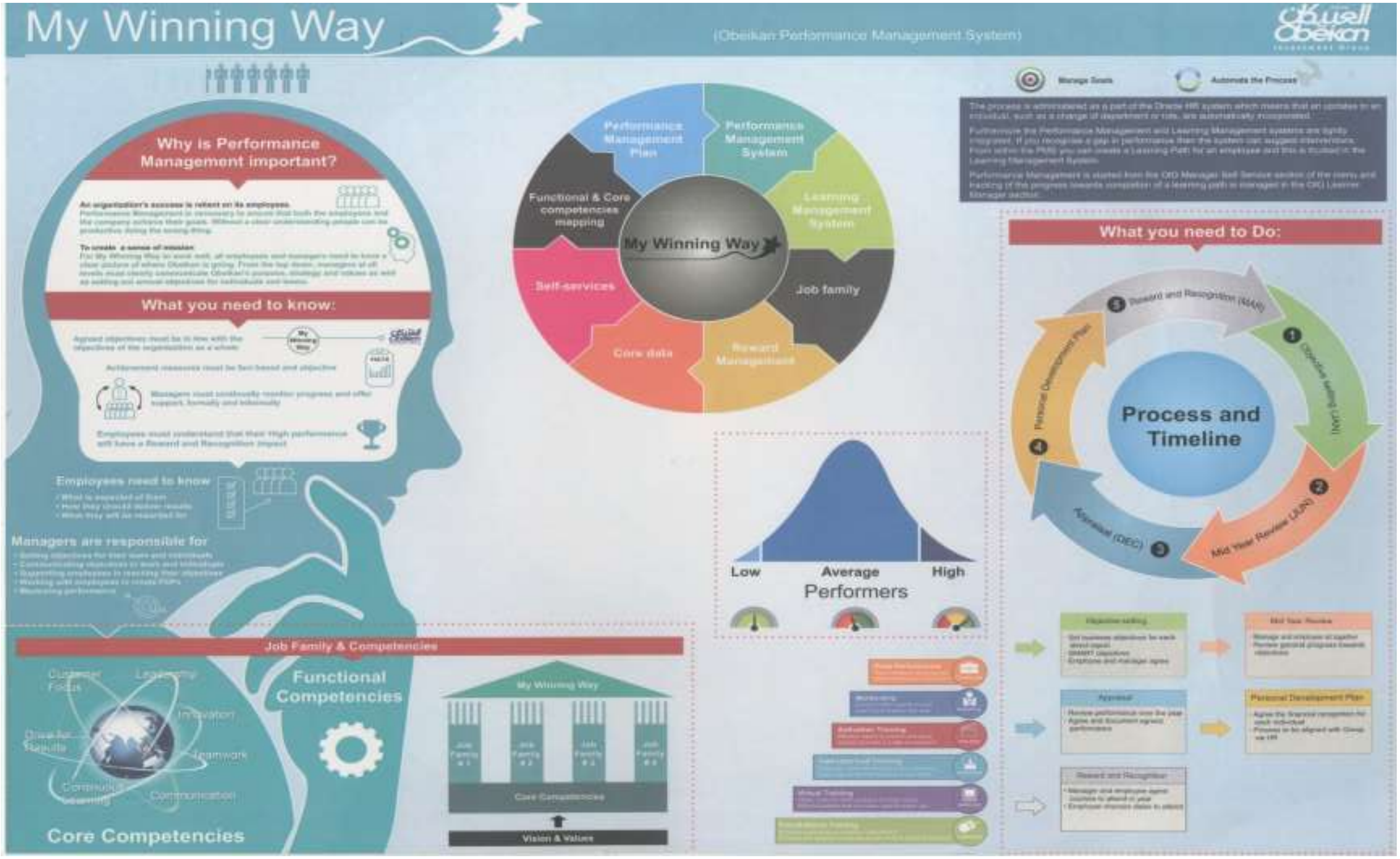


Figure 4-53: Obeikan Performance Management System

Figure 4-54: Sample of Visual Management at Obeikan


Implementation
Level of Standardization

Obeikan Rigid Plastic	*INTEGRATED MANAGEMENT SYSTEM*	ORP-	
	Die cleaning in Techne BM	*Revision* 1	*Page* 2/3
		Date of Implementation	

Process	Work to be done	Tools / Parts	Time in min	Machine Status	Illustration	Responsible	Remarks & Signature
START							
1 Preperation	Prepare the tools & PPE for Die cleaning	Copper rode Copper brush, Silicone spray	0 MIN	ONLINE		Operator	
2 Preperation	Call the bagging operator near to the machine and handover the tools and ask him to be ready at Right side	N/A	0 MIN	ONLINE	N/A	Operator	

Figure 4-55: Sample of Standardization at Obeikan

4.4.2. Aquat Foods (Al Baik)

1. Company Background:

AQUAT Food is an associated company with ALBAIK which is one of the largest food industries that has a manufacturing base industry and food services in Saudi Arabia. ALBAIK started in 1974, and in the year 2000, AQUAT Food was licensed to be a producer of ALBAIK food requirements, inaugurated a state-of-the-art food processing factory. The company serves more than 50 locations in diverse cities in Saudi Arabia. Missions of the company include following the highest standards of food safety, service and quality, providing the most competitive value possible, and hiring and dealing with highly motivated, successful and ethical team members, suppliers, and franchisees. AQUAT was awarded ISO 22000:2005 certification for its food safety management systems as the first food services firm in Saudi Arabia that has attain this level.

2. Interviewee Background:

The applicant for this company has 11 years of experience as a quality assurance manager. His bachelor degree is in Microbiology and Environmental Sciences, and then he has a post graduate diploma in Total Quality Management. In addition, he has a technical diploma in Statistical Process Control and a Six Sigma Green Belt.

3. General Questions Responses:

The interviewee preferred to respond with written answers to this section of the interview as it shown below.

1. Do you think organizations in Saudi Arabia are familiar with lean?

"Yes, to some extent, it may not be remarkable in majority of organizations, but international exposure of Saudi Businesses by means of multiversity of work force and joint ventures with international firms may have contributed to the promotion of lean concept of some companies, particularly with the ongoing growth of sustainability thinking and the need to optimize resources."

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

"Main success factors include but not limited to the following:

- Management commitment and involvement
- Training and education
- Employee participation and empowerment, and their job security and respect.
- Alignment to strategy and long term objectives
- Customer involvement, supplier involvement, cross functional integrations,
- Use of technology
- Environmental awareness and social responsibility."

3. How long would you say it took to have a reasonable level of lean implementation in your company?

"Five to seven years."

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

"Yes, may be cross functional resource utilization projects and joint investments in infra - structure in human development projects within defined future goals that tailored to implement lean concept on national level."

4. Lean Transformation Level at Aquat Foods (Al Baik)

Table 4-20 shows the responses regarding lean assessment at Aquat Foods. The interviewee was asked to provide examples for each measure that is implemented in his company. As result, the company has attained perfect level of lean transformation compared to other local companies as it will be shown below. Table 4-21 and Figure 4-56 show that Aquat has 87% in engagement and drivers categories, and then 80% in the training category. Moreover, it has 73% in processes, 70% in culture, and 60% in the deployment categories.

Table 4-20: Interview Responses for Lean Assessment at Aquat Foods (Al Baik)

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Adopt HR policies that support lean goals	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x

Table 4-21: Scores Summary for Lean Transformation at Aquat Foods (Al Baik)

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	7	2	3.50	70%
Deployment	12	4	3.00	60%
Engagement	13	3	4.33	87%
Training	8	2	4.00	80%
Processes	11	3	3.67	73%
Drivers	13	3	4.33	87%

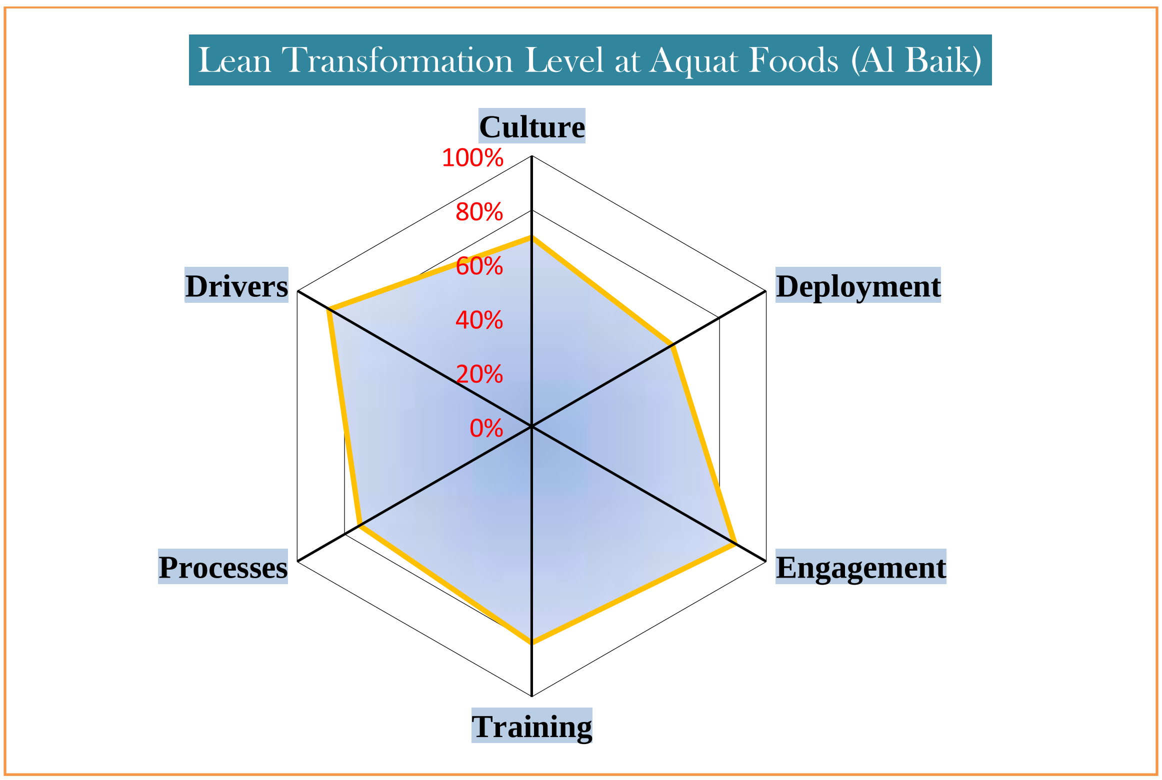


Figure 4-56: Lean Transformation Level at Aquat Foods (Al Baik)

5. Supported Documents:

The following figures below demonstrate the values for the company and customer feedback. Although Albaik values do not seem to be very supportive to lean, the information provided in the interview and the assessment for the company indicated that Albaik has a good level of lean transformation, and even better than some of multinational companies. The customer feedback survey and other tools to get the customers' feedback that Albaik offers are supportive to what the company has achieved in the assessment regarding the VOC.

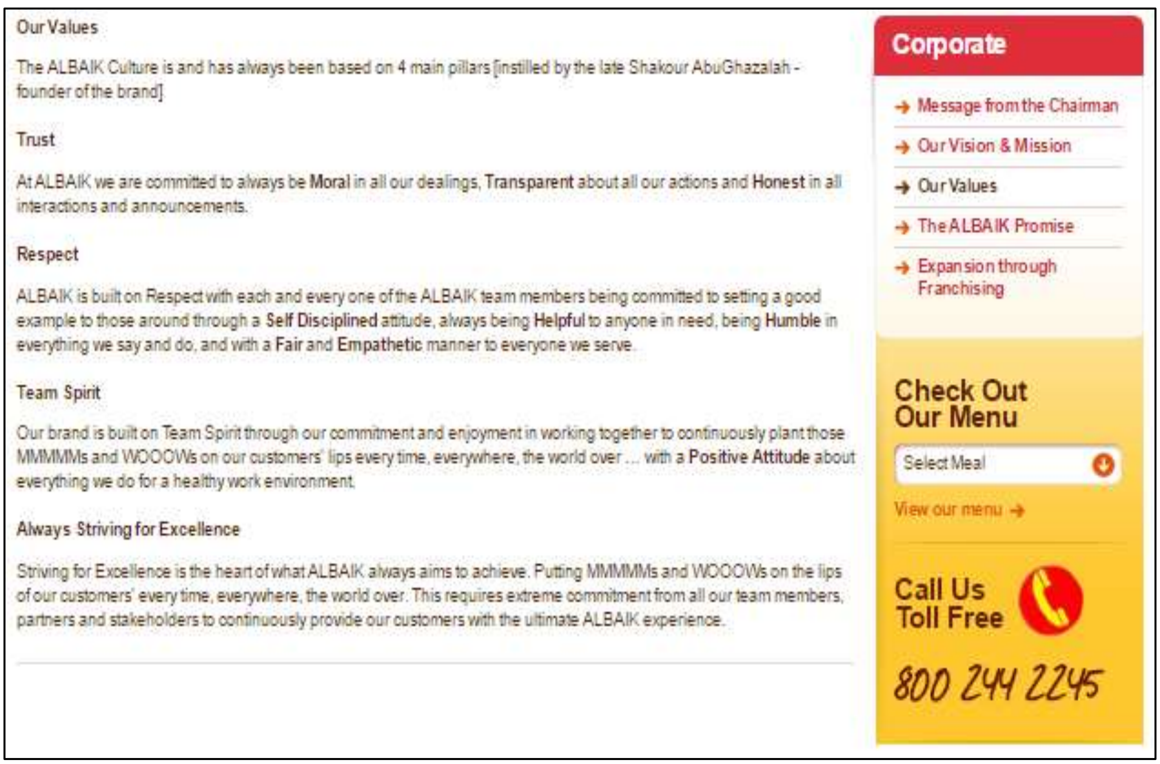


Figure 4-57: Albaik Values

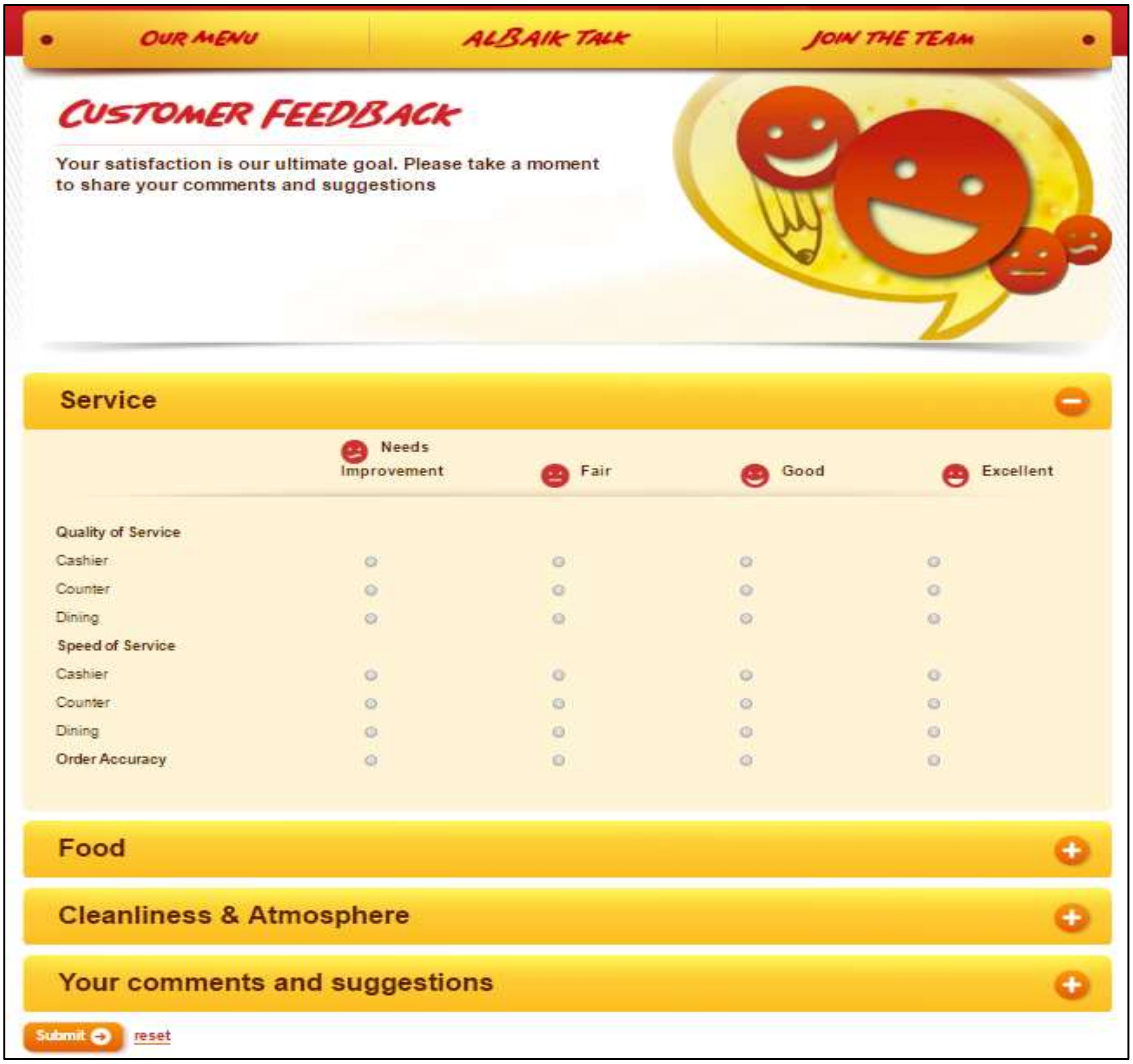


Figure 4-58: Customer Feedback Survey at Albaik

6. References:

- http://www.albaik.com/en
- https://en.wikipedia.org/wiki/Al_Baik

4.4.3. Almarai Company

1. Company Background:

Almarai Company started in 1977, and according to the company profile on LinkedIn, it is the largest integrated dairy foods company in the world. The company has around 42,000 employees servicing around 100,000 retail outlets with a turnover that exceeded 13.8 million in 2015. Almarai has obtained ISO 22000 accreditation for its dairy farms, and ISO 9001-2000 for its all divisions.

2. Interviewee Background:

The interviewee for this company has 16 years of experience in different companies in the UK and Saudi Arabia. He worked for six years as a team leader at Toyota Motor Manufacturing Company in UK. In addition, for the last seven years he has been a Lean Process Control Manager, an Operational Excellence Manager, and currently he is a Senior Business Excellence Manager. His bachelor's degree is in Civil Engineering, and his master's degree is in Operation and Supply Chain.

3. General Questions Responses:

<u>1. Do you think organizations in Saudi Arabia are familiar with lean?</u>

"From what I see it is about the people's interest, it depends on If companies want to have a climate change and looking for improving their quality and economy."

Then, he was asked to give a percentage for lean implementation level in Saudi Arabian local and multinational companies, he responded:

“I wouldn’t know exactly I know that companies like ARAMCO and Obeikan have started and achieved good level. I actually cannot give number for the company.”

Then, he was asked how about Almarai as a local company can you give a percentage, he responded:

“I believe we have a great understanding of lean. To give a percentage for local companies as in my own opinion I would estimate that for local company as 5% and for multinational company I don’t know”

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

“Willing to change, top down support, and level of competency with techniques. I think these are the main three drivers.”

3. How long would you say it took to have a reasonable level of lean implementation in your company?

“I properly say 12 months.”

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

"I think it is important to work on people's development and focuses on making lean as a part of their DNA."

4. Lean Transformation Level at Almarai Company

Table 4-22 shows the responses regarding lean assessment at Almarai Company. The interviewee was asked to provide examples for each measure that is implemented in his company. As result, the company has attained an average level of lean transformation as shown below. Table 4-23 and Figure 4-59 show that Almarai Company has 60% in training, 50% in processes, and 47% in drivers categories, which is a good level of implementation. In addition, the company has a low level in in culture, engagement, and deployment categories.

Table 4-22: Interview Responses for Lean Assessment at Almarai Company

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	
	Less than 1 year	x
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Table 4-23: Scores Summary for Lean Transformation at Almarai Company

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	3	2	1.50	30%
Deployment	7	4	1.75	35%
Engagement	5	3	1.67	33%
Training	5	2	2.50	50%
Processes	9	3	3.00	60%
Drivers	7	3	2.33	47%

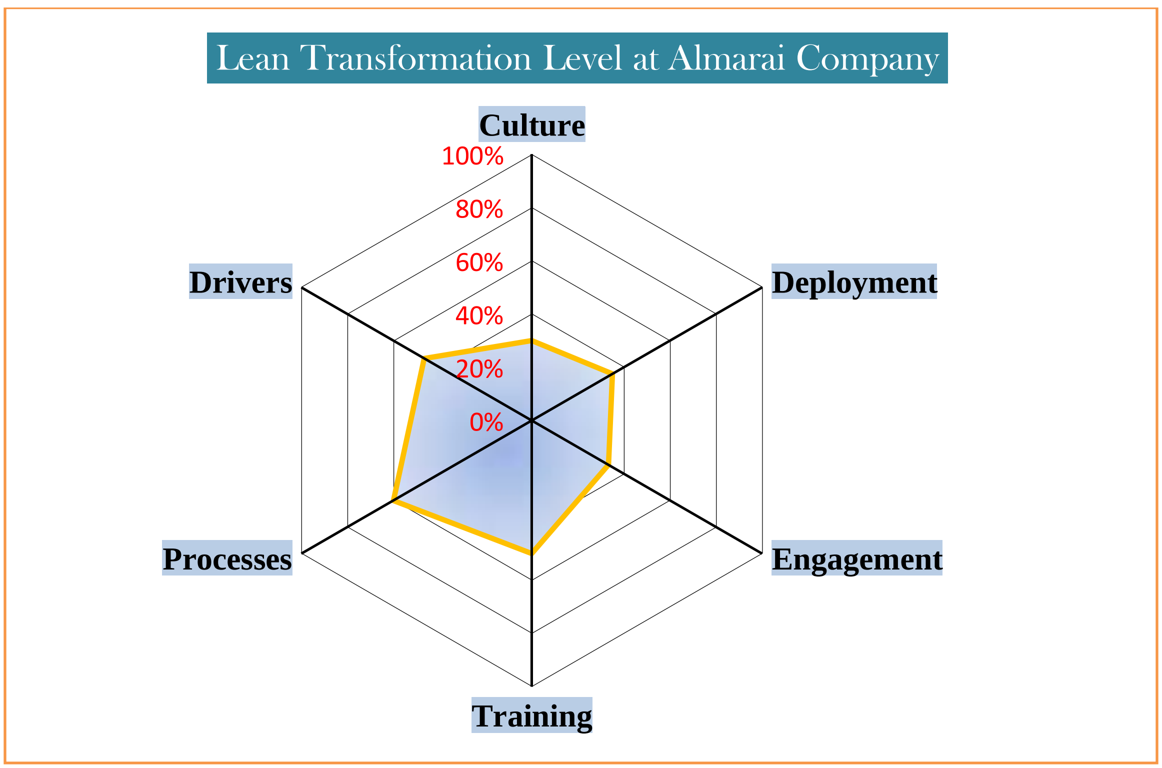


Figure 4-59: Lean Transformation Level at Almarai Company

5. Supported Documents:

The figures below were provided as supported documents for lean transformation level at Almarai Company. In addition, examples for some lean methods that were applied are shown below. After analyzing these documents, it can be concluded that the company has a good start toward achieving a successful transformation to lean. Moreover, top management is very supportive to lean transformation as it is noticed in their leadership system and strategic plans.

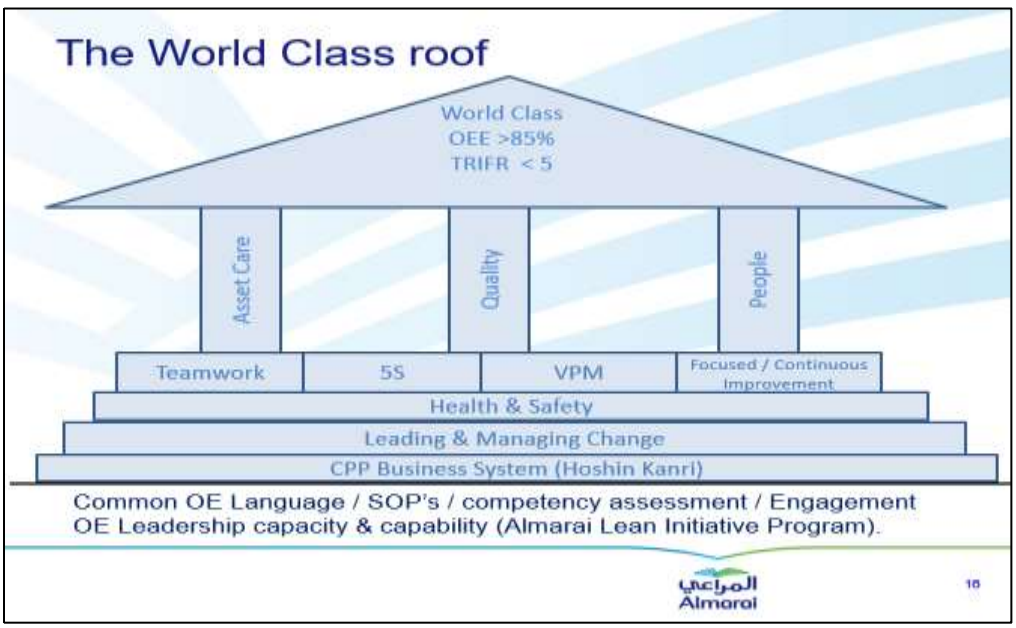


Figure 4-60: Almarai Operational Excellence Strategy

Figure 4-61: Almarai 2015 Manufacturing Focus - Development of Hoshin Kanri

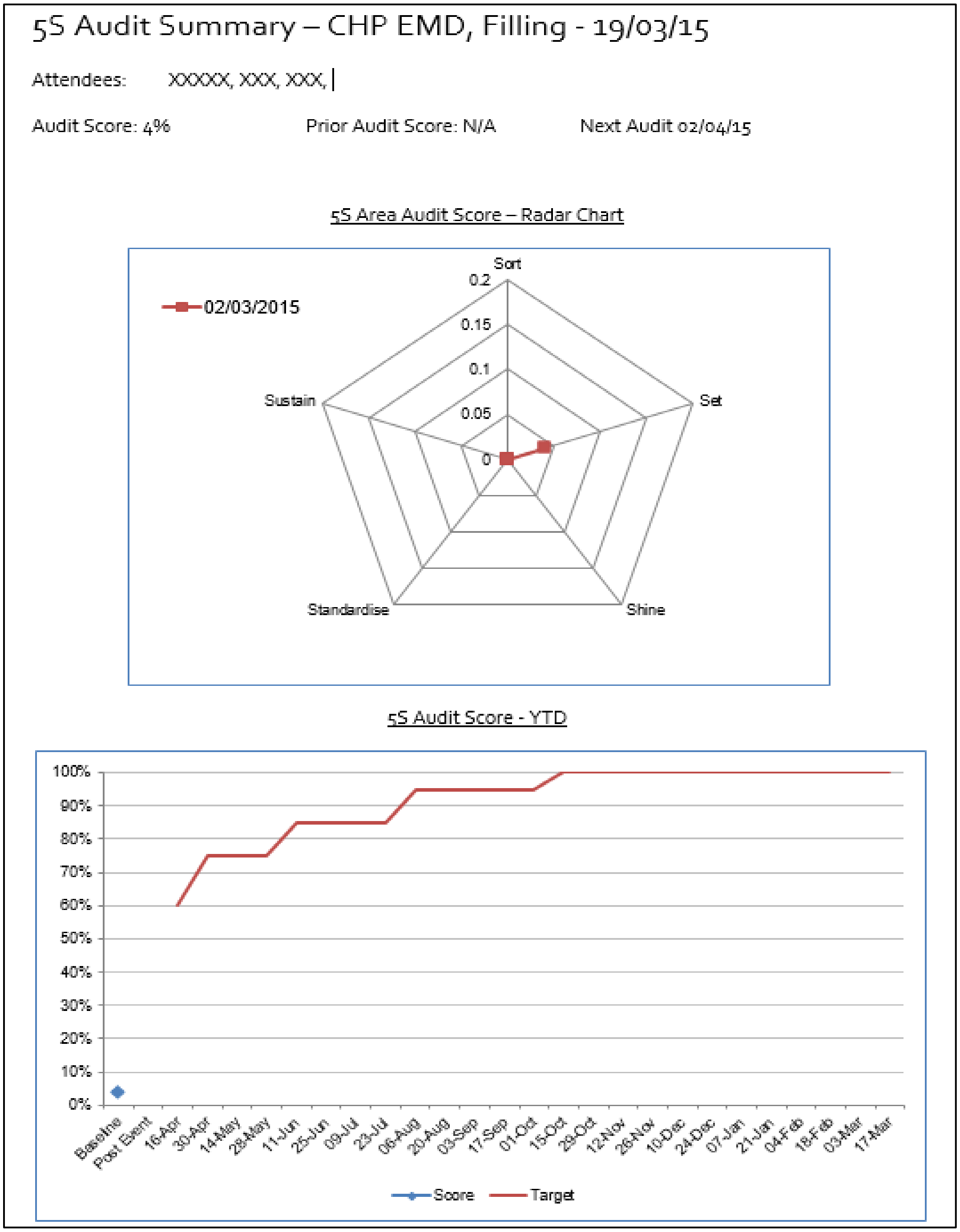


Figure 4-62: Almarai 5S Audit Summary (Part 1)

Summary of Non Conformances from Audit

Sort

- Excess materials kept in workshop and in office.
- No information, notices or KPIs posted
- No Cleaning equipment available. Reliance on getting equipment from Production
- A number of obsolete/slow moving items kept in workshop (UHT bends, hoses & polycarbonate sheets)

Set in Order

- No location indicators. No map of where things are. Shelves had no location indicators to highlight what items are to be stored in specific locations
- No min/max quantity indicators
- No line markings/demarcation
- Waste oil drum not clearly labelled to indicate contents

Shine

- Floor not clean
- Not all machine surfaces have been cleaned
- Regular cleaning is not evident
- Walls were dirty
- Shelves in Oil Cabinet not clean, and were oily.

Standardise

- No Area standards are posted in the area
- No cleaning schedule (with assigned responsibility to team members) is available.
- Area standards are not being followed *(can't be done if it's not posted)*
- Area procedures are not posted
- Area procedure is not being followed *(can't be done if it's not posted)*

Sustain

- Blank 5S audit sheets are not available
- No 5S audit roster (needs to include all members of the team, and not just the managers).
- 5S results are not posted in the area
- Non conformance sheet is not available
- No improvement since last audit *(note – this was the initial audit)*

Figure 4-63: Almarai 5S Audit Summary (Part 2)

Figure 4-64: Sample of Almarai Lean Six Sigma Green Belt Project

Figure 4-65: Sample of Almarai Lean Six Sigma Yellow Belt Project

6. References:

- ➢ https://www.linkedin.com/company-beta/218694/
- ➢ http://www.almarai.com

4.4.4. Arabian Chemical Terminals (ACT)

1. Company Background:

ACT started in 1985 as a family business operated by Mobil Saudi Arabia which then now called ExxonMobil for 15 years. Then, the company became under Reza Investment Group which has around 4000 employees. In 2012, the group developed a Bulk Liquid Chemical Terminal, which serves the petrochemical industries in the area by receiving, storing, and re-delivering petroleum based products and liquid petrochemicals. The company now owns two terminals in Saudi Arabia with 51 tanks and three jetties. ACT has adopted the process approach advocated by ISO 9000:2005 and fulfilled ISO 9001:2008 requirements.

2. Interviewee Background:

Interviewee from this company has more than 10 years working experience in Netherland and Saudi Arabia. He worked for six years as a Business Development Manager in one of the company’s terminals. He holds a PhD in Strategic Managements and Entrepreneurship and has a mechanical engineering background.

3. General Questions Responses:

1. Do you think organizations in Saudi Arabia are familiar with lean?

"Not really, I think no."

Then, he was asked to give a percentage for lean implementation level in Saudi Arabian local and multinational companies, and he responded:

"Of course international companies buy lean like Toyota; it is made by them. However, I don't know the percentage in Saudi Arabia. I would say multinational companies in Saudi Arabia are familiar with lean with level of 80% and local that I have seen with level of less than 20%"

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

"I have introduced the following critical success factors in our company:

- Fist is to train the involve people. All stakeholders need to be trained. They have to be aware about lean to make it success.
- Implementation overall of the company. Lean for a company is not a subject of one department, it is overall or nothing.
- Keep on tracking it.
- Reward for achievements."

3. How long would you say it took to have a reasonable level of lean implementation in your company?

"Two years."

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

"Well, often people misuse the term of Lean with Lean Six Sigma. However, I think for a successful lean transformation in Saudi Arabia, it is important to implement Six Sigma. This is common in Holland and the U.S. I think and I don't see that here in Saudi. For example, the company should approach Six Sigma projects in addition to Kaizen, 5S, Hoshin, etc."

4. Lean Transformation Level at Arabian Chemical Terminals

Table 4-24 shows the responses regarding lean assessment at ACT. The interviewee was asked to provide examples for each measure that is implemented in his company. As result, the company has attained an average level of lean transformation as it will be shown below. Table 4-25 and Figure 4-66 show that this company has 50% in training, 50% in culture, and 47% in processes. In addition, the company has low level in engagement categories as of 20%.

Table 4-24: Interview Responses for Lean Assessment at Arabian Chemical Terminals

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Table 4-25: Scores Summary for Lean Transformation at Arabian Chemical Terminals

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	5	2	2.50	50%
Deployment	6	4	1.50	30%
Engagement	3	3	1.00	20%
Training	5	2	2.50	50%
Processes	7	3	2.33	47%
Drivers	4	3	1.33	27%

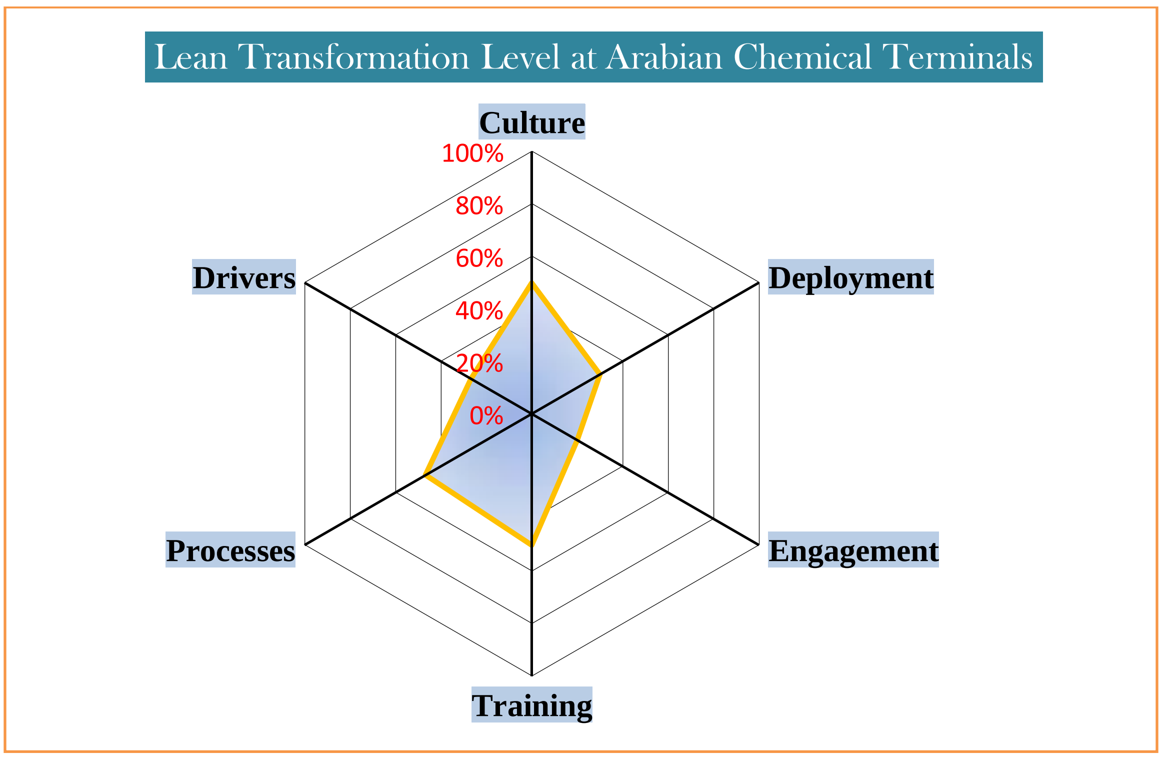


Figure 4-66: Lean Transformation Level at Arabian Chemical Terminals

5. Supported Documents:

Figures below were provided as some of the supported documents for lean transformation level at ACT. After analyzing these documents in addition to the information in the interview, it can be concluding that the company has a good start toward achieving a successful transformation to lean. Moreover, top management is very supportive to lean transformation as it is noticed in their leadership system and strategic plans.

SOPs are based on PDCA philosophy.

The 4-steps of the Deming Cycle are defined as follows:

1. Plan: Here we create the plan to revise business process components to improve results.
2. Do: Implement the new process or processes. This is often done on a very small scale (remember it's small, continuous, incremental improvement we're after).
3. Check: Measure the improvements.
4. Act: Analyse differences in expected improvements, actual improvements, and previous state. Based on this, determine where your next improvements will be made. Here we also look at the mistakes made in executing the Deming Cycle and take action so we don't make those same mistakes next time.

Figure 4-67: One of the Quality Management Concepts in ACT

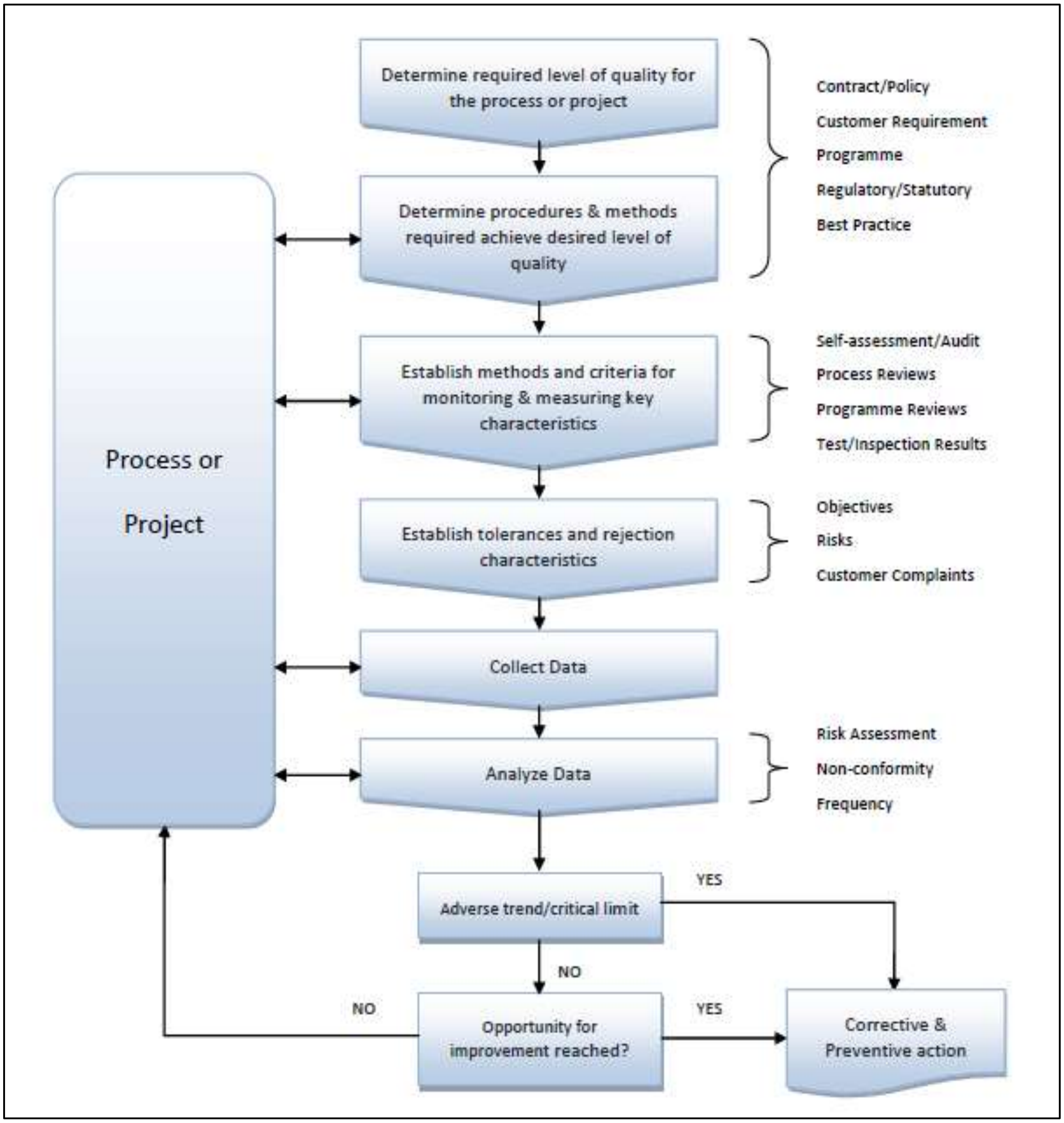


Figure 4-68: Quality Planning Process Map Followed in ACT

Operational Excellence

ACT values safety over production as the main asset for its manpower. In another word, ACT cares for each employee working in any ACT facility. To ensure the safety of each person, reliability of equipment and the quality of production, ACT put in place the "Tenets of Operation";

- Never operate equipment outside of design or environmental limits.
- Always move to a safe, controlled condition, and seek assistance when a situation is not understood.
- Always operate with safety devices in service.
- Always follow all safe work practices/procedures and act to stop unsafe conditions and actions.
- Always produce a product that meets or exceeds your customers' requirements.
- Never contaminate or compromise a dedicated system.
- Always report environmental, health, and safety compliance information accurately and on time.
- Always address abnormal conditions and clarify/understand procedures before proceeding.
- Always follow written procedures for high risk or unusual situations.
- Always involve people with expertise and firsthand knowledge in decisions, improvements and changes.

Tenets are intended to protect people, the environment, and equipment based on three common sense principles:

- DO IT SAFELY or NOT AT ALL!
- THERE'S ALWAYS TIME TO DO IT RIGHT!
- IF IT'S WORTH DOING, DO IT BETTER!

Figure 4-69: Operation Excellence at ACT

6. References:

- http://arabianchemicalterminals.com/
- https://www.linkedin.com/company-beta/8389747/

4.4.5. Oil Company in Saudi Arabia

The name of this company is not stated based on the interviewee's request.

1. Company Background:

    This company is a large-sized Saudi company which was founded in 1988. It is the world's largest oil and gas company. It has a fleet of oil tankers and invests in refineries, marketing, and distribution ventures in other countries such as the USA, Japan, South Korea, and China. Number of employees in this company is around 70,000 in its diverse locations. All departments and refineries are ISO certified; for instance, the Environmental Management System (EMS) is based on ISO 14001-2004 specifications was developed and implemented.

2. Interviewee Background:

    The interview for this company was conducted with two interviewees. The first one is an Inspection Engineer with 15 years of experience in quality and process improvement. He holds a master's degree in Quality Systems Engineering and he has Lean Six Sigma Black Belt. The second interviewee is an engineering consultant and responsible for the new business development department at the company more than 15 years of experience.

3. General Questions Responses:

The interviewee preferred to respond with written answers to this section of the interview as shown below.

1. Do you think organizations in Saudi Arabia are familiar with lean?

"No, the majority know about it, however, rarely implement it."

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

1. "Awareness of lean principles and benefits.
2. Involvement of people in the implementation phase of lean.
3. Management commitment.
4. Hire or develop professionals to facilitate lean implementation.
5. The extent of business opportunities.
6. Establish measures to demonstrate lean effect of bottom line."

3. How long would you say it took to have a reasonable level of lean implementation in your company?

"Companies' transformation to lean may take five to eight years."

4.Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

"Refer to Saudi Vision 2030 to obtain more details about the transformation."

4. Lean Transformation Level at the Oil Company

Table 4-26 shows the responses regarding lean assessment at the Oil Company. The interviewee was asked to provide examples for each measure that is implemented in his company. Table 4-27 and Figure 4-70 show that the Oil Company has 67% in drivers category, which is a high percentage, and 20% in the engagement category as a low level of implementation. Moreover, it has 33% in processes and 50% in the culture, deployment, and training categories.

As a result, the company has attained a high level of lean transformation compared to other local companies. The company needs to focus more in the engagement category as well to improve both the culture and process categories.

Table 4-26: Interview Responses for Lean Assessment at Oil Company

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
See the value in developing internal lean leaders and Senseis.	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x

Table 4-27: Scores Summary for Lean Transformation at Oil Company

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	5	2	2.50	50%
Deployment	10	4	2.50	50%
Engagement	3	3	1.00	20%
Training	5	2	2.50	50%
Processes	8	3	2.67	53%
Drivers	10	3	3.33	67%

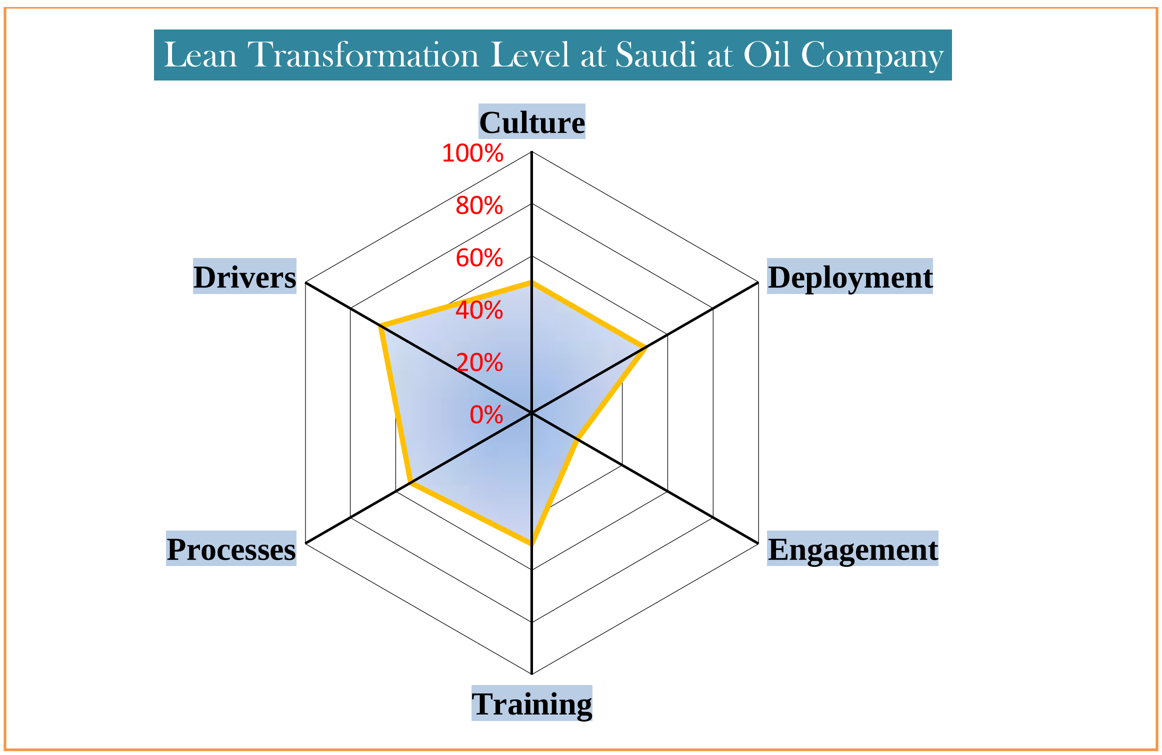


Figure 4-70: Lean Transformation Level at Oil Company

5. Supported Documents:

The figures below were provided as some of the supported documents for the lean transformation level at the Oil Company. After analyzing these documents in addition to the information in the interview, it can be concluded that the company has a good level in achieving a successful transformation to lean. Moreover, the management is very supportive of lean transformation as noticed in their strategic plans and quality management systems.

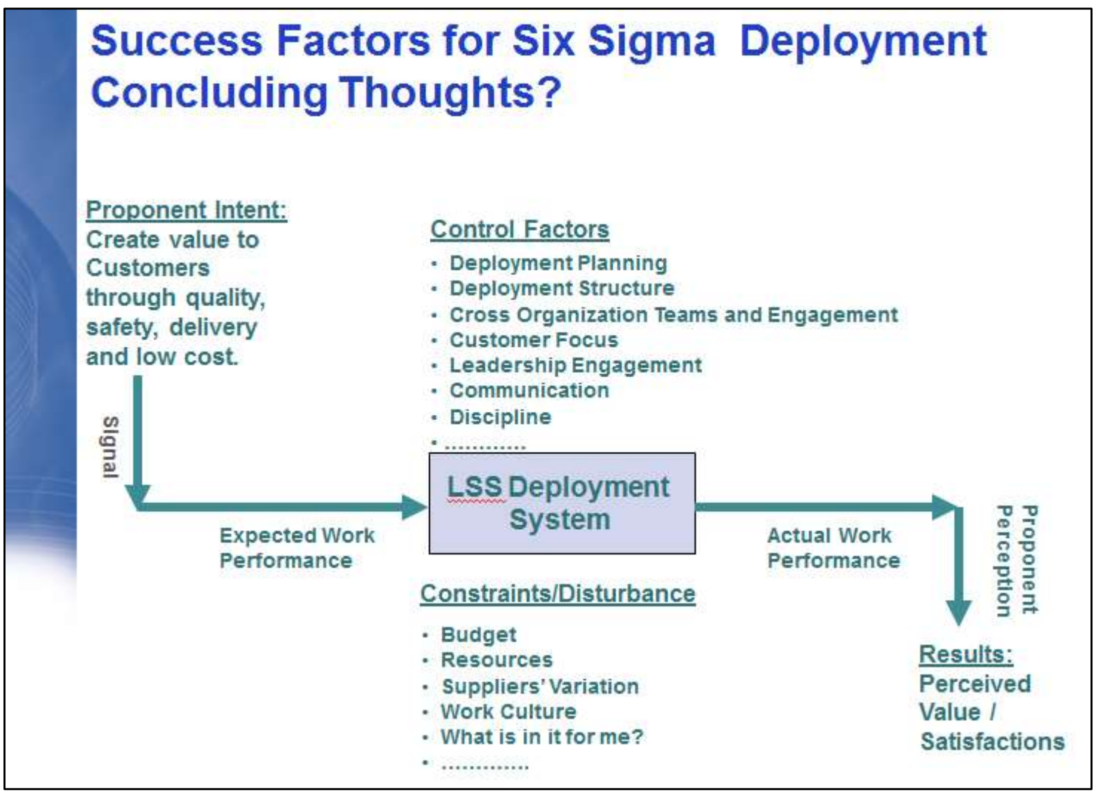


Figure 4-71: Sample of Training Material Used at Oil Company

Success Factors for Six Sigma Deployment
What can be done?

Focus Area	
Functional Control / Threats	• Define engagement rules across organizations • Promote cross functional teams • Identify benefits to all • Define and monitor Roles and Responsibilities
Budget Constraint	• Design a program that goes with available budget • Capitalize on internal resources
Unavailability of high rate training providers	• Start with a small group using credible training institute and roll down • Design a certification program where work projects are main drivers to learn
Lack of Assessment and in process checks	• Have periodic LSS program reviews and assessments
Lack of KPIs	• Require, monitor and assess In-process deployment KPIs

Figure 4-72: Sample of Training Material Used at Oil Company

Success Factors for Six Sigma Deployment
What can be done?

Focus Area	What Can be Done?
Jumping to conclusion w/o data	• Instill structured DMAIC Approach • Ask for evidence supporting Decisions to create appropriate behaviors
Lack of Information on what the customer consider as a value	• Create Customer clinics
Failure to acquire appropriate data or right Analysis	• Require data collection plan • BBs/MBBs as mentors / monitors
Inability to translate customer concerns to process concerns	• Deploy tools to translate customer concerns to Process Parameters
No commitment to deploy the solutions	• Project team and champion sign with owner commitment agreement • Project team work with constraints to obtain workable / implementable solutions

Figure 4-73: Sample of Training Material Used at Oil Company

Figure 4-74: Approached Quality Managements Principles at Oil Company

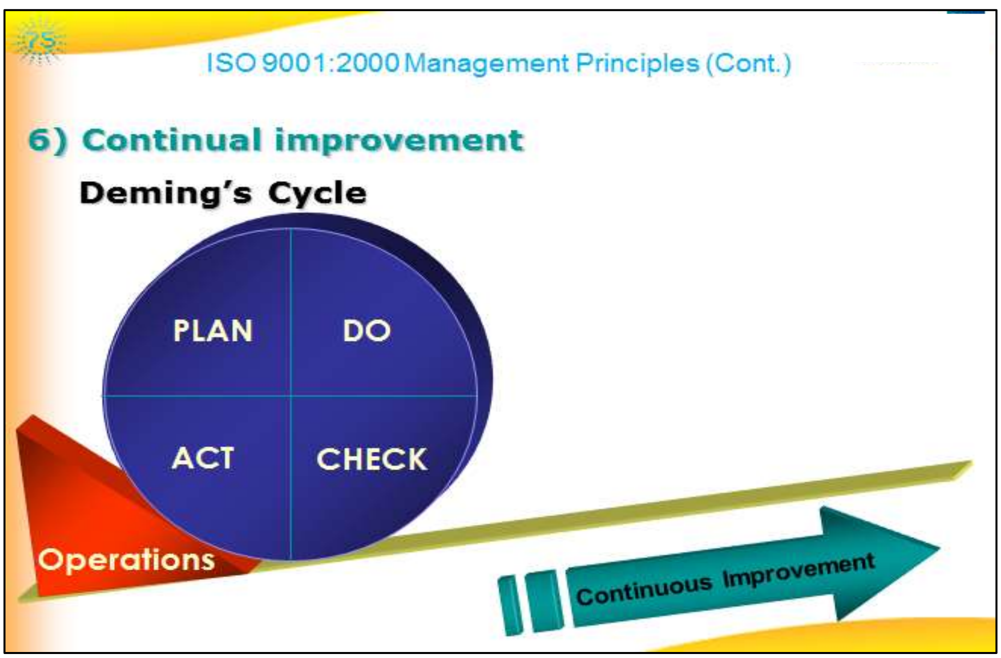


Figure 4-75: Sample of approached CI principle at Oil Company

4.4.6. NADEC Foods

1. Company Background:

The National Agricultural Development Company (NADEC) was started in 1981 and 20% of the company is owned by the government. It is one of the largest agricultural and food processing firms in the Middle East and North Africa. According to the 2015 annual report, the company has about 7,000 employees and about 40,000 daily products in Saudi Arabia and Gulf Cooperation Council (GCC) countries. NADEC has obtained ISO 9001, ISO 22000, and ISO 17025. The company has earned different local and international awards. For example, in 2015, NADEC was awarded as the *World Leadership Congress & Awards* and *Kantar World Panel* places NADEC brand in the top 10 most popular brands in Saudi Arabia.

2. Interviewee Background:

The interview for this company was conducted with two interviewees. The first is a supply chain professional with 10 years working experience in end-to-end supply chain management. He has worked for four years as a Planning & Site Logistics Director and was in charge of leadership and logistics operations, which covers both site warehouses and long haul transportation, optimizing current resources, leading necessary projects to improve service levels, reducing operational costs, and drive operational excellence. The second interviewee has seven years working experience with NADEC as a plant operations and organization development manager, and lean manufacturing manager. He led the Industrial Organization Excellence project with 750 employees at NADEC.

3. General Questions Responses:

1. Do you think organizations in Saudi Arabia are familiar with lean?

"No, not all of them. As I noticed many companies in Saudi Arabia are not familiar with what lean is covering. I think they just know that lean is a good thing in manufacturing without deep knowledge about lean. It is important to know the impact of adapting lean to the management, vision, and their strategic plans. The head in companies should believe that change to lean is the future of the company. It is almost impossible to transfer to lean, if top management does not support this change"

Then, he was asked to give a percentage for lean implementation level in Saudi Arabian local and multinational companies; he responded:

"To be very optimistic, for local I would say 50% and 95% for multinational companies. My numbers are about companies in Saudi Arabia which I think it represent the other developing countries."

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

"First and the most important factor is top management believe. I meant the executive should be convinced and buy it. I have witnessed this in NADEC. Second, like any other transition it is crucial to involve people on board such as workers on operations, shop floor and warehouse. Third, actually in developing countries we are lacking of a discipline in manufacturing. Discipline means consistency we need to change the habit of being not patient and try different method every day. Thus, it is essential that to have a commitment to the transformation to lean."

3. How long would you say it took to have a reasonable level of lean implementation in your company?

"With applying the previous factors such as management buy it, I think to see results I would say within three years. Lean is a continuous journey and there will be always room for improvements"

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

"When I worked in a multinational company lean program was brought from the mother company which is organized and explained step-by-step. However, in some cases there were some principles that not addressed very well because the trainer was not aware about it. We had the feeling that some of lean tools are difficult and complicated but actually it is not. Some lean tools you do not have to be very sophisticated to use them. To sum up, proper training is very important to simply educate people and engage them to achieve a successful level of lean transformation."

4. Lean Transformation Level at NADEC Foods

Table 4-28 shows the responses regarding lean assessment at NADEC Foods. The interviewee was asked to provide examples for each measure that is implemented in his company. Table 4-29 and Figure 4-76 show that NADEC has 53% in drivers and 50% in the training and culture categories. For the engagement category, the company has 40%, for deployment category it has 45%, and 47% for processes category.

As result, the company has attained an average level of lean transformation. NADEC Foods needs to focus more in engagement category as well as to improve deployment and process categories.

Table 4-28: Interview Responses for Lean Assessment at NADEC Foods

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Table 4-29: Scores Summary for Lean Transformation at NADEC Foods

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	5	2	2.50	50%
Deployment	9	4	2.25	45%
Engagement	6	3	2.00	40%
Training	5	2	2.50	50%
Processes	7	3	2.33	47%
Drivers	8	3	2.67	53%

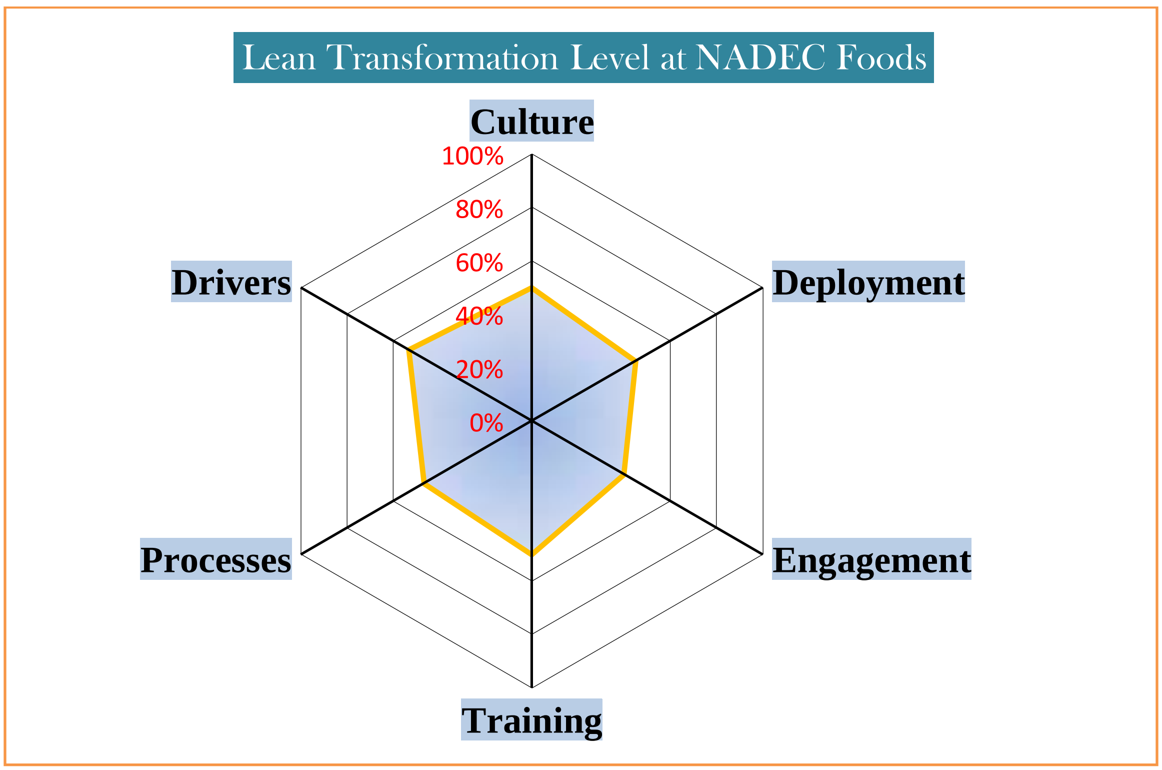


Figure 4-76: Lean Transformation Level at NADEC Foods

5. Supported Documents:

The 2015 NADEC Foods annual report (Arabic version) and one of the interviewee's LinkedIn page were retrieved as supported documents that support some of lean programs at NADEC Foods. By analyzing these documents in addition to the interview information, it can be concluded that the company has a good start toward achieving a successful transformation to lean. Moreover, the upper management is very supportive towards lean transformation as is noticed in their leadership system and strategic plans.

Lean Manufacturing Manager
NADEC
June 2013 – March 2015 (1 year 10 months)

Industrial Organization (750 employees) Excellence:
☐ Build Industrial Organization Structure – ZERO Base.
☐ Organization development plan
☐ Resources efficacy KPI's
☐ Identify recruitment priorities and plan
☐ Follow-up recruiting steps with HR-Recruiting

Industrial Operation Development:
☐ Establish Safe Working Environment
☐ Establish LEAN working culture
☐ Build a training plan for employees on LEAN Methodologies (5S, AM, PM, FDS, VSM, ... etc)
☐ Implement Manufacturing Performance Management Standards
☐ Organization KPI's definition.

Losses Management:
☐ Losses Reading
☐ Losses Mapping
☐ Losses Reduction

Company Initiatives:
☐ Establish new innovations management
☐ Member of the company initiatives MFT, representing Industrial Department.
☐ Manage initiative execution inside the plants.

Figure 4-77: Sample of Duties for a Lean Manufacturing Manager at NADEC

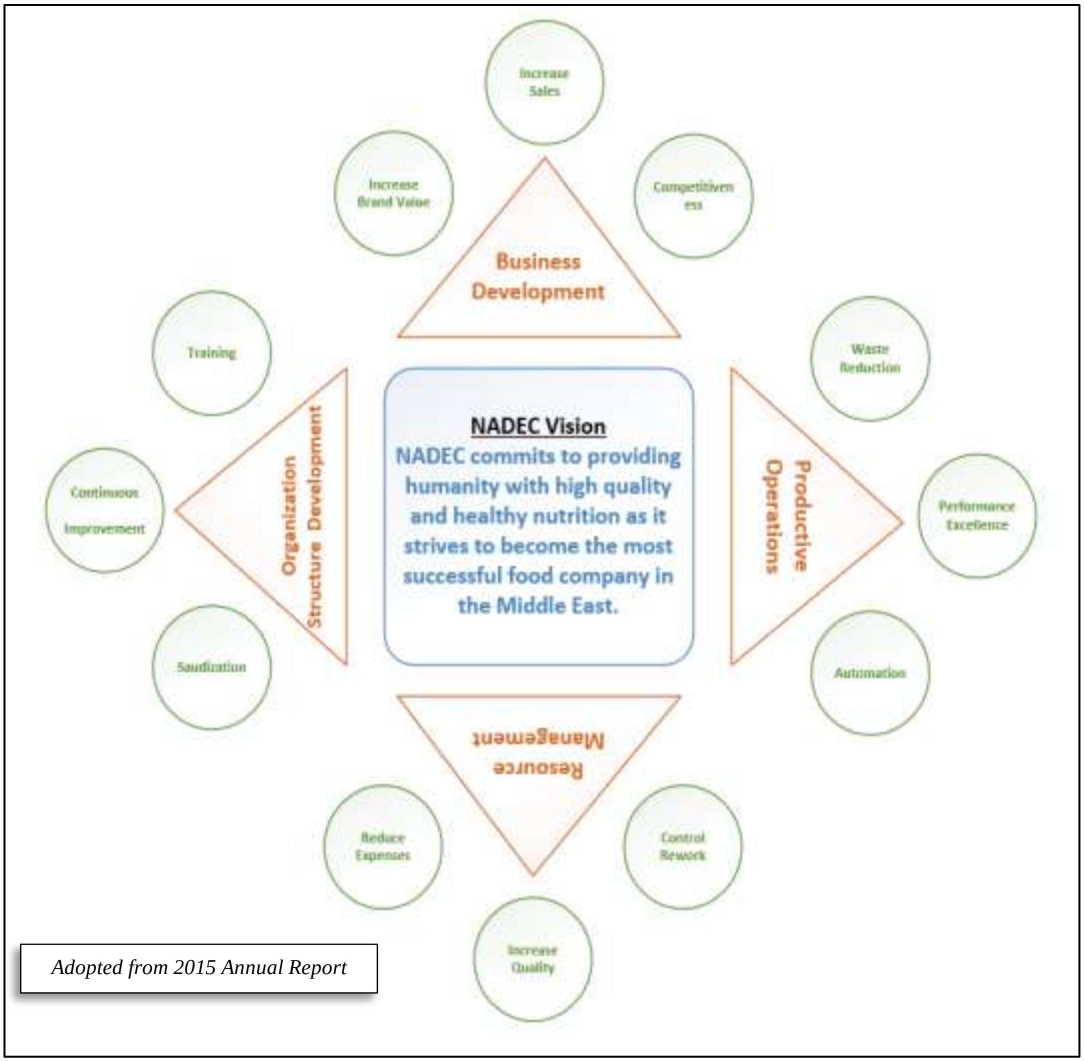


Figure 4-78: NADEC Strategy Core Elements

6. References:

- www.nadec.com.sa
- https://www.linkedin.com/company/nadecfoods
- https://en.wikipedia.org/wiki/Nadec

4.4.7. United Sugar Company (part of Savola Group)

1. Company Background:

United Sugar Company is one of Savola Group Companies. It was established in 1995 and currently is considered as one of the top three refineries in the world in capacity. The core values of the company come from Savola Group values, which include self-nourishment, interactive nourishment (teamwork dynamics), and released nourishment (organizational culture). The company's products are distributed in 70 countries around the world. United Sugar Company has obtained ISO 22000, ISO 9001:2008 and OHSAS 18001.

2. Interviewee Background:

The interview for this company was conducted with two interviewees. The first one has seven years of experience in quality and process improvement at United Sugar Company. He is in charge of developing, controlling product structure and packaging materials for more than 300 SKUs[11], and approving a turnover worth over $1 billion across 70 countries around the world. In addition, he is IRCA Certified for ISO 9001:2008 Lead Auditor and ISO 22000 Internal Auditor. The second interviewee has 13 years of experience at different companies in Savola Group. He is leading the Total Productive Manufacturing (TPM) program at the Company.

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[11] A stock-keeping unit (SKU) is a unique number to identify a billable item in a firm's inventory.

3. General Questions Responses:

1. Do you think organizations in Saudi Arabia are familiar with lean?

"I think lean is not popular in local companies in Saudi Arabia and in multinational companies are also weak."

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

"In my opinion the most important factor is management support. Like in our company when the top management believed in the TPM program, they fully support it. They dedicated a full time team to implement it"

3. How long would you say it took to have a reasonable level of lean implementation in your company?

"I don't have a specific answer but let's talk about TPM program in our company. The management target for TPM was three years."

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

"I would say that we were working to be certified and get British the Retail Consortium (BRC) and ISO 22000 and I found that some of requirements that associated with these programs can support the lean initiative in the company."

4. Lean Transformation Level at United Sugar Company

Table 4-30 shows the responses regarding lean assessment at United Sugar Company. The interviewee was asked to provide examples for each measure that is implemented in his company. Table 4-31 and Figure 4-79 show that United Sugar Company has 33% in engagement and drivers categories, and 10% only in training category. For processes category the company has 27%, and for deployment and processes categories it has 20%.

As result, the company has attained a low level of lean transformation. United Sugar Company started TPM, which is a good start point to achieve a successful lean transformation. It is crucial for the company to invest more on training and increase the level of awareness about lean in the entire level of the organization.

Table 4-30: Interview Responses for Lean Assessment at United Sugar Company

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	
	Less than 1 year	x
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	
	Less than 1 year	x
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	
	Less than 1 year	x
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	x
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	x
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Table 4-31: Scores Summary for Lean Transformation at United Sugar Company

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	2	2	1.00	20%
Deployment	4	4	1.00	20%
Engagement	5	3	1.67	33%
Training	1	2	0.50	10%
Processes	4	3	1.33	27%
Drivers	5	3	1.67	33%

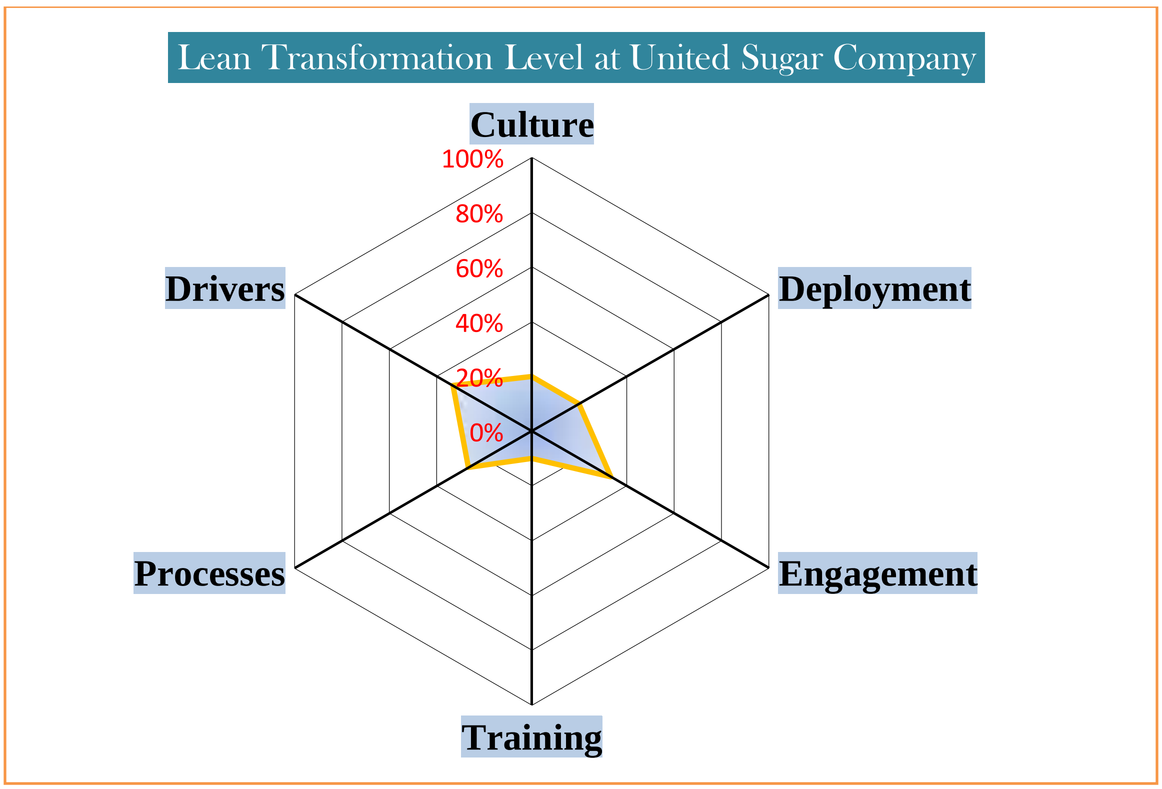

Figure 4-79: Lean Transformation Level at United Sugar Company

5. Supported Documents:

The figures below were provided as supported documents for the lean transformation level at United Sugar Company. In addition, examples for some lean methods that were applied are shown below. After analyzing these documents, it can be concluded that the company has taken the first step toward achieving a successful transformation to lean. Moreover, top management is very supportive to lean transformation as it is observed by supporting the TPM program in the company.

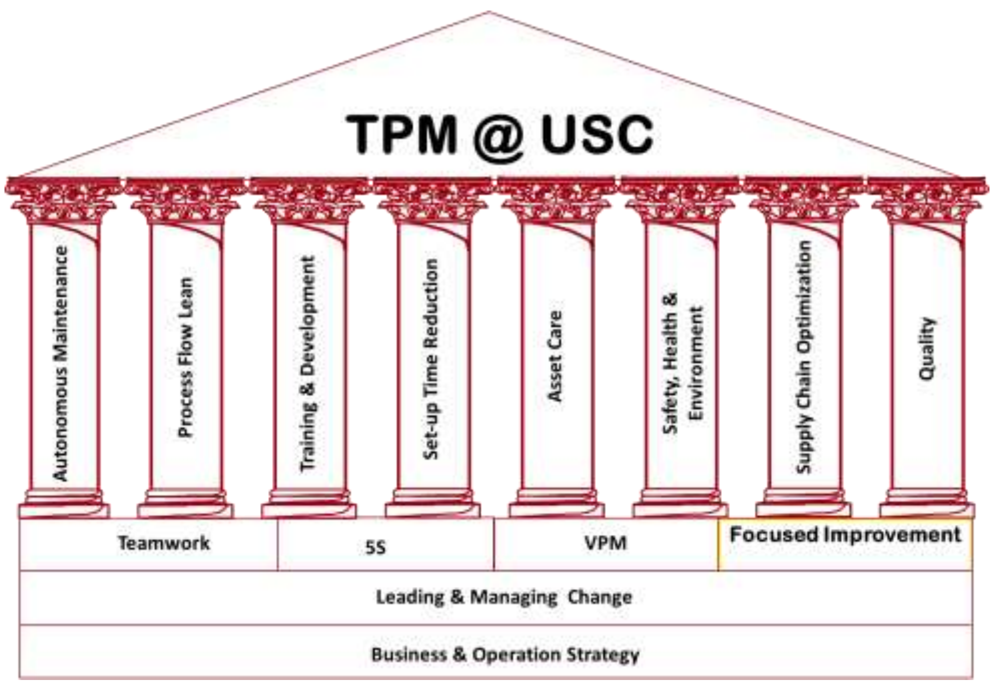

Figure 4-80: TPM Framework at United Sugar Company

Figure 4-81: TPM Deployment Stages Followed at United Sugar Company

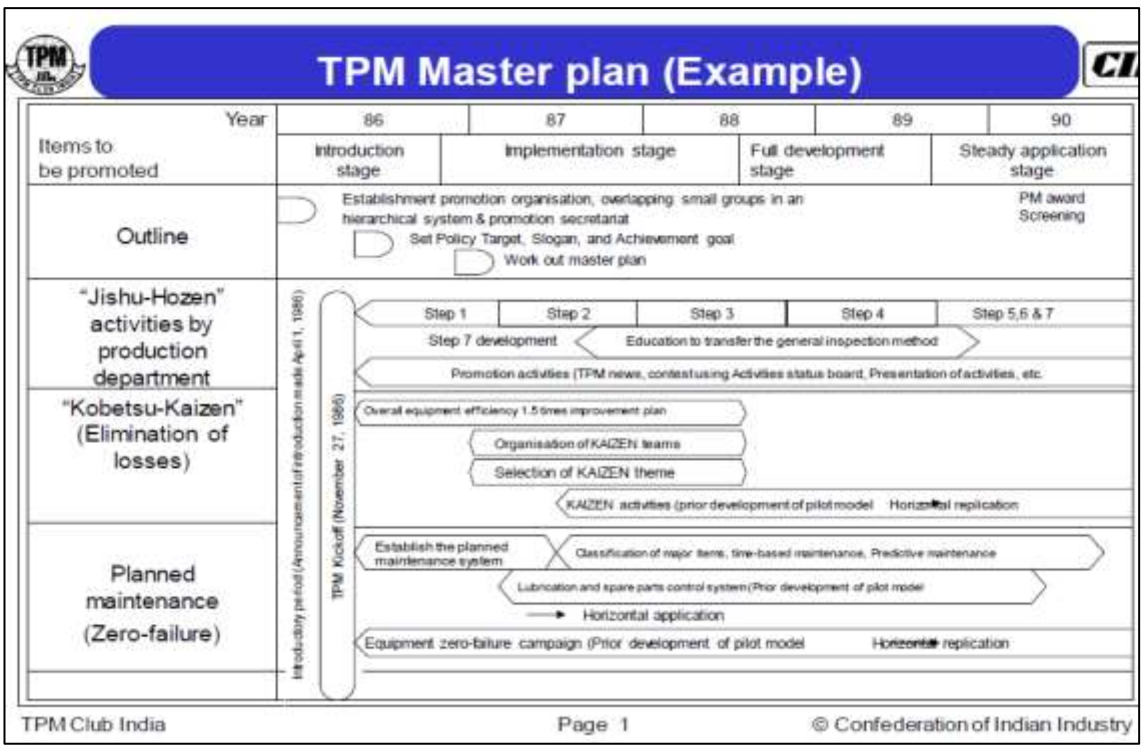

Figure 4-82: Example for TPM Master Plan Followed at United Sugar Company (Part 1).

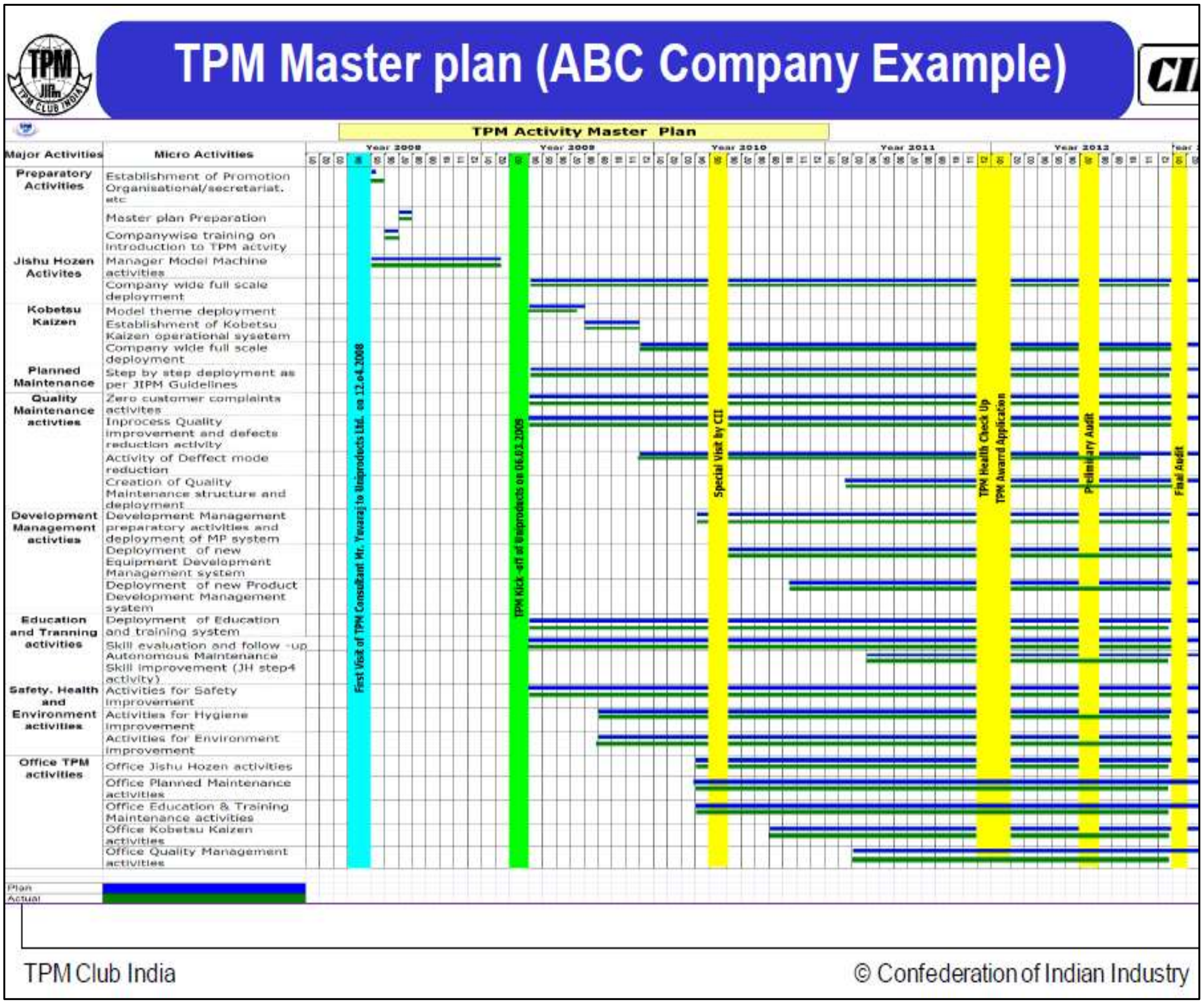

Figure 4-83: Example for TPM Master Plan Followed at United Sugar Company (Part 2)

6. References:

- ➢ http://www.unitedsugar.com/
- ➢ https://www.savola.com/

4.4.8. The National Industrialization Company (TASNEE)

1. Company Background:

TASNEE was established in 1985 and is the first joint-stock industrial company fully owned by the private sector. The company works in different areas, including petrochemicals, chemicals, plastics, and metals manufacturing, industrial services, and environmental technologies. TASNEE and its affiliated companies have obtained different quality accreditations such as ISO 9001, ISO 14001, OHSAS 18001, ISO 22000. The company has obtained several awards; for instance, in 2015 it was awarded by Tatweej Academy the Golden Order of Merit for prudent management in the Arab world. In addition, TASNEE was awarded by Royal Commission in Jubail as the best Environmental Performance for years 2012, 2013, and 2014.

2. Interviewee Background:

The interviewee for this company has 19 years of experience in different local and multinational companies in Saudi Arabia. He worked for 10 years in Procter & Gamble in different positions such as the operation manager, development manager, and supply network operation manager for Middle East & Africa, Baby Care Category. He has a background in Electrical Engineering and has completed a training program called *Finance for Executives* in 2015.

3. Genera Questions Responses:

1. Do you think organizations in Saudi Arabia are familiar with lean?

"See in general the answer is no. I have worked in many companies and I think just few companies, which have a relation with multinational companies or they hire individual employee who worked previously in a multinational company that has good lean implementation, are familiar with lean. For example Obeikan Company is one of the local companies that have very good lean program because most of the managers were previously employee at P&G or other multinational companies. "

Then, he was asked to give a percentage for lean implementation level in Saudi Arabian local and multinational companies, he responded:

"All multinational companies in Saudi Arabia, that operated by the mother company, are 100% applying lean. For instance, P&G and Johnson Control are some of these companies. For local companies I cannot give you a number but in my opinion 50% of local companies now started lean programs because they are hiring professionals with working experience on lean". Savola is an example they actually applying lean because the x-professionals from P&G and because there is a need for lean to survive nowadays."

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

"The most important things about lean are to cause cost improvement in a short time and to boost the efficiency. The main success factors for lean transformation would be management support lean or any other transformation will never success without 100% management support. Not only support but involvement also. This factor is the first and the most important success factor. Second factor is investing in capabilities. Transformation lean will be achieved if you have very capable teams that apply it in the entire sections in a company. In sum, these are the main factors which also will help to overcome with the other obstacles that would face."

3. How long would you say it took to have a reasonable level of lean implementation in your company?

"I would say just to build foundation phase you will need a period of six months to one year. Minimum you will need this period to build the foundation and this is what I have noticed in different companies. In this phase you will work on a culture change in the company. By the way, you cannot focus on long-term only in your lean transformation program. You have to apply short-term programs in parallel to gain people confidence and help you to move on."

Then, he was asked" you mentioned foundation phase, how many phases the program should be in Saudi Arabia" he responded:

"My opinion is three phases. Phase one is to build right culture and right procedures. Phase two is sustainable improvement which is to check systems in phase one are applied and stayed for at least one year. Phase three is improvement or innovation phase because it is a continuous improvement. This might take about three years in total but it never stops. "

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

"For lean transformation in developing countries it requires two things. First, you are not only transforming systems and equipment but you are transforming people culture which is very challenging. In addition, if you have heard about the Saudi Arabian transformation program 2020 which include accomplishment to a level that styles Saudi industrial products to be globally competitive. I think without transforming to lean in addition to following international standards such as ISO this goal would be very difficult. You have to be competitive in quality and price. Lean transformation also helps the 2020 programs such as Saudization by building and investing in people capabilities."

4. Lean Transformation Level at TASNEE

Table 4-32 shows the responses regarding lean assessment at TASNEE. The interviewee was asked to provide examples for each measure that is implemented in his company. Table 4-33 and Figure 4-84 show that TASNEE has high level of implementation as 80% in culture category, and an average level as 30% in training category. Moreover, it has 60% in processes, 47% in drivers, 40% in engagement, and 35% in deployment categories.

As result, the company has attained high level of lean transformation compared to other local companies. The company needs to invest more in training category which is going to increase the deployment level.

Table 4-32: Interview Responses for Lean Assessment at TASNEE

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	x
	More than 9 years	
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Table 4-33: Scores Summary for Lean Transformation at TASNEE

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	8	2	4.00	80%
Deployment	7	4	1.75	35%
Engagement	6	3	2.00	40%
Training	3	2	1.50	30%
Processes	9	3	3.00	60%
Drivers	7	3	2.33	47%

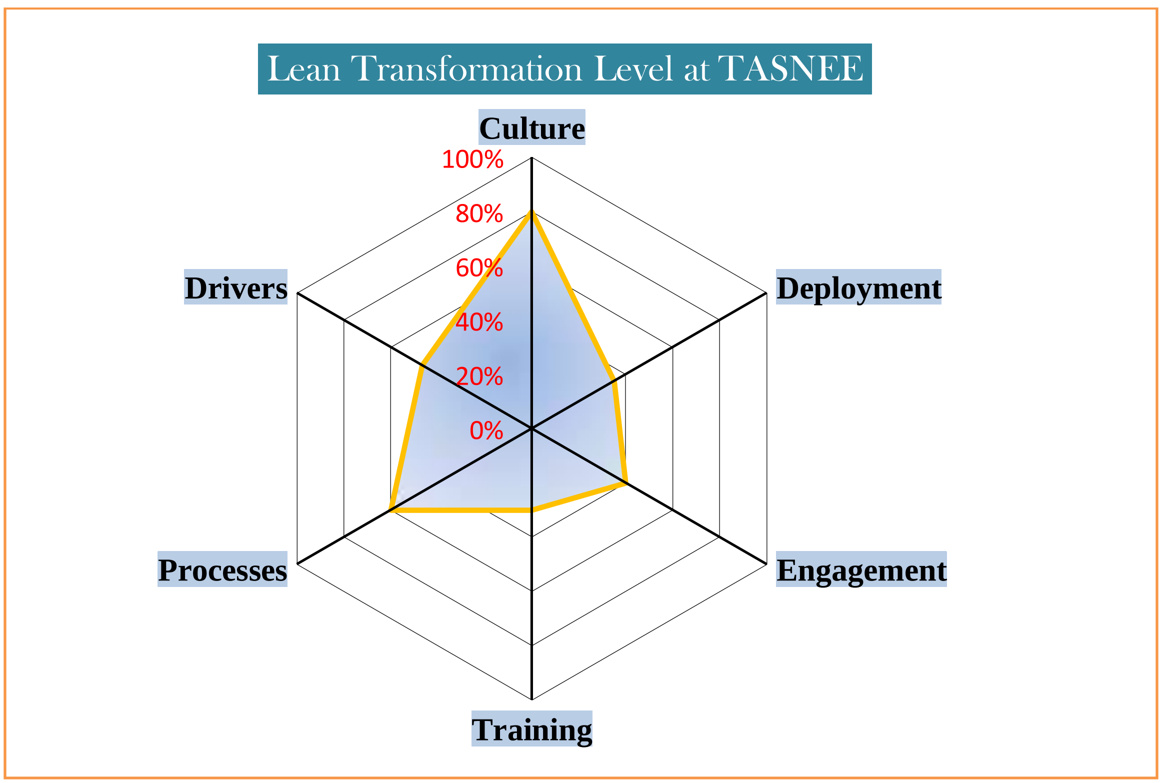

Figure 4-84: Lean Transformation Level TASNEE

5. Supported Documents:

The figures below were provided as supported documents for lean transformation level at TASNEE. In addition, examples for some lean methods that were applied are shown below. After analyzing these documents, it can be concluding that the company has achieved a good level toward transformation to lean. Moreover, executives at TASNEE are very supportive to lean transformation as it is noticed in their leadership system and strategic plan.

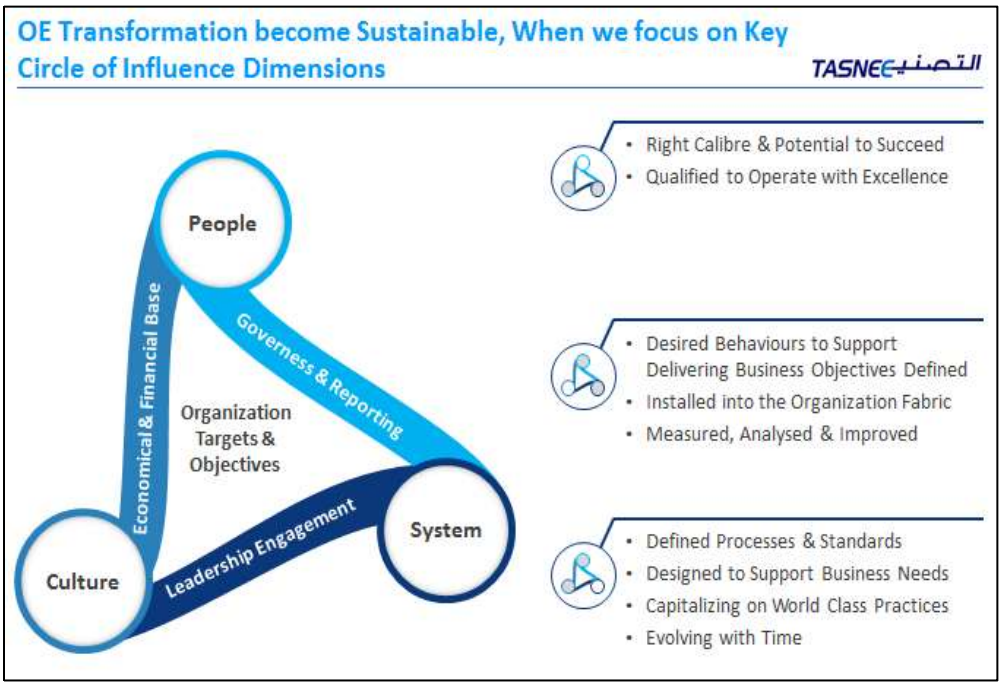

Figure 4-85: Organization Targets and Objectives at TASNEE

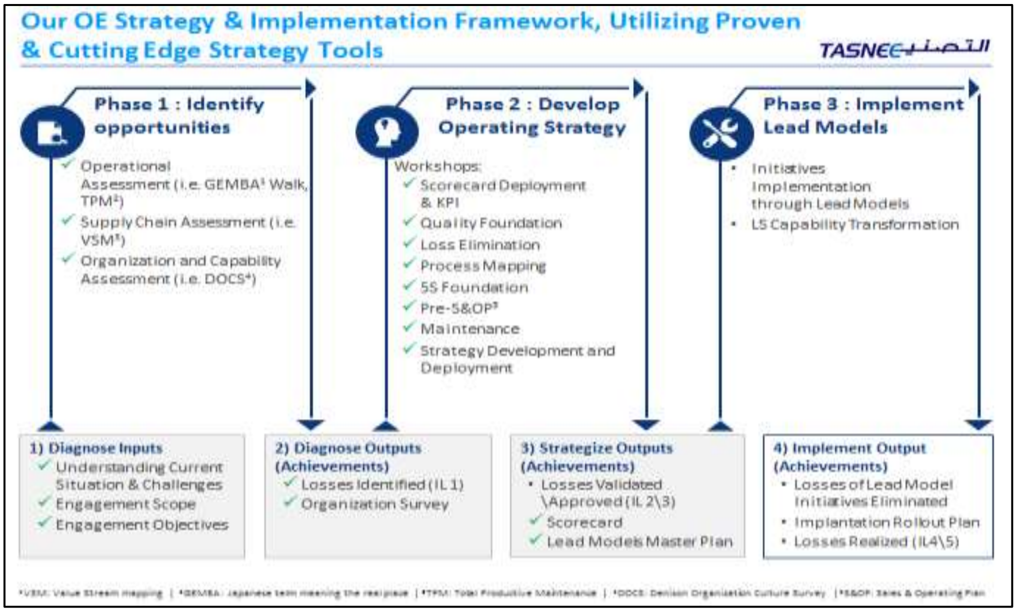

Figure 4-86: TASNEE's Strategy and Implementation Plan

Figure 4-87: Sample of Standard Scorecard at TASNEE

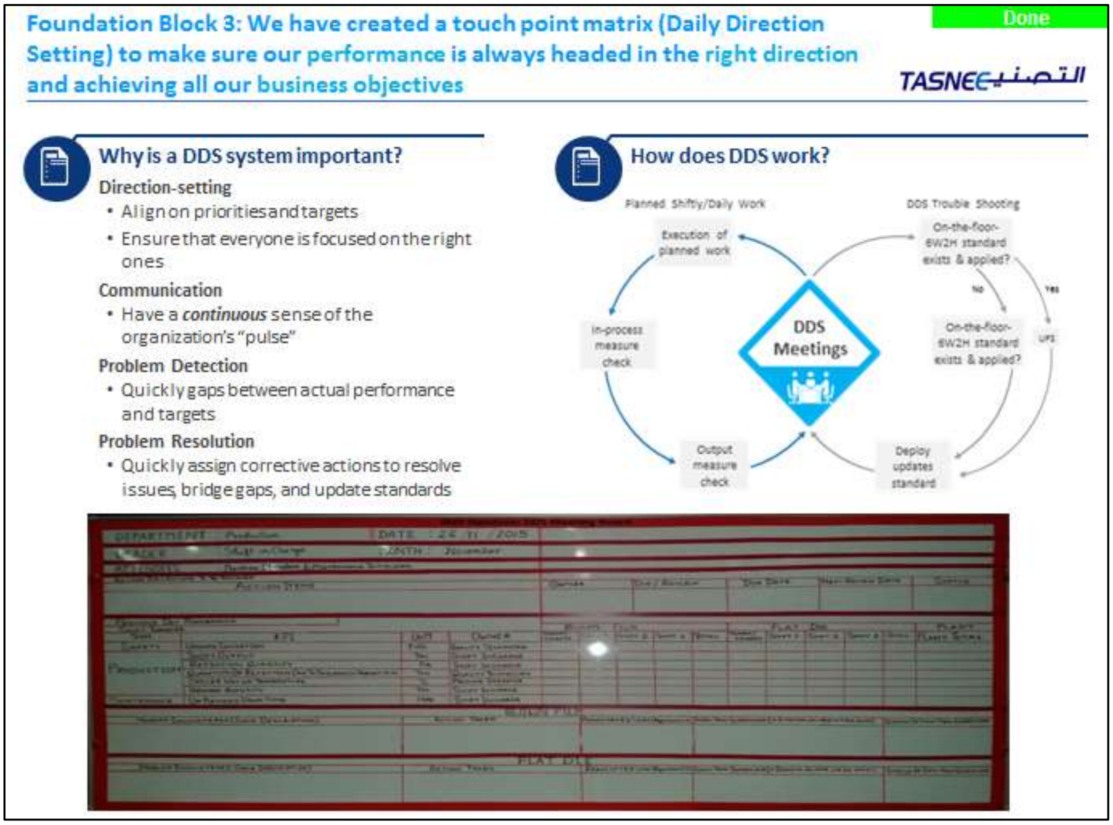

Figure 4-88: Sample of Communication System at TASNEE

Figure 4-89: Sample of 5s Implementation at TASNEE

6. References:

- ➢ http://tasnee.com/
- ➢ https://www.linkedin.com/company-beta/127975/

4.4.9. Saudi Airlines (Saudia)

1. Company Background:

With a gift from U.S. to a Saudi Arabia's king, Saudia was launched in 1945. Currently, the company has more than 139 aircraft, which makes it one of the largest major airlines in the area. Saudi Airlines runs to 80 destinations across Asia, Africa, Europe, and North America. The company has obtained several awards, such as in 2013 Saudia achieved the *Quality Awards Silver Winner 2013 – Middle East & North Africa*. In addition, in 2014 Saudia named the *Best Connected Airline with OnAir for Internet Service* and *Middle East Internal Audit Excellence Award*. Most companies and airport stations associated with Saudia have attained an ATA Safety Audit for Ground Operations (ISAGO) ISO 9001:2008, and ISO 14001:2004.

2. Interviewee Background:

For this company, the interviewee has more than 20 years of work experience. He worked for 12 years HR specialist, and then for seven years as a project manager for quality projects, and for five years he was responsible for performance management initiatives, succession planning and leadership development, and talent programs. He has a Master of Science in Industrial Engineering and he is a founding member of the Saudi Quality Council.

3. General Questions Responses:

The interviewee preferred to respond with written answers to this section of the interview as shown below.

1. Do you think organizations in Saudi Arabia are familiar with lean?

"I don't think so. Multinational companies might be familiar but I think also they're facing cultural difficulties and resistance to change."

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

"The measures in the second section on the interview as it explained to me are very important critical success factors to achieve a good level of lean implantation. However, for developing countries such as Saudi Arabia I think the main factors would be: management commitment, strategic planning that support lean, and people in charge from the beginning of the journey until attaining strategic goals."

3. How long would you say it took to have a reasonable level of lean implementation in your company?

"In local companies especially large sized companies like our company I believe it would take five years minimum. In multinational companies definitely it takes less."

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

“One of the things that help to increase people’s awareness about lean and quality management systems is to encourage leaders participate in organizations like American Society of Quality (ASQ) and in Saudi Arabia we have the Saudi Quality Council. In addition, I think Saudi Arabian vision 2030 is going to play a major role that enforces all companies to match its transformation goals.”

4. Lean Transformation Level at Saudi Airlines

Table 4-34 shows the responses regarding lean assessment at United Sugar Company. The interviewee was asked to provide examples for each measure that is implemented in his company. Table 4-35 and Figure 4-90 show that Saudi Airlines has 40% in deployment category and 33% in the engagement, drivers, and processes categories. It then drops to 20% for training and culture categories. As result, the company has attained a low level of lean transformation.

Table 4-34: Interview Responses for Lean Assessment at Saudi Airlines

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Adopt HR policies that support lean goals	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	x
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Table 4-35: Scores Summary for Lean Transformation at Saudi Airlines

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	2	2	1.00	20%
Deployment	8	4	2.00	40%
Engagement	5	3	1.67	33%
Training	2	2	1.00	20%
Processes	5	3	1.67	33%
Drivers	5	3	1.67	33%

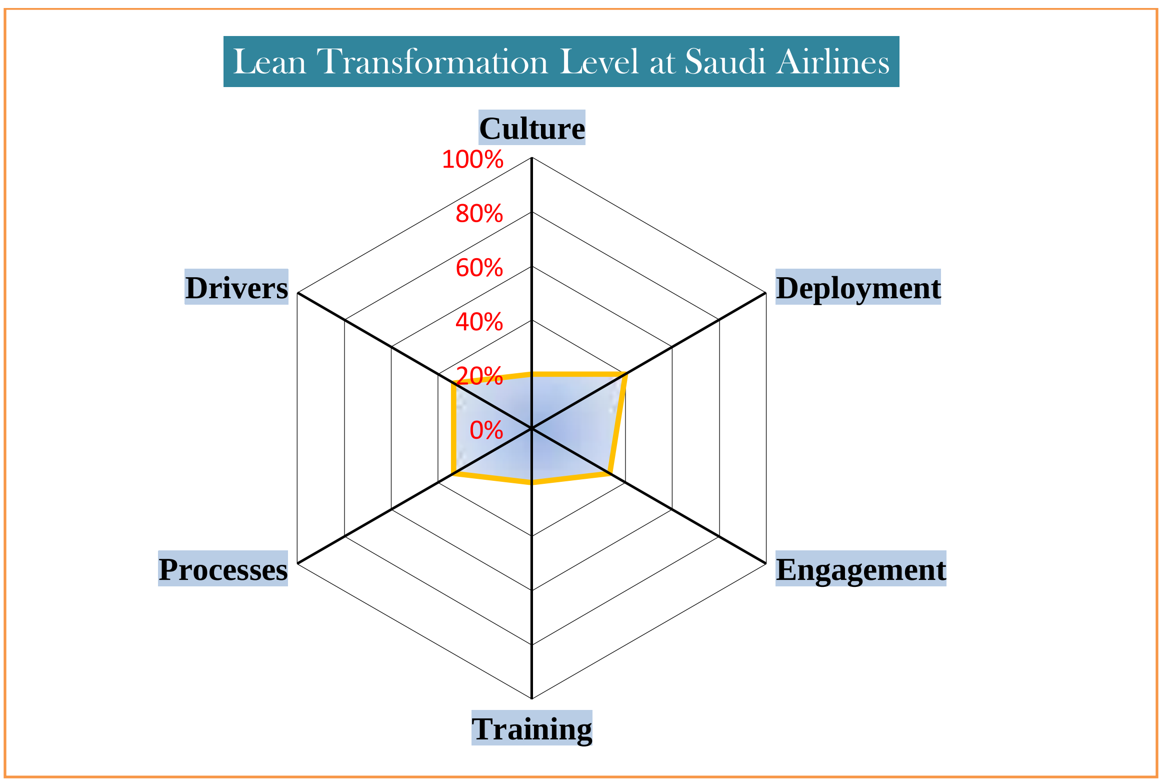

Figure 4-90: Lean Transformation Level at Saudi Airlines

5. Supported Documents:

There were no supported documents provided for this company. However, the interviewee explained that Saudia has several practices and programs which can be considered as a base for lean transformation. For example, many departments applied Six Sigma projects, and this lead Saudia to have leaders who have Six Sigma Master Black Belt, Black Belt, Green Belt, and Yellow Belt. In addition, Saudia is deploying HR program called ADAA which aims to drive employees to be capable in the strategic goals of the company.

6. References:

- http://www.saudiairlines.com
- https://www.linkedin.com/company-beta/16886/

4.4.10. Saudi Electricity Company (SEC)

1. Company Background:

The Saudi Electricity Company was formed in 2000 by combining several companies in different regions Saudi Arabia under one company which listed also as joint stock company. Figure 4-91 shows brief facts about the company in year 2014. SEC has obtained *King Abdul Aziz Quality Award* in year 2011.

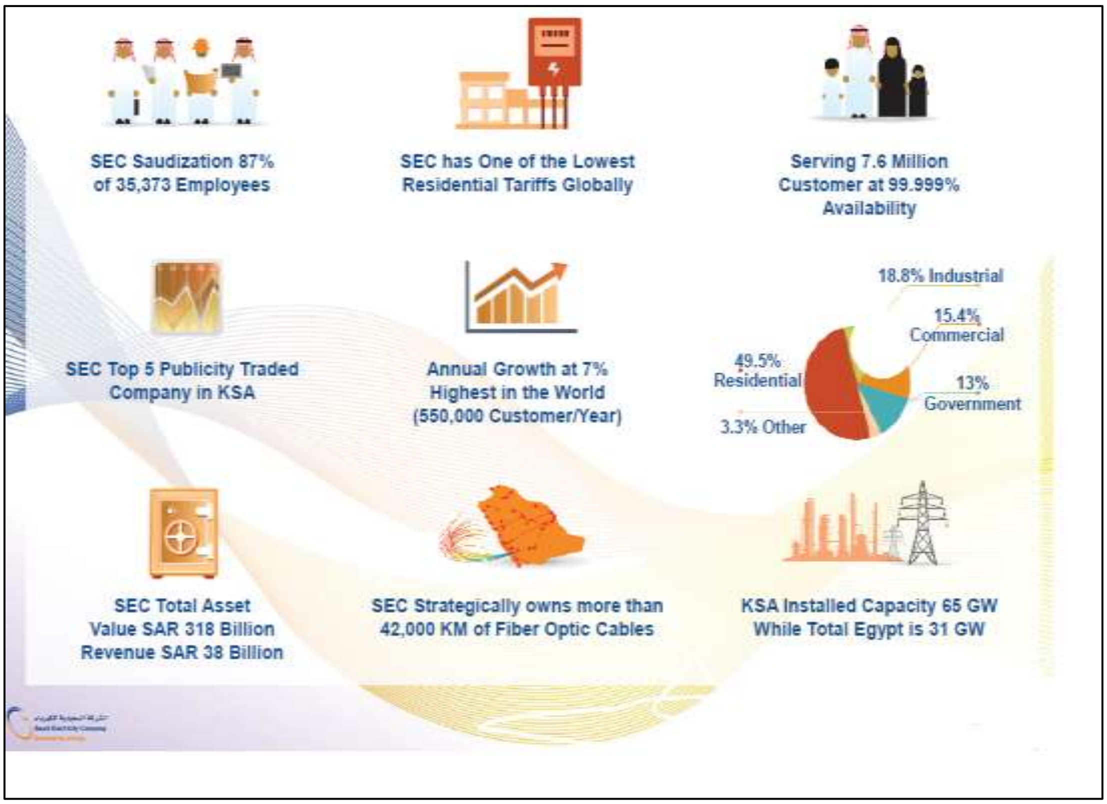

Figure 4-91: SEC’s Facts 2014

2. Interviewee Background:

The applicant for this company has 10 years of working experience. He has a master's degree in System Engineering and the title for his thesis was *Implementation of Lean Manufacturing in Saudi Manufacturing Organizations: An Empirical Study*. He is currently in charge of training leaders about processes improvements programs.

3. General Questions Responses:

The interviewee preferred to respond with written answers to this section of the interview as shown below.

1. Do you think organizations in Saudi Arabia are familiar with lean?

"Most of Saudi organizations are not familiar with lean."

2. What are main success factors for lean transformation in Saudi Arabia? Can you please provide me with some examples?

"Young Leadership because they are open minded for new and good ideas for good change and not refusing changes just for the reason of *no one did it before*"

3. How long would you say it took to have a reasonable level of lean implementation in your company?

"Due to company size and current situation unless strong leader takes big responsibilities"

4. Are there any other key points that related to lean transformation in Saudi Arabia or any other developing countries that you would like to add?

"The most key point related to lean here in Saudi Arabia are cultural barriers and resistance to changes."

4. Lean Transformation Level at Saudi Electricity Company

Table 4-36 shows the responses regarding lean assessment at Saudi Electricity Company. The interviewee was asked to provide examples for each measure that is implemented in his company. Table 4-37 and Figure 4-92 show that SEC has 47% in the drivers category, and 40% in the deployment and processes categories. The company has 20% in the culture, engagement, training categories.

As a result, the company has attained a low level of lean transformation. Although it has average levels in the drivers, deployment, and processes categories, it needs more effort in increasing the other categories to the average level even better. If the ASTP program is deployed effectively, all categories will score higher numbers and a reasonable level of lean transformation will be attained.

Table 4-36: Interview Responses for Lean Assessment at Saudi Electricity Company

Culture	Response	
Have their own version of the Toyota Production System (TPS) that is not just a document, but a significant part of the company's culture	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Recognize that developing a lean culture is a lengthy process and that lean is never-ending	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Engagement	Response	
Dedicate full-time resources to lean improvement	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Seek to provide regular communications on lean throughout the organization.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Adopt HR policies that support lean goals	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	

Processes	Response	
Utilize value stream mapping to identify and drive improvement opportunities	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize standard work as the baseline for continuous improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize Hoshin Kanri or policy deployment to align company goals and lean strategies	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	

Deployment	Response	
Drive lean implementation from the top down	Not Applied	x
	Less than 1 year	
	1-3 Years	
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize consultants from established lean companies like Toyota as Senseis to help guide their initial learning and lean improvement.	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Implement lean in both manufacturing and non-manufacturing areas	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Recognize that once they have made progress on becoming lean internally, they should extend lean implementation to their suppliers	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Training	Response	
Invest in training for employees to learn about lean	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
See the value in developing internal lean leaders and Senseis.	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Drivers	Response	
Use the Voice of the Customer (VOC) as a driver of improvements	Not Applied	
	Less than 1 year	
	1-3 Years	
	4-6 Years	x
	7-9Years	
	More than 9 years	
Utilize kaizen at a regular cadence to drive continuous improvement	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	
Utilize appropriate metrics and visual management to drive lean improvements	Not Applied	
	Less than 1 year	
	1-3 Years	x
	4-6 Years	
	7-9Years	
	More than 9 years	

Table 4-37: Scores Summary for Lean Transformation at Saudi Electricity Company

Category	Total Score of Each Category	No. of Questions Each Category	Ratio	Implementation Level
Culture	2	2	1.00	20%
Deployment	8	4	2.00	40%
Engagement	3	3	1.00	20%
Training	2	2	1.00	20%
Processes	6	3	2.00	40%
Drivers	7	3	2.33	47%

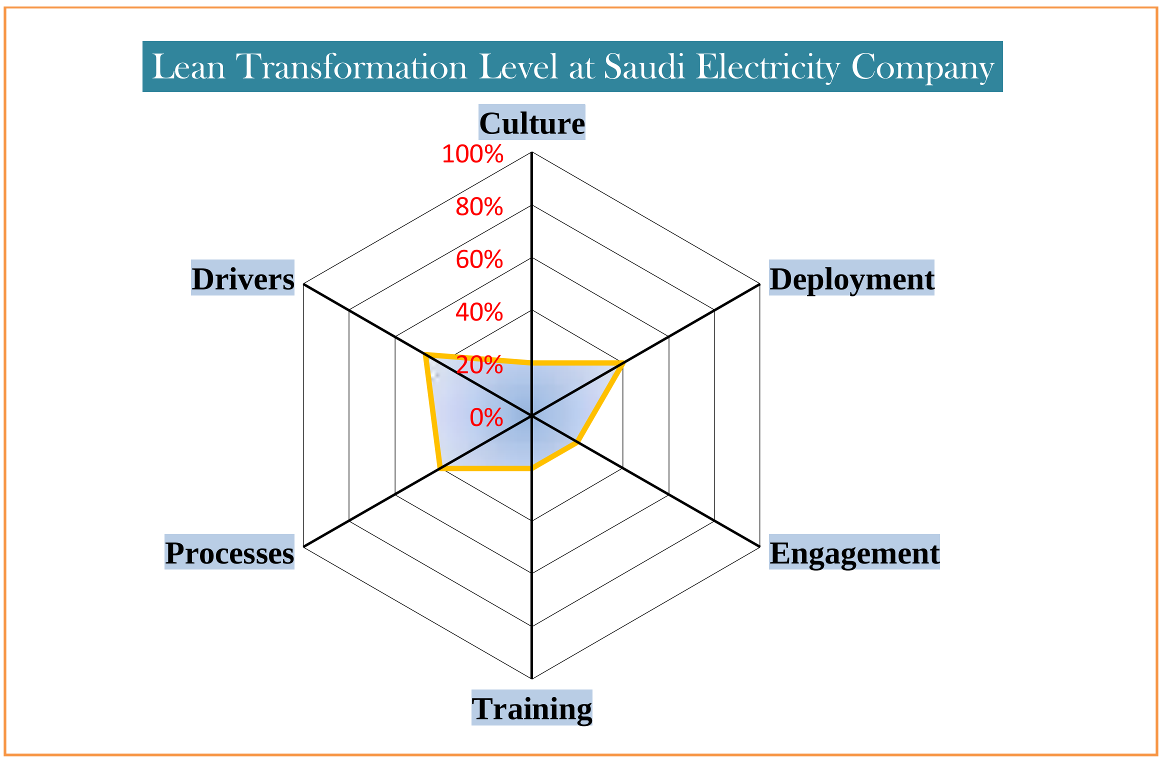

Figure 4-92: Lean Transformation Level at Saudi Electricity Company

5. Supported Documents:

The company's leadership and strategies support improvements and transformation to better systems. For example, SEC's vision includes being committed to improvement, and values include "how we act: active excellence (we are focused, detailed and agile)" (para 3). Moreover, the figures below explain SEC's transformation program with mainly three strategic goals in order to be the best and most cost-effective electricity provider in Saudi Arabia.

Figure 4-93: SEC's Accelerated Strategic Transformation Program (ASTP)

Figure 4-94: SEC's Six Key Areas

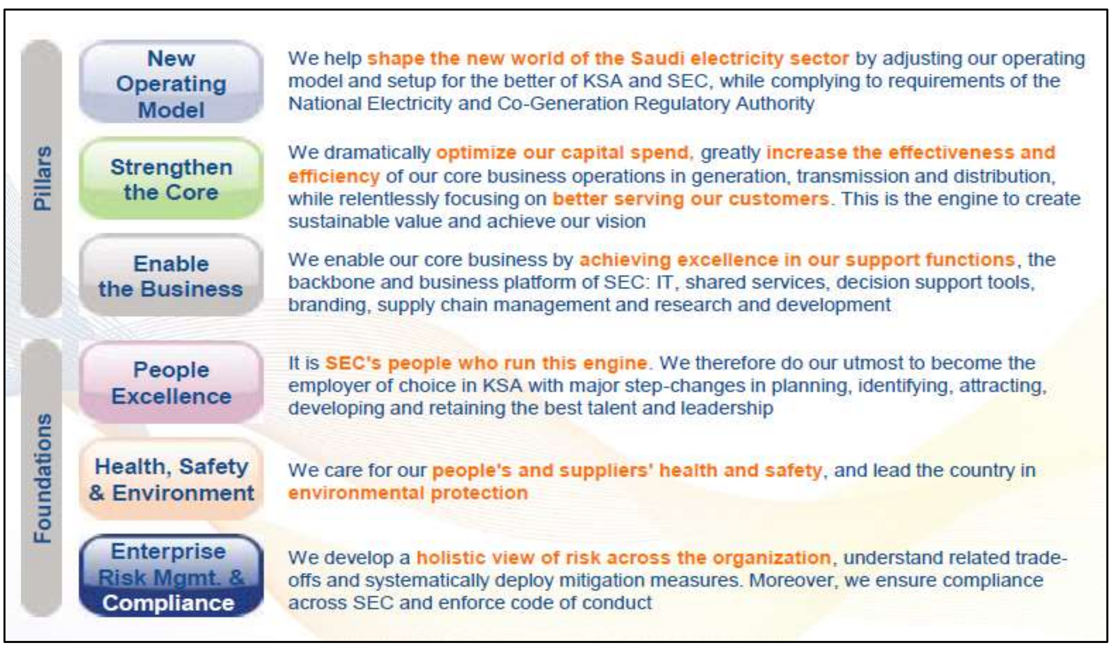

Figure 4-95: Real Impact on SEC

Figure 4-96: KPI Measure Success at SEC

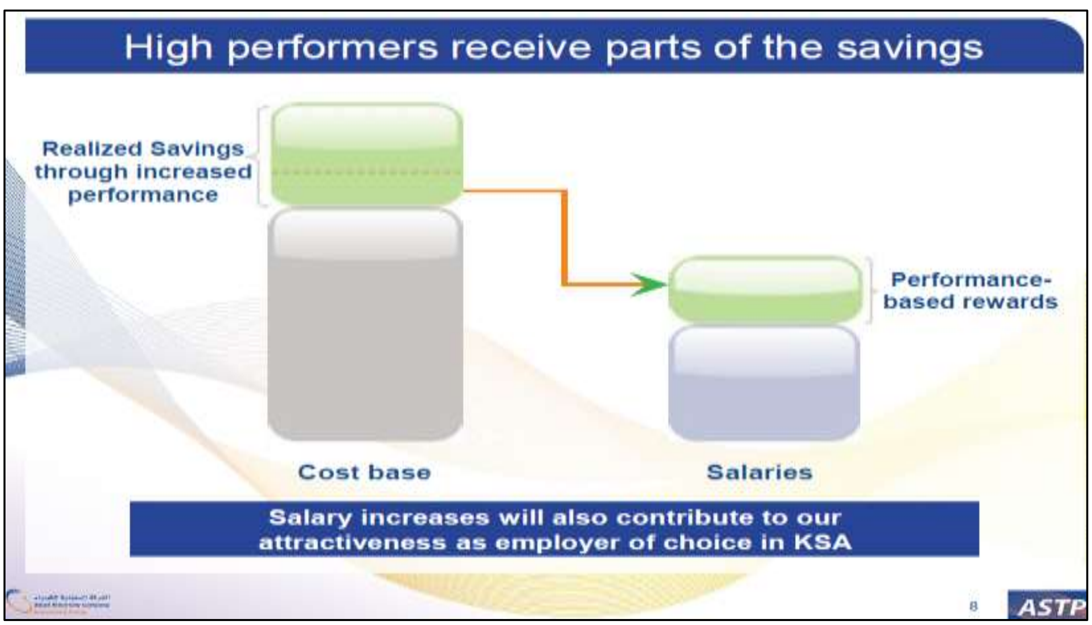

Figure 4-97: Performance Based Rewards at SEC

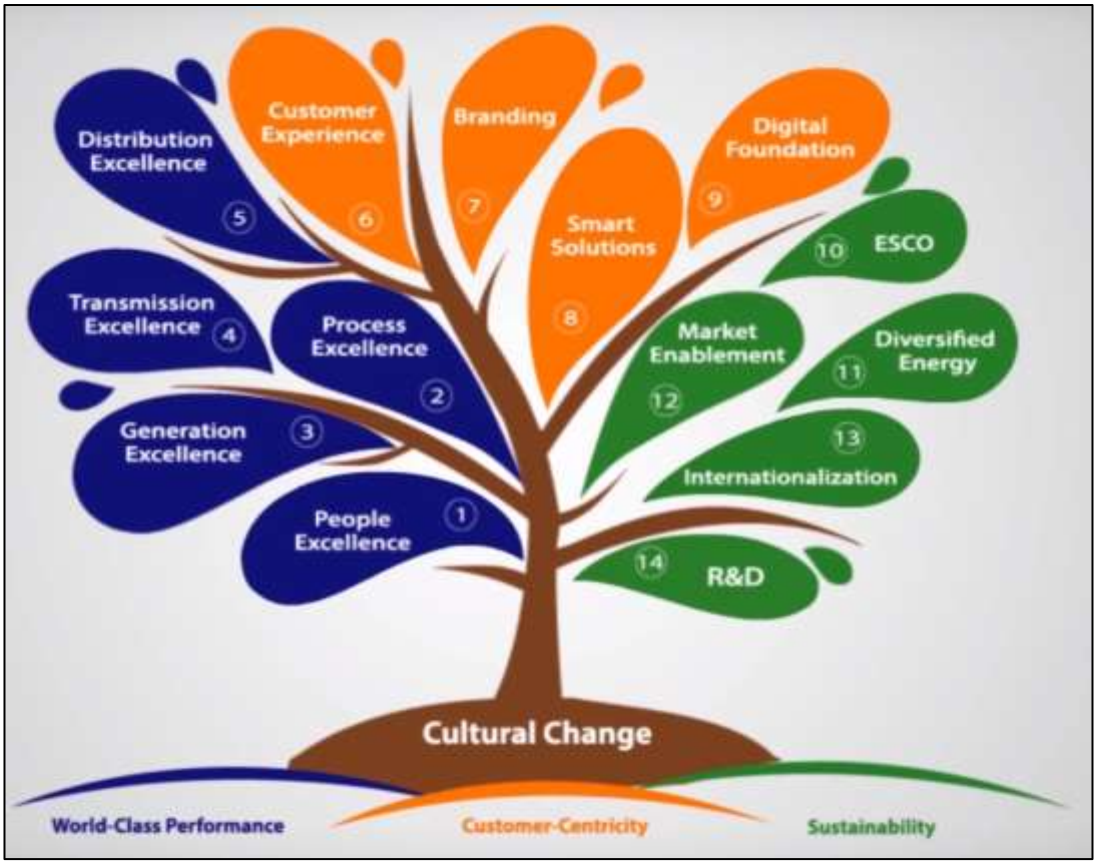

Figure 4-98: SEC’s ASTP Framework

6. References:

- (Kadasah & AlKhedran, 2014)
- https://www.se.com.sa/en-us/Pages/home.aspx
- https://www.se.com.sa/en-us/Pages/StrategicPlan.aspx

4.5 Summary for All Local Companies

Table 4-38 summarizes the scores of the assessment for a lean transformation level in local Saudi Arabian companies. In addition, the mean, median and standard deviation were calculated. The presented standard deviation of each category is high, which shows a high variation of each company from the calculated mean. Figure 4-99 shows the lean radar chart for all multinational companies and it can indicated that these companies have an average of 66.8 in the process category and 66.3% in both the culture and training categories. These results reflect that Saudi Arabian multinational companies have a good level of lean implementation for these categories, and some companies like Toyota and P&G have 100% of implementation for these categories.

Table 4-38: Scores and Statistical Summary for Local Companies

Category	Albaik	Almarai	ATC	ARAMCO	NADEC	Obiekan	S. Airlines	SEC	TASNEE	U. Sugar	Mean	Median	STDEV
Culture	70	30	50	50	50	50	20	20	80	20	44.0	50	20
Deployment	60	35	30	50	45	55	40	40	35	20	41.0	40	11
Engagement	87	33	20	20	40	40	33	20	40	33	36.6	33	19
Training	80	50	50	50	50	60	20	20	30	10	42.0	50	20
Processes	73	60	47	53	47	47	33	40	60	27	48.7	47	13
Drivers	87	47	27	67	53	47	33	47	47	33	48.8	47	17

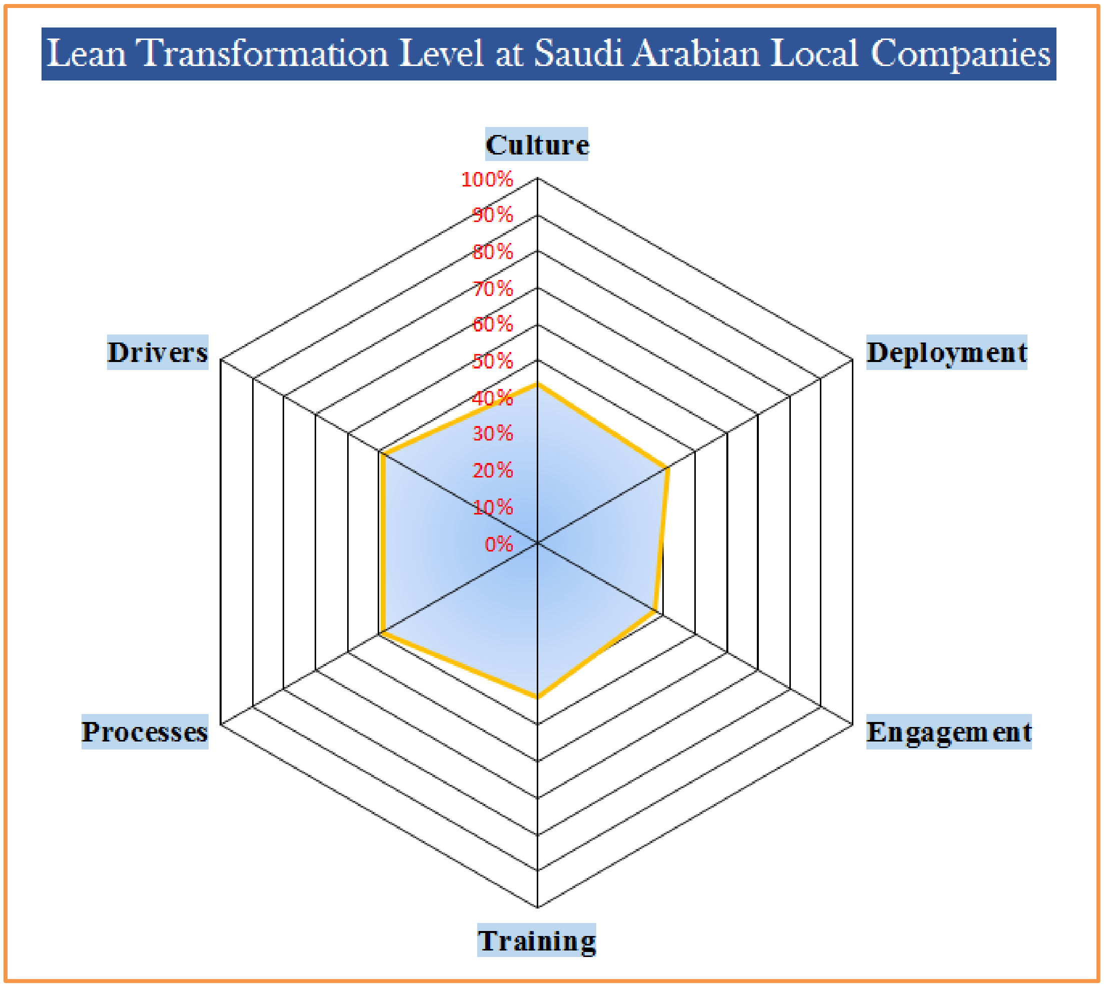

Figure 4-99: Lean Transformation Level at Saudi Arabian Local Companies

4.6 Multinational vs. Local Companies

Based on the calculated standard deviation for local and multinational companies, local companies have less variation than multinational companies.

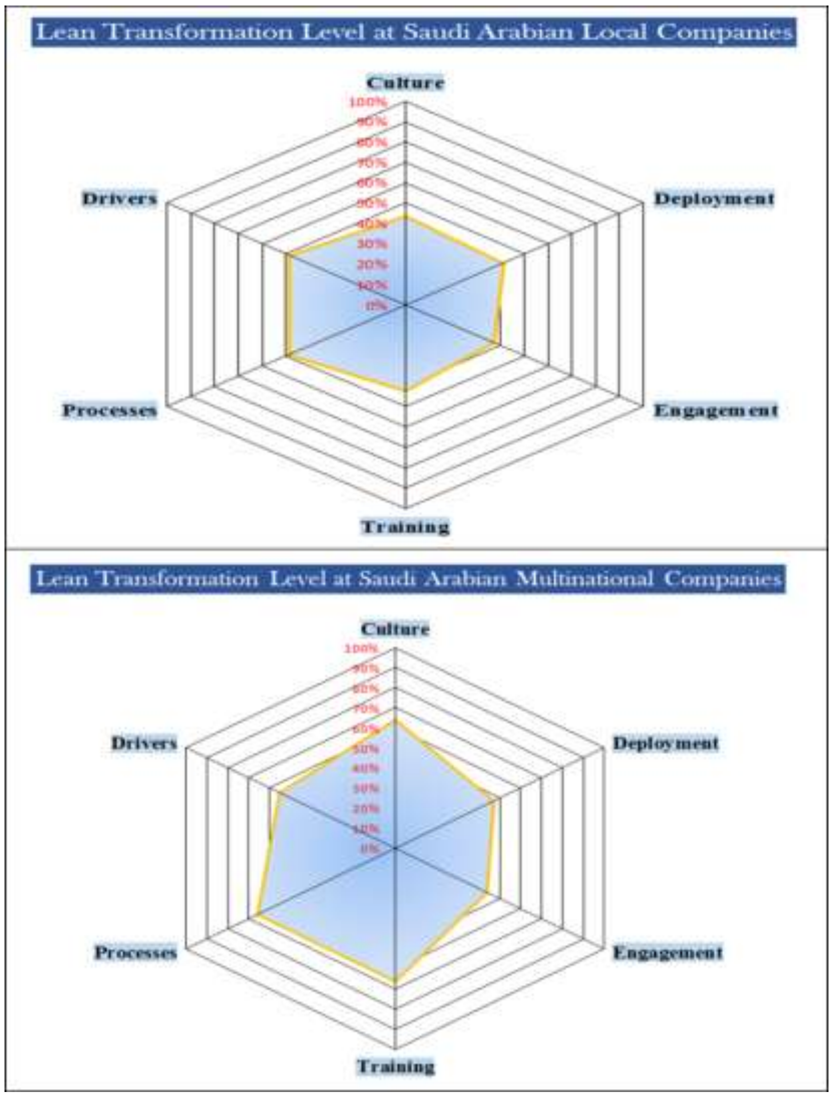

Figure 4-100: Lean Transformation Level for Multinational vs. Local Companies

4.6.1. t-Test for the Difference Between Means[12]

In this section, a t-test was used to investigate the difference between two means for multinational and local companies. Here, μ_1 and μ_2 are the true mean for the multinational and local companies respectively. The null and alternative hypotheses are as follows:

$$H_0: \mu_1 = \mu_2$$

$$H_1: \mu_1 \neq \mu_2$$

The following notations were used in conducting the above test:

μ_1: population mean of multinational companies (unknown but constant)

μ_2: population mean of local companies (unknown but constant)

n_1: size of sample taken from multinational companies

n_2: size of sample taken from local companies

$\bar{x}_1$: sample average of multinational companies

$\bar{x}_2$: sample average of local companies

$\bar{s}_1^2$: sample variance of multinational companies

$\bar{s}_2^2$: sample variance of local companies

---

[12] Reference used for the t-test is the *Applied Statistics and Probability for Engineers* by Montgomery and Runger (1999)

T_v: the *t*-distribution with *v* degrees of freedom

α: level of significance,

PV: P-value.

Since the variances of the two types of companies are unknown and different (there is no reason to believe that they are equal), it follows that:

$$\frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \sim T_v$$

where *v* is the degrees of freedom of the *t*-distribution and is given by:

$$v = \left\lfloor \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{(s_1^2/n_1)^2}{n_1 - 1} + \frac{(s_2^2/n_2)^2}{n_2 - 1}} \right\rceil$$

Thus, the test statistic (T_0) is given by:

$$T_0 = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

A sample size of size six are available for both types of companies, and the data is shown in Table 4-39:

Table 4-39: Sample Size for Observations

Observation Number	Multinational	Local
1	66.3	44.0
2	47.5	41.0
3	49.4	36.6
4	66.3	42.0
5	66.8	48.7
6	57.4	48.8
Sample average	59.0	43.5
Sample variance	78.9	22.3

To conduct the test, a significance level of 0.05 was used. The results are shown in Table 4-40.

Table 4-40: Results for Testing the Difference between Multinational and Local Companies

v	8	degrees of freedom
T_0	3.76	test statistic
PV	0.0055	P-value

Since the p-value is significantly less than the significance level ($PV << \alpha$), the null hypothesis is rejected; that is, there is no statistical evidence that the means of the multinational and local companies are the same.

4.7 ISM for Multinational Companies

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21
B1		V	A	V	V	O	O	O	O	O	O	A	O	O	O	V	A	O	O	O	O
B2			V	O	V	O	O	O	V	V	O	V	O	V	O	X	A	O	O	O	O
B3				V	X	O	O	O	O	X	A	A	O	X	O	A	O	O	V	O	X
B4					V	A	V	V	A	V	O	A	V	A	X	X	A	O	V	O	V
B5						A	V	A	A	X	O	A	V	A	O	A	X	V	O	O	X
B6							V	X	A	A	O	O	O	O	O	A	O	O	O	O	V
B7								A	A	A	A	A	V	V	O	A	A	O	O	O	A
B8									X	X	V	V	V	X	O	X	V	V	V	V	V
B9										A	O	A	V	A	A	A	X	V	V	V	V
B10											O	X	V	X	O	V	X	V	V	V	V
B11												V	V	V	O	A	O	V	O	O	V
B12													V	V	O	V	V	O	O	V	V
B13														A	O	A	A	A	A	A	O
B14															O	O	O	V	V	O	V
B15																V	V	O	O	O	V
B16																	A	V	V	O	V
B17																		V	V	V	V
B18																			V	X	A
B19																				X	O
B20																					A
B21																					

Figure 4-101: Structural Self-Interaction Matrix for Multinational Companies

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21
B1	1	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0
B2	1	1	1	1	1	0	1	1	1	0	1	0	0	0	0	1	0	0	0	0	0
B3	1	1	1	1	0	0	0	1	1	1	1	0	1	0	0	1	0	0	0	0	0
B4	0	0	0	1	1	0	1	1	1	1	0	0	1	0	1	0	1	0	0	0	0
B5	0	0	1	1	1	1	1	0	1	0	0	0	1	0	1	1	1	1	1	1	1
B6	0	0	0	1	0	1	1	0	0	0	0	1	0	0	0	1	1	0	0	0	1
B7	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
B8	0	0	0	1	0	0	1	1	1	1	1	0	1	0	0	1	1	1	1	1	0
B9	0	0	0	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	0
B10	0	0	0	1	1	1	1	1	1	1	0	1	1	1	0	0	1	0	0	0	1
B11	0	0	0	0	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0	1	0
B12	0	1	1	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	1	0	0
B13	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0
B14	0	1	1	1	1	0	0	1	1	0	0	0	0	1	0	0	1	0	0	0	0
B15	0	1	0	1	1	1	0	0	1	1	0	1	0	0	1	1	1	1	1	1	0
B16	1	1	1	1	1	0	1	1	1	1	0	1	0	0	1	1	1	0	0	0	1
B17	1	1	0	1	1	1	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0
B18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
B19	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0
B20	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0
B21	0	0	0	1	0	0	0	1	1	1	0	0	1	0	0	1	1	0	0	1	1

Figure 4-102: Initial Reachability Matrix for Multinational Companies

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21	Driving
B1	1	1	1	1*	1*	1*	1	1	1	1*	1*	1*	1*	1*	1*	1*	1	0	0	0	1*	18
B2	1	1	1	1	1	1*	1	1	1	1*	1	1*	1*	1*	1*	1	1*	1*	0	0	1*	19
B3	1	1	1	1	1*	1*	1*	1	1	1	1	1*	1	1*	1*	1	1*	0	0	0	1*	18
B4	1*	1*	1*	1	1	1*	1	1	1	1	1*	1*	1	1*	1	1*	1	0	0	0	1*	18
B5	1*	1*	1	1	1	1	1	1*	1	1*	1*	1*	1	1*	1	1	1	1	1	1	1	21
B6	1*	1*	1*	1	1*	1	1	1*	1*	1*	1*	1	1*	1*	1*	1	1	0	0	0	1	18
B7	1*	1*	1*	1*	1*	1*	1	1*	1*	1*	1*	1*	0	1*	1*	1*	1*	0	0	0	1	17
B8	1*	1*	1*	1	1*	1*	1	1	1	1	1	1*	1	1*	1*	1	1	1	1	1	1*	21
B9	1*	1*	1*	1	1	1	1	1*	1	1	1	1	1	1	1*	1	1	1	1	1	1*	21
B10	1*	1*	1*	1	1	1	1	1	1	1	1*	1	1	1	1*	1*	1	0	0	0	1	18
B11	1*	1*	1*	1*	1	1	1	1	1	1*	1	1	1	1	1*	1*	1*	0	0	1	1*	19
B12	1*	1	1	1	1	1	1	1*	1*	1*	1*	1	1	1	1*	1	1	1	1	0	1*	20
B13	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1	1*	1*	1*	1	1	1*	1*	1*	21
B14	1*	1	1	1	1	1*	0	1	1	1*	1*	1*	1*	1	1*	1*	1	0	0	0	1*	17
B15	0	1	1*	1	1	1	1*	1*	1	1	1*	1	0	1*	1	1	1	1	1	1	1*	19
B16	1	1	1	1	1	1*	1	1	1	1	1*	1	1*	1*	1	1	1	0	0	0	1	18
B17	1	1	1*	1	1	1	1*	1	1	1	1*	1	1	1	1*	1	1	1	1	1	1*	21
B18	1*	1*	1*	1*	1*	1*	0	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1	1	1	1*	20
B19	1*	1*	1*	1*	1*	1*	0	1*	1*	1*	1*	1*	1	1*	1*	1*	1*	1	1	1	1*	20
B20	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1	1*	1*	1*	1*	1	1	1	1*	21
B21	1*	1*	1*	1	1*	1*	1*	1	1	1	1*	1*	1	1*	1*	1	1	0	0	1	1	19
Depeinding	20	21	21	21	21	21	18	21	21	21	21	21	19	21	21	21	21	11	10	11	21	

Figure 4-103: Final Reachability Matrix for Multinational Companies

Table 4-41: Levels of Barriers for Local Companies – 1st, 2nd & 3rd iterations

	Reachability Set	Antecedent Set	Intersection Set	Level
2	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,21	1
3	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,21	1
4	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,21	1
5	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1
6	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,21	1
8	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1
9	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1
10	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,21	1
11	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,20,21	1
12	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19, ,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19, ,21	1
14	1,2,3,4,5,6,,8,9,10,11,12,13,14,15,16,17,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,,8,9,10,11,12,13,14,15,16,17,,21	1
15	,2,3,4,5,6,7,8,9,10,11,12,,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	,2,3,4,5,6,7,8,9,10,11,12,,14,15,16,17,18,19,20,21	1
16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17 ,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17 ,21	1
17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1
21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,20,21	1
1	1,7,13	1,7,13,18,19,20	1,7,13	2
7	1,7	1,7,13,20	1,7	2
13	13,18,19,20	13,18,19,20	13,18,19,20	3
18	13,18,19,20	13,18,19,20	13,18,19,20	3
19	13,18,19,20	13,18,19,20	13,18,19,20	3
20	13,18,19,20	13,18,19,20	13,18,19,20	3

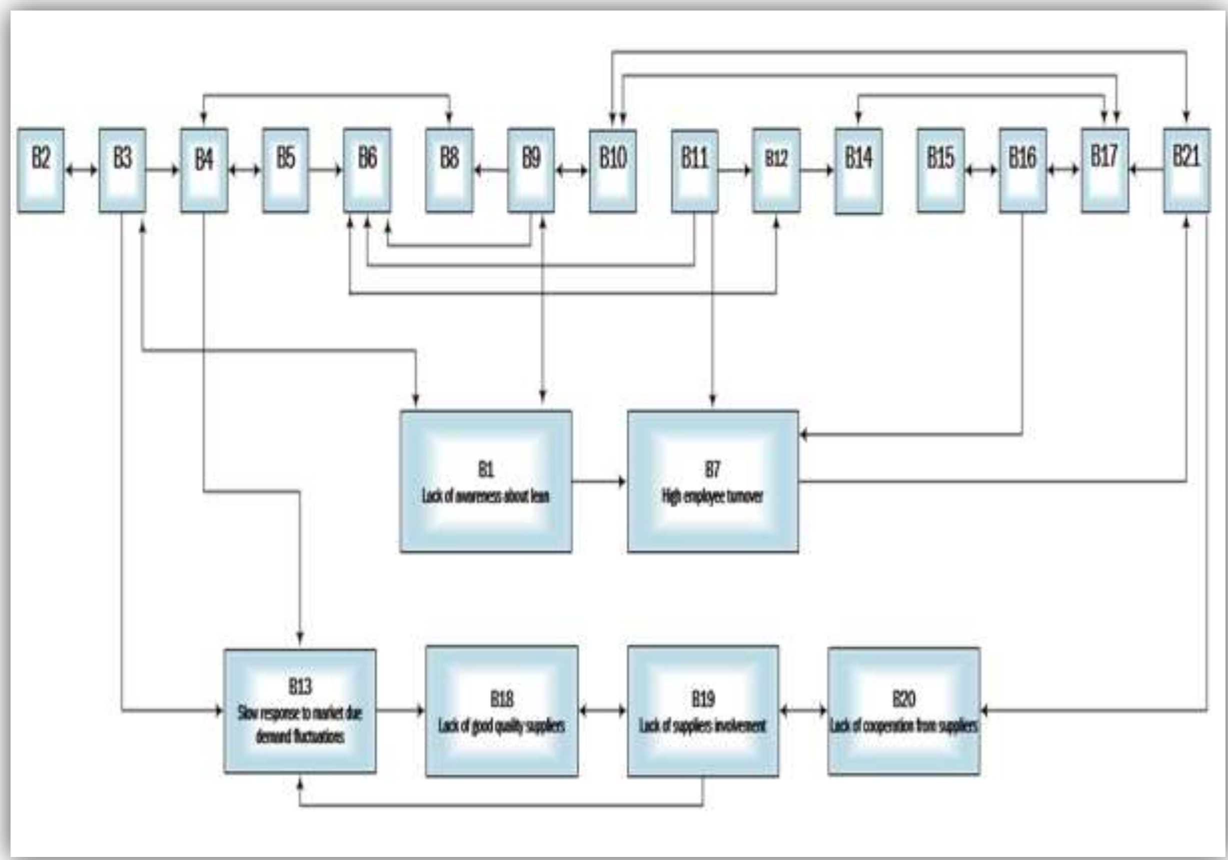

Figure 4-104: ISM for Multinational Companies

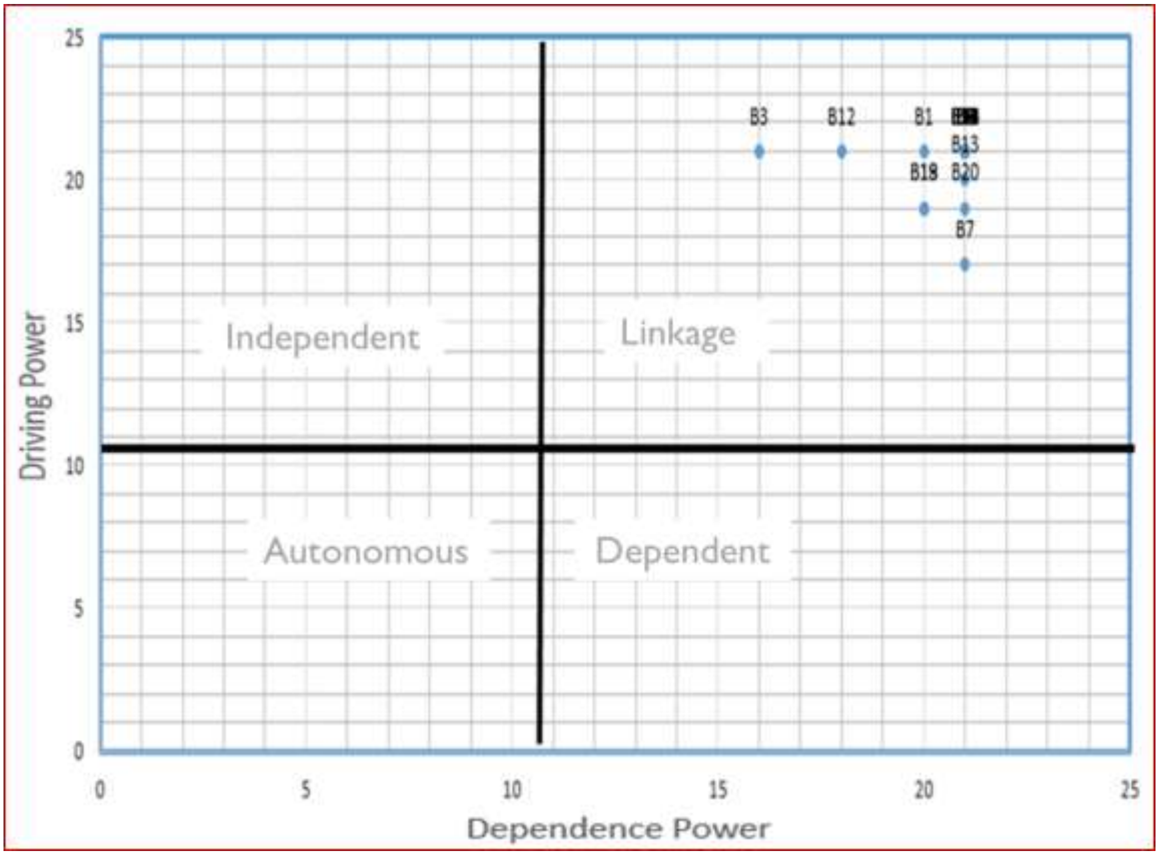

Figure 4-105: MICMAC Analysis for Multinational Companies

4.8 ISM for Local Companies

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21
B1		V	A	V	V	O	O	O	O	O	O	A	O	O	O	V	A	O	O	O	O
B2			V	O	V	O	O	O	V	V	O	V	O	V	O	X	A	O	O	O	O
B3				V	X	O	O	O	O	X	A	A	O	X	O	A	O	O	V	O	X
B4					V	A	V	V	A	V	O	A	V	A	X	X	A	O	V	O	V
B5						A	V	A	A	X	O	A	V	A	O	A	X	V	O	O	X
B6							V	X	A	A	O	O	O	O	O	A	O	O	O	O	V
B7								A	A	A	A	A	V	V	O	A	A	O	O	O	A
B8									X	X	V	V	V	X	O	X	V	V	V	V	V
B9										A	O	A	V	A	A	A	X	V	V	V	V
B10											O	X	V	X	O	V	X	V	V	V	V
B11												V	V	V	O	A	O	V	O	O	V
B12													V	V	O	V	V	O	O	V	V
B13														A	O	A	A	A	A	A	O
B14															O	O	O	V	V	O	V
B15																V	V	O	O	O	V
B16																	A	V	V	O	V
B17																		V	V	V	V
B18																			V	X	A
B19																				X	O
B20																					A
B21																					

Figure 4-106: Structural Self-Interaction Matrix for Local Companies

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21
B1	1	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0
B2	1	1	1	1	1	0	1	1	1	0	1	0	0	0	0	1	0	0	0	0	0
B3	1	1	1	1	0	0	0	1	1	1	1	0	1	0	0	1	0	0	0	0	0
B4	0	0	0	1	1	0	1	1	1	1	0	0	1	0	1	0	1	0	0	0	0
B5	0	0	1	1	1	1	1	0	1	0	0	0	1	0	1	1	1	1	1	1	1
B6	0	0	0	1	0	1	1	0	0	0	0	1	0	0	0	1	1	0	0	0	1
B7	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
B8	0	0	0	1	0	0	1	1	1	1	1	0	1	0	0	1	1	1	1	1	0
B9	0	0	0	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	0
B10	0	0	0	1	1	1	1	1	1	1	0	1	1	1	0	0	1	0	0	0	1
B11	0	0	0	0	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0	1	0
B12	0	1	1	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	1	0	0
B13	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0
B14	0	1	1	1	1	0	0	1	1	0	0	0	0	1	0	0	1	0	0	0	0
B15	0	1	0	1	1	1	0	0	1	1	0	1	0	0	1	1	1	1	1	1	0
B16	1	1	1	1	1	0	1	1	1	1	0	1	0	0	1	1	1	0	0	0	1
B17	1	1	0	1	1	1	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0
B18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
B19	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0
B20	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0
B21	0	0	0	1	0	0	0	1	1	1	0	0	1	0	0	1	1	0	0	1	1

Figure 4-107: Initial Reachability Matrix for Local Companies

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21	Driving
B1	1	1	1	1*	1*	1*	1	1	1	1*	1*	1*	1*	1*	1*	1*	1	0	0	0	1*	18
B2	1	1	1	1	1	1*	1	1	1	1*	1	1*	1*	1*	1*	1	1*	1*	0	0	1*	19
B3	1	1	1	1	1*	1*	1*	1	1	1	1	1*	1	1*	1*	1	1*	0	0	0	1*	18
B4	1*	1*	1*	1	1	1*	1	1	1	1	1*	1*	1	1*	1	1*	1	0	0	0	1*	18
B5	1*	1*	1	1	1	1	1	1*	1	1*	1*	1*	1	1*	1	1	1	1	1	1	1	21
B6	1*	1*	1*	1	1*	1	1	1*	1*	1*	1*	1	1*	1*	1*	1	1	0	0	0	1	18
B7	1*	1*	1*	1*	1*	1*	1	1*	1*	1*	1*	1*	0	1*	1*	1*	1*	0	0	0	1	17
B8	1*	1*	1*	1	1*	1*	1	1	1	1	1	1*	1	1*	1*	1	1	1	1	1	1*	21
B9	1*	1*	1*	1	1	1	1	1*	1	1	1	1	1	1	1*	1	1	1	1	1	1*	21
B10	1*	1*	1*	1	1	1	1	1	1	1	1*	1	1	1	1*	1*	1	0	0	0	1	18
B11	1*	1*	1*	1*	1	1	1	1	1	1*	1	1	1	1	1*	1*	1*	0	0	1	1*	19
B12	1*	1	1	1	1	1	1	1*	1*	1*	1*	1	1	1	1*	1	1	1	1	0	1*	20
B13	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1	1*	1*	1*	1	1	1*	1*	1*	21
B14	1*	1	1	1	1	1*	0	1	1	1*	1*	1*	1*	1	1*	1*	1	0	0	0	1*	17
B15	0	1	1*	1	1	1	1*	1*	1	1	1*	1	0	1*	1	1	1	1	1	1	1*	19
B16	1	1	1	1	1	1*	1	1	1	1	1*	1	1*	1*	1	1	1	0	0	0	1	18
B17	1	1	1*	1	1	1	1*	1	1	1	1*	1	1	1	1*	1	1	1	1	1	1*	21
B18	1*	1*	1*	1*	1*	1*	0	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1	1	1	1*	20
B19	1*	1*	1*	1*	1*	1*	0	1*	1*	1*	1*	1*	1	1*	1*	1*	1*	1	1	1	1*	20
B20	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1	1*	1*	1*	1*	1	1	1	1*	21
B21	1*	1*	1*	1	1*	1*	1*	1	1	1	1*	1*	1	1*	1*	1	1	0	0	1	1	19
Depeinding	20	21	21	21	21	21	18	21	21	21	21	21	19	21	21	21	21	11	10	11	21	

Figure 4-108: Final Reachability Matrix for Local Companies

Table 4-42: Levels of Barriers for Local Companies – 1st Iteration

	Reachability Set	Antecedent Set	Intersection Set	Level
B1	1,2,4,5,8,9,10,11,12,14,15,16,17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1,2,4,5,8,9,10,11,12,14,15,16,17	1
B2	1,2,3,4,5,8,9,10,12,14,16,17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	1,2,3,4,5,8,9,10,12,14,16,17	1
B3	1,2,3,4,5,6,7,8,9,10,11,12,14,15,16,17,19,21	2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	2,3,4,5,6,7,8,9,10,11,12,14,15,16,17,19,21	
B4	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,21	1
B5	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,21	
B6	1,2,3,4,5,6,7,8,9,10,12,14,15,16,17,21	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	3,4,5,6,7,8,9,10,12,14,15,16,17,21	
B7	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,21	3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,20,21	3,4,5,6,7,8,9,10,11,12,13,14,16,17,21	
B8	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	
B9	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1
B10	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	
B11	1,2,3,4,6,7,8,9,10,11,12,13,14,15,16,17,18,21	1,3,4,5,7,8,9,10,11,12,13,14,16,17,18,19,20,21	1,3,4,7,8,9,10,11,12,13,14,16,17,18,21	
B12	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,21	1
B13	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	4,5,7,8,9,10,11,12,13,14,16,17,18,19,20	4,5,7,8,9,10,11,12,13,14,16,17,18,19,20	
B14	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1
B15	1,3,4,6,9,12,14,15,16,17,21	1,3,4,5,6,7,8,9,10,11,13,15,16,17,18,19,20,21	1,3,4,6,9,15,16,17,21	
B16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1
B17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1
B18	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	5,8,9,10,11,13,14,15,16,17,18,19,20,21	5,8,9,10,11,13,14,15,16,17,18,19,20,21	
B19	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	3,4,8,9,10,13,14,16,17,18,19,20	3,4,8,9,10,13,14,16,17,18,19,20	
B20	2,3,4,5,6,8,9,10,11,12,13,14,15,16,17,18,19,20,21	8,9,10,12,13,17,18,19,20,21	8,9,10,12,13,17,18,19,20,21	
B21	1,2,3,4,5,6,7,8,9,10,11,12,14,15,16,17,18,20,21	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	3,4,5,6,7,8,9,10,11,12,14,15,16,17,18,20,21	

Table 4-43: Levels of Barriers for Local Companies – 2nd Iteration

	Reachability Set	Antecedent Set	Intersection Set	Level
B1	~~1,2,4,5,8,9,10,11,12,14,15,16,17~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1,2,4,5,8,9,10,11,12,14,15,16,17~~	~~1~~
B2	~~1,2,3,4,5,8,9,10,12,14,16,17~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21~~	~~1,2,3,4,5,8,9,10,12,14,16,17~~	~~1~~
B3	3,5,6,7,8,10,11,15,19,21	3,5,6,7,8,10,11,13,15,18,19,20,21		
B4	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,21~~	~~1~~
B5	3,5,6,7,8,10,11,13,15,18,21	3,5,6,7,8,10,13,15,18,19,20,21	3,5,6,7,8,10,13,15,18,21	
B6	3,5,6,7,8,10,15,21	3,5,6,7,8,10,11,13,15,18,19,20,21	3,5,6,7,8,10,15,21	2
B7	3,5,6,7,8,10,11,13,15,21	3,5,6,7,8,10,11,13,18,19,221	3,5,6,7,8,10,11,13,21	
B8	3,5,6,7,8,10,11,13,15,18,19,20,21	3,5,6,7,8,10,11,13,,18,19,20,21	3,5,6,7,8,10,11,13,,18,19,20,21	
B9	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1~~
B10	3,5,6,7,8,10,11,13,15,18,19,20,21	3,5,6,7,8,10,11,13,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	
B11	3,,6,7,8,10,11,13,15,18,21	3,5,,7,8,10,11,13, ,18,19,20,21	3,7,8,10,11,13, ,18,19,,21	
B12	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,21~~	~~1~~
B13	3,5,6,7,8,10,11,13,15,18,19,20,21	,5,7,8,10,11,13 ,18,19,20,21	,5,7,8,10,11,13 ,18,19,20,21	
B14	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1~~
B15	3,6 ,15 ,21	3,5,6,7,8,10,11,13,15,18,19,20,21	3,6 ,15 ,21	2
B16	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1~~
B17	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1~~
B18	3,5,6,7,8,10,11,13,15,18,19,20,21	,5, ,8,10,11,13, ,18,19,20,21	,5, ,8,10,11,13, ,18,19,20,21	
B19	3,5,6,7,8,10,11,13,15,18,19,20,21	3,,8,10,13, ,18,19,20,	3,,8,10,13, ,18,19,20,	
B20	3,5,6,8,10,11,13,15,18,19,20,21	,8,10 ,13, ,18,19,20,21	,8,10 ,13, ,18,19,20,21	
B21	3,5,6,7,8,10,11, ,15,18 ,20,21	3,5,6,7,8,10,11,13,15,18,19,20,21	3,5,6,7,8,10,11, ,15,18 ,20,21	2

Table 4-44: Levels of Barriers for Local Companies – 3rd Iteration

	Reachability Set	Antecedent Set	Intersection Set	Level
~~B1~~	~~1,2,4,5,8,9,10,11,12,14,15,16,17~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1,2,4,5,8,9,10,11,12,14,15,16,17~~	~~1~~
~~B2~~	~~1,2,3,4,5,8,9,10,12,14,16,17~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21~~	~~1,2,3,4,5,8,9,10,12,14,16,17~~	~~1~~
B3	3,5,7,8,10,11, , ,19,	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11, , ,19,	3
~~B4~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,21~~	~~1~~
B5	3,5,6,7,8,10,11,13,15,18,	3,5,6,7,8,10,13,15,18,19,20	3,5,6,7,8,10, ,13,15,18,	
~~B6~~	~~3,5,6,7,8,10,15,21~~	~~3,5,6,7,8,10,11,13,15,18,19,20,21~~	~~3,5,6,7,8,10,15,21~~	~~2~~
B7	3,5,7,8,10,11,13	3,5,7,8,10,11,13,18,19,	3,5,7,8,10,11,13	3
B8	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3
~~B9~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1~~
B10	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3
B11	3,7,8,10,11,13,18	3,5,7,8,10,11,13,18,19,20	3,7,8,10,11,13,18	3
~~B12~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,21~~	~~1~~
B13	3,5,7,8,10,11,13,18,19,20	,5,7,8,10,11,13,18,19,20	,5,7,8,10,11,13,18,19,20	
~~B14~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1~~
~~B15~~	~~3,6,15,21~~	~~3,5,6,7,8,10,11,13,15,18,19,20,21~~	~~3,6,15,21~~	~~2~~
~~B16~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21~~	~~1~~
~~B17~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21~~	~~1~~
B18	3,5,7,8,10,11,13,18,19,20	,5,8,10,11,13,18,19,20	,5,8,10,11,13,18,19,20	
B19	3,5,7,8,10,11,13,18,19,20	3,8,10,13,18,19,20	3,8,10,13,18,19,20	
B20	3,5,8,10,11,13,18,19,20	,8,10,13,18,19,20	,8,10,13,18,19,20	
~~B21~~	~~3,5,6,7,8,10,11, ,15,18 ,20,21~~	~~3,5,6,7,8,10,11,13,15,18,19,20,21~~	~~3,5,6,7,8,10,11, ,15,18 ,20,21~~	~~2~~

Table 4-45: Levels of Barriers for Local Companies – 4th &5th Iterations

	Reachability Set	Antecedent Set	Intersection Set	Level
B1	1,2,4,5,8,9,10,11,12,14,15,16,17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1,2,4,5,8,9,10,11,12,14,15,16,17	1
B2	1,2,3,4,5,8,9,10,12,14,16,17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21	1,2,3,4,5,8,9,10,12,14,16,17	1
B4	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,21	1
B9	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1
B12	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,20,21	1
B14	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1
B16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,21	1
B17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1
B21	3,5,6,7,8,10,11, ,15,18 ,20,21	3,5,6,7,8,10,11,13,15,18,19,20,21	3,5,6,7,8,10,11, ,15,18 ,20,21	2
B6	3,5,6,7,8,10,15,21	3,5,6,7,8,10,11,13,15,18,19,20,21	3,5,6,7,8,10,15,21	2
B15	3,6 ,15 ,21	3,5,6,7,8,10,11,13,15,18,19,20,21	3,6 ,15 ,21	2
B3	3,5,7,8,10,11, , ,19,	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11, , ,19,	3
B7	3,5,7,8,10,11,13	3,5,7,8,10,11,13,18,19,	3,5,7,8,10,11,13	3
B8	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3
B10	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3,5,7,8,10,11,13,18,19,20	3
B11	3,7,8,10,11,13,18	3,5,7,8,10,11,13,18,19,20	3,7,8,10,11,13,18	3
B5	5,13,18	5,13,18,.19.20	5,13,18	4
B13	5,13,18,19,20	5,13,18,19,20	5,13,18,20	4
B18	5,13,18,19,20	5,13,18,19,20	5,13,18,19,20	4
B19	19,20	19,20	19,20	5
B20	19,20	19,20	19,20	5

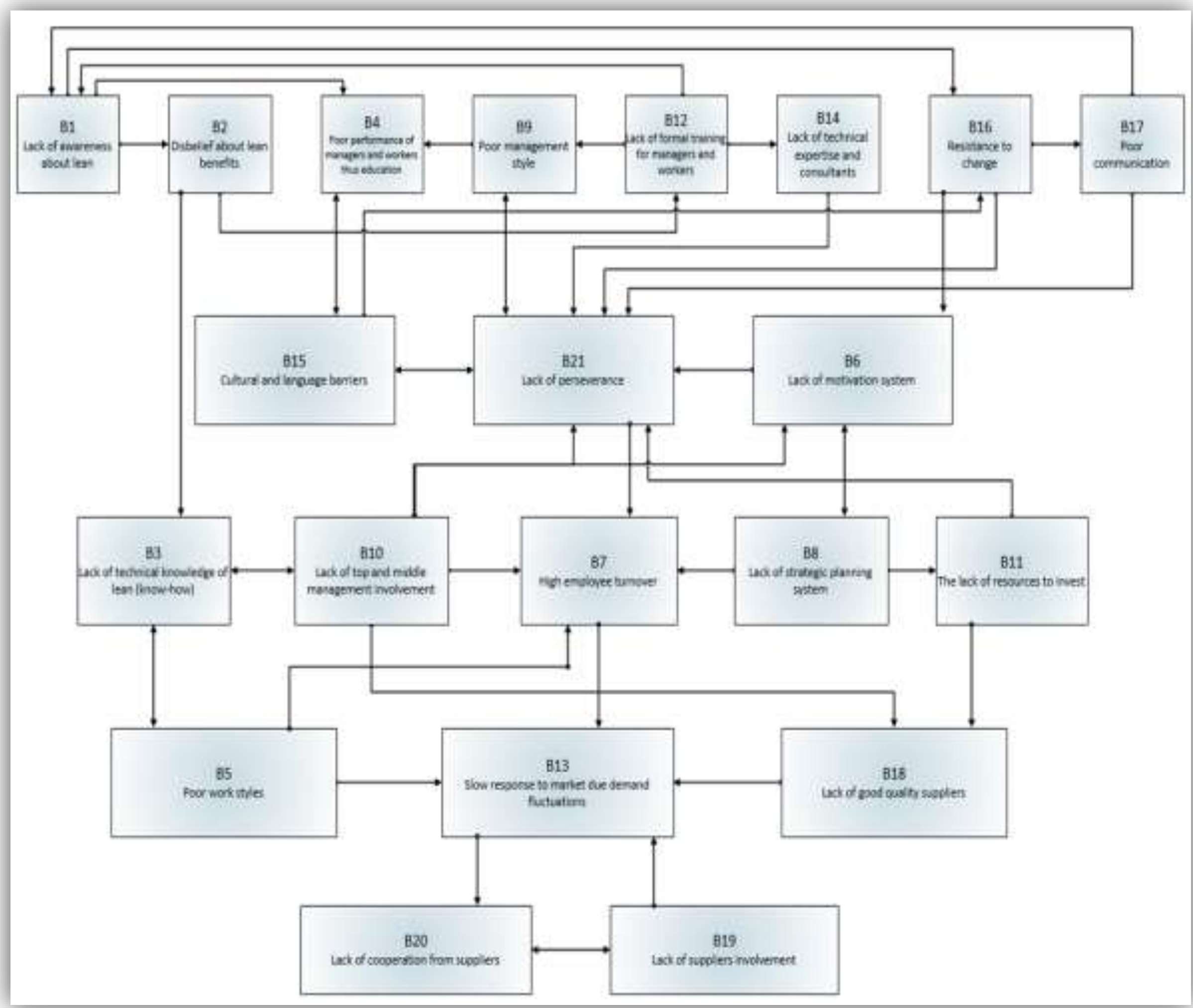

Figure 4-109: ISM for Local Companies

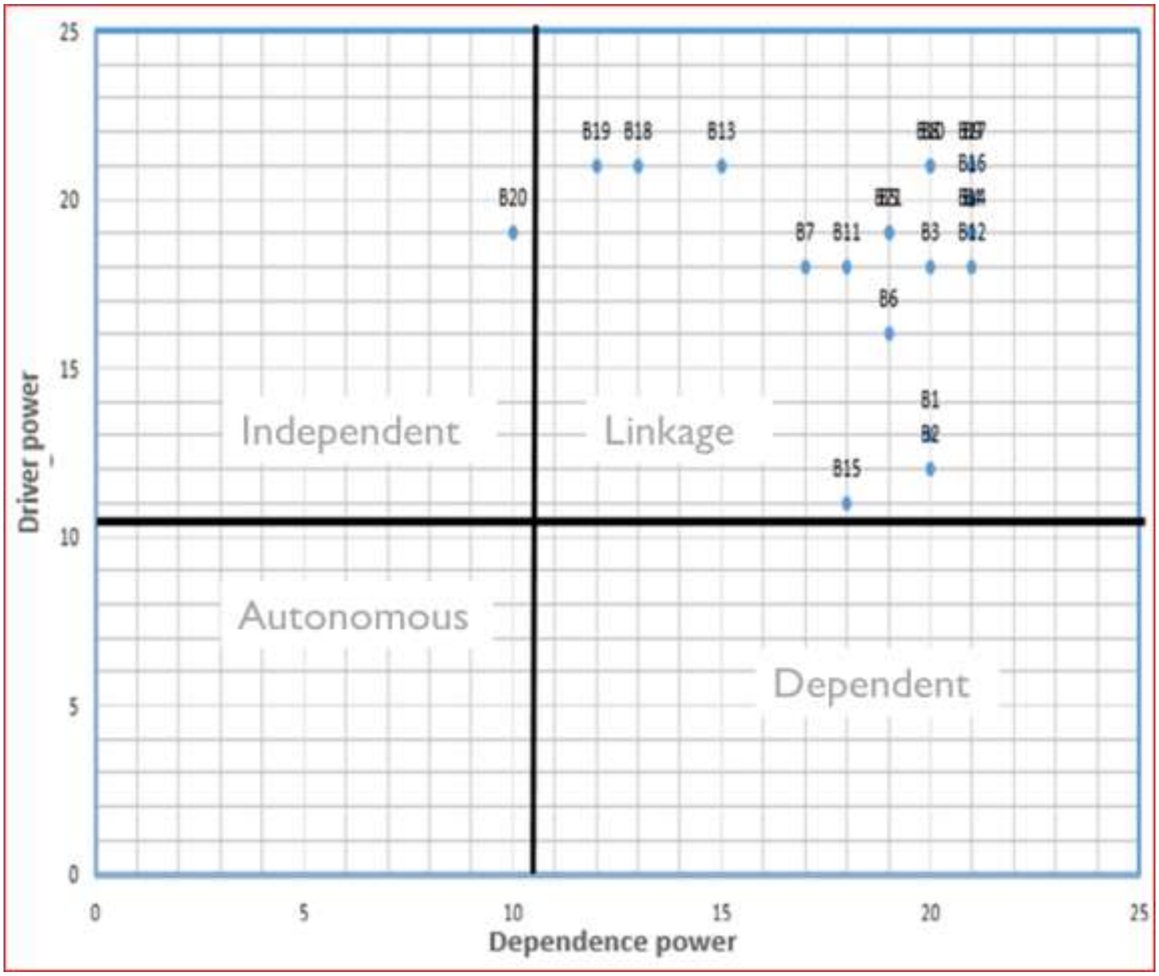

Figure 4-110: MICMAC Analysis for Local Companies

CHAPTER 5 FRAMEWORK DEVELOPMENT

5.1 Introduction

Stephen Corbett, a principal in McKinsey's Toronto office maintains that:

> The biggest challenges in adopting the lean approach in nonindustrial environments are to know which of its tools or principles to use and how to apply them effectively. In emerging markets such as China or India, manufacturing managers trying to implement the lean approach also face these challenges. Differences in everything from culture to infrastructure mean that managers can't apply the lean tools and techniques used in manufacturing operations in Moline or Munich to nonindustrial environments or to manufacturing plants in the developing world; the approach must be tailored to the realities of specific environment (Corbett, 2007, p. 1).

In fact, any widely known models such as the five principles of lean thinking would work in developing countries; nonetheless, many models lack a proper starting point. Chalice (2007) indicates that starting the journey of lean initiative could be done by one or more activities, such as conducting lean baseline assessment, mass training employees in lean, and analysis the internal overall equipment effectiveness and loss. In addition, the integration of existing improvement practices with multiple disciplines and techniques is required because in the new global economic agenda, the changes in laws and regulations and the high insistence from stakeholders have increased the pressure and responsibility to ensure that the implementation of a sustainable transformation through lean implementation is achievable (Martínez-Jurado & Moyano-Fuentes, 2014; Yusup et al., 2015). Accordingly, the proposed framework reacted to general practices regarding lean transformation in developing countries, assessed a lean transformation level, and constructed the ISM for barriers to achieve a successful lean transformation.

5.2 Description of Framework Components

Figure 5-1 shows the conceptual framework for lean transformation in developing countries. The framework consists of four phases and provides a distinct timeline for each phase. The timeline for multinational companies for all phases is shorter than the timeline for local companies. Moreover, the framework contains three stations for assessment and brainstorming for the barriers and aids analysis. The first assessment is conducted by the executive leadership and lean transformation team in the foundation phase. The second assessment is after Phase I to evaluate the implemented techniques and take corrective actions if needed, as well as reward lean leaders and Kaizen groups.

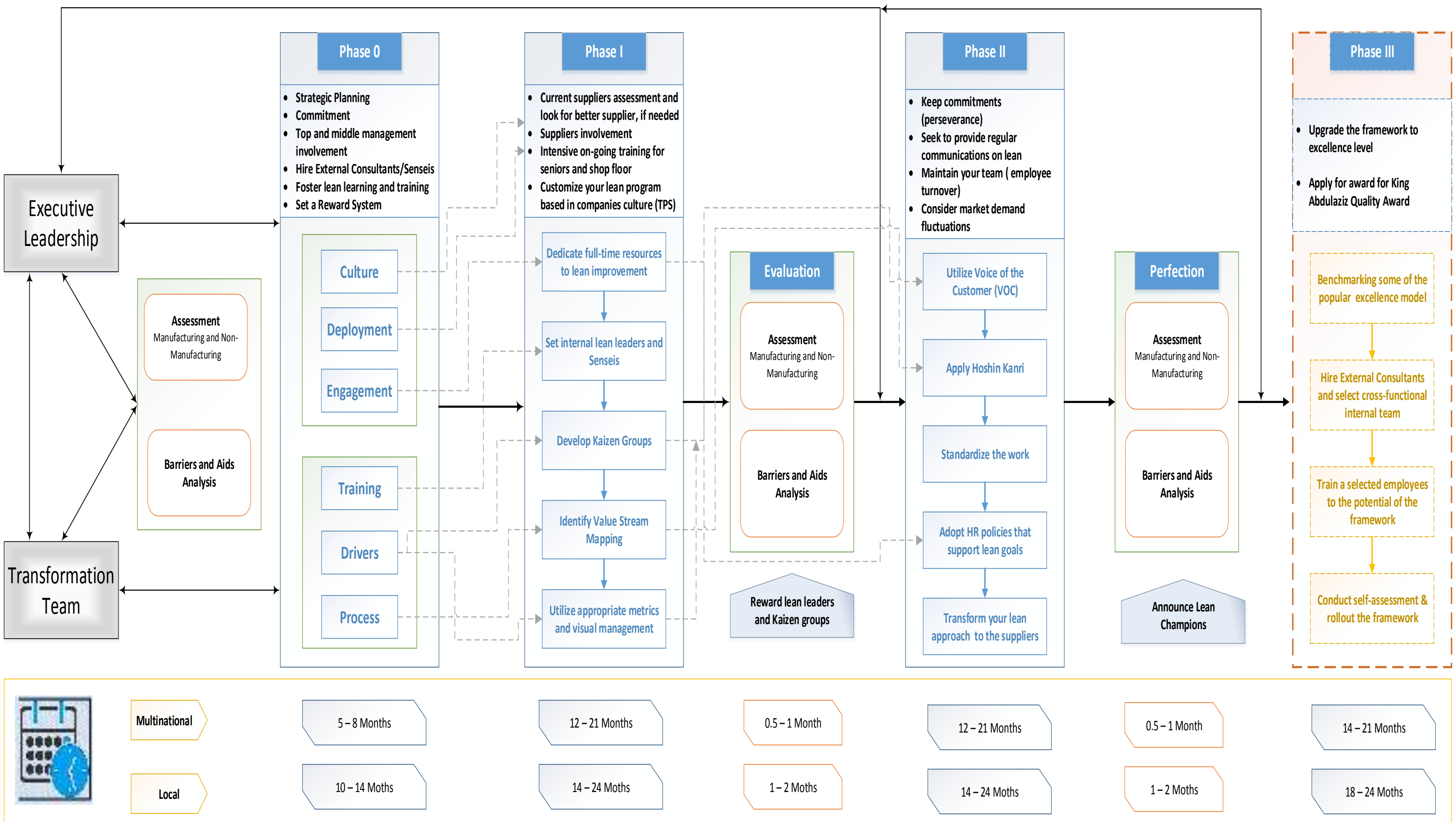

Figure 5-1: Framework for Lean Transformation in Developing Countries

The third assessment is to ensure that the transformation to lean is showing significant results, and that all parties of the transformation believe that lean is a continuous improvement system that never ends. In addition, in this stage of perfection it is essential to reward lean champions to encourage them to move toward excellence in Phase III.

5.2.1. Foundation and Phase 0

The first element in the framework is the executive leadership of the company, such as CEO, COO, CFO, etc., and may be all or some of the board of directors. Lean transformation should start from a commitment of the executive directors who play a key role in providing leadership and strategic direction for the organization and welcoming the potential to boost efficiency as well as who fully support the initiative. J. K. Liker (2004) states that:

> a prerequisite to change is for top management to have an understanding and commitment to leveraging the Toyota Way to become a lean learning organization. This understanding and commitment extends to building the lean systems and culture and, the most difficult for Western companies, sustaining and constantly improving the system. (p. 306)

Early focus on leadership philosophy is an important way to increase efficiency and control costs (T. S. Bateman & Snell, 2011).

The major hindrance in lean transformation is employee resistance to change and this comes form of lack of leadership vision, recognizing employees for their efforts, and understanding lean principles (Tranholt-Hochstein, 2015). Moreover, D. R. Brown (2013) believes that lack of a clear leadership vision, communication plan, and reward system are major reasons that make transformation in organizations often fail. Deming once said that "eighty-five percent of all operation and business problems are the fault of management" (R. Brown, 2014, p. 58)

Consequently, for a successful and sustained lean transformation, it is crucial to start with leadership to create the foundation for the paradigm shift. The best-fit leadership style is the transformational leadership which incorporates a strategic vision based upon changes that advance innovation and creativity. Adopting a strong leadership system like the one in Toyota Production System will solve most of the staff problems (J. Liker & Convis, 2012).

The second element of the foundation is transformation team. This team should be created by the executive leadership, and it should be a cross-functional team from various levels of the company, such as the top management, seniors, and shop floors as well as from different departments such sales, HR, and customer service. R. Brown

(2014) claims that undoubtedly team is the most important asset of lean thinking "without team, however, you can't do lean" (p.60). Starbird (2016) maintains that organizing teams is one of the steps for leading the transformation of lean and it is essential for the team to have right education for efficiency and enough resources for efficiency.

Both the executive leadership and the lean transformation team are responsible to the following:

1. Conduct self-assessment for all sections, including manufacturing and non-manufacturing, and brainstorming for barriers and the proper aids.

2. Set up strategic goals for the transformation, taking into consideration six categories of the critical success factors, which include culture, deployment, engagement, training, drivers, and processes.

3. Ensure top and middle management commitment and involvement. For lean to be applied successfully, it is crucial to ensure leadership commitment, employee engagement in the education and process, and organizational readiness (Radnor, Walley, Stephens, & Bucci, 2006)

4. Seek and hire external consultants/senseis. The consultants can help to coach executive leaders on lean, develop a lean learning and training plan, set the measurements or metrics for the transformation, and guide the set up of the reward system.

5. Start the training program from top level to the shop floor. Part of the training should be on-the-job training, which is very important for employees' motivation and faster learning.

6. Continuing to conduct the assessment, and barriers and aid analysis after each phase. In addition, to be a backup anytime one is needed.

The timeline for the foundation and Phase 0 for multinational is between five to eight months. Based on the interview analysis, multinational companies have a better leadership level and usually the transformation is guided and mentored by the main company. However, the duration of this phase in local companies is between ten months to one year and two months. Longer duration for local companies is due to the need of creating some elements from scratch.

5.2.2. Phase I and Evaluation

Once the baseline and the strategic planning for lean transformation are adopted, the next phase is to start with the first level that is found in the ISM, which was related to suppliers' quality, involvement, and cooperation. In this phase, the transformation team and the consultants should mainly focus on the following:

1. Conduct an assessment for current suppliers and look for better suppliers, if needed.
2. Involve suppliers in the transformation.
3. Intensive ongoing training for senior employees and shop floor. One success strategy for sustainable lean implementation is to invest in training and educating of senior leaders and workers in viewing lean as a philosophy for managing (Pentlicki, 2015).
4. Customize the lean program based in the company's culture, such as TPS.
5. Dedicate full-time resources to lean improvement.
6. Set internal lean leaders and senseis.
7. Implement continues the improvement method; namely, Kaizen. Start the Kaizen by training, creating Kaizen groups, setting up reward systems, announcing the winners, and preparing a showroom for the best projects to be seen by all employees.
8. Identify a Value Stream Mapping (VSM), which is powerful diagnostic and planning tool for a successful lean implementation.

9. Develop proper metrics and visual management. Implement a lean 6S method, which is also called 5S+1 or 5S+Safety. It is observed from the interviews with Saudi Arabian companies that 5S is one of the most-used lean tools and some people shorten the lean concept to 5S.

This phase might take multinational companies one year to one year and nine months, and local companies one year and two months to two years. This phase is the bottleneck because it requires more effort and concentration.

Furthermore, the transformation team should test the tools and techniques which were used in this phase and brainstorm them to overcome any obstacles that the company faced so far. Also, it is important that if the lean transformation reflects significant results, lean leaders and Kaizen groups should be rewarded. This will motivate them and encourage others in the company to do their best. D. R. Brown (2013) believes that a lack of a clear leadership vision, communication plan, and reward system are the major reasons that make transformation in organizations fail. The evaluation timeline is estimated to be within one month in multinational companies and between one to two months in local companies.

5.2.3. Phase II and Perfection

This phase includes additional important methods and actions to achieve a successful and then sustained lean transformation in any organization. The executive leaders and transformation team should concentrate on the following:

1. Encourage themselves and other parties in the transformation journey to continue their commitments. This is important to avoid lack of perseverance which was one of the main barriers in developing countries. Tranholt-Hochstein (2015) maintains that for lean system to be success it is essential to have a continuous leadership involvement and support. “Executive leadership needs to champion LMS and provide direction and support through engagement and actions. Unengaged leaders allow employees to determine the importance of LMS. Employees perceiving LMS as unimportant may impede progress. Leaders who included LMS in the strategic plan, measured progress, and engaged during activities had the most success” (p.170).

2. Afford systematic communications regarding lean across the company.

3. A Voice of the Customer (VOC) should be considered in lean transformation. Although most of the interviewed companies have a customer service and complaint system, limited companies have involved that in their strategy and focus in their transformations.

4. Apply Hoshin Kanri. In the Japanese language, Hoshin means compass/direction, and Kanri means management. It is “a systemic process for aligning top management strategic decision with the needs of the shop floor

Standardize actions as reference line for continuous improvement" (Masai et al., 2015, p. 227). For successful lean implementations, Dombrowski and Mielke (2014) define five fundamental principles of lean leadership, and one of these principles is Hoshin Kanri.

5. Restructure HR policies that support lean goals.

6. Transform this lean roadmap to the company's suppliers.

The expected duration for this phase to be implemented in multinational companies is between one year to one year and nine months, and for local companies is between one year and two months to two years. This phase must be followed by an assessment in order to measure the previous actions and attain perfection. Womack and Jones (2010) states that "perfection - meaning the complete elimination of *muda* - is surely impossible. So, shouldn't managers eventually stop efforts to improve the process and simply manage it in a steady state, avoiding variances from (normal) performance?" (p. 90). The assessment timeline is estimated to be within one month in multinational companies and between one and two months in local companies. Only three of the eighteen case study companies have reached to perfection level. These companies are Toyota Saudi Arabia, P&G Saudi Arabia, and Aquat Foods (Al Baik).

5.2.4. Phase III Excellence Level

Accomplishing Phase 0 to Phase II can provide significant results, such as cost reduction, an increase in productivity and efficiency, and a boost in the level of quality. However, Phase III is perhaps an advanced level for companies in developing countries to reach. This level is the transition or upgrade from a lean system to the performance excellence level. None of the case study companies has accomplished this level. For this phase, the executive leaders and transformation team should work on upgrading the current framework to a framework for the excellence level in developing countries. The following are the suggested steps to implement the performance excellence framework:

1. Benchmarking some of the popular excellence models.
2. Hire External Consultants and select a cross-functional internal team.
3. Train selected employees to the potential of the framework.
4. Conduct self-assessment and rollout the framework.
5. Apply for awards such as Malcolm Baldrige National Quality Award. Companies in Saudi Arabia can apply for King Abdulaziz Quality Award (KAQA). KAQA was established by the King of Saudi Arabia in 2002 and is intended to maximize

quality, efficiency, and productivity in diverse sectors within the country[13].

These steps would take one year to one year and nine months for multinational companies, and one year and four months to two years for local companies.

5.3 Framework Validation

Firstly, a content validity analysis by subject matter experts was performed for the content of the assessment, barriers, and the framework. In addition, the framework validation was based on the four key measures of the quality of designing case study which include construct validity, internal validity, external validity, and reliability. Table 3-9 in Chapter 3 demonstrates these measures in details. Construct validity is achieved by performing multiple sources of evidence and reviewing a draft report of the case study by interviewees (Yin, 2013). Accordingly, validation of the framework was through a multiple case study analysis of ten local and eight multinational Saudi Arabian companies. In addition, an expert in the subject matter was applied to validate the assessment, ISM, and the proposed framework, as well as examining supporting documents that were provided by the case study companies.

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[13] Retrieved from www.kaqa.org.sa

The interview candidates from the case studies companies were selected as experts for validation. Two experts from the multinational companies Toyota Saudi Arabia and PepsiCo, and two from the local companies Almarai Company and Obeikan Plastic Company. Each expert was provided a draft report of his company, overall findings of lean assessment, ISM for barriers, the proposed framework, and the validation form. Figures 5.2, 5.3, 5.4, 5.5, and 5.6 below show the experts' validation report.

To sum up, the construct validity was achieved by having multiple sources of evidence which included the interview and supplementary documents, and having experts from the case study companies review draft reports of the case study. Internal validity also was accomplished by using pattern matching to compare the lean transformation levels among case study companies and by using explanation building in the data analysis. The replication logic of a multiple case study analysis helps to achieve external validity. Lastly, reliability was considered by having a database for each case study and by having a case study protocol which confirmed that the case study could be repeated by a different researcher.

Validation Form

- Company: Abdul Latif Jameel
- Position: Director
- Lean Role: Kaizen and Lean Transformation
- Work Experience: 14 Years in Kaizen and Lean activities

Lean Transformation Level

Category	Feedback	Corrective Action
Lean Transformation Level at your company	Agree with your score	Company name: Abdul Latif Jameel Motors - KSA
Overall all Lean Transformation Level Multinational Companies	Agree with your score	None
Overall all Lean Transformation Level Local Companies	Process is under 30% especially with small size and medium size companies	None

Barriers Analysis

Category	Feedback	Corrective Action
Barriers List	Great tools	None
ISM for multinational companies	B6 is the highest cause	None
ISM for local companies	B9 is the highest cause	None

Framework for Lean Transformation

Category	Feedback	Corrective Action
Framework Components	Excellent	None
Phase 0 (Foundation)	Excellent. Change management can be added to this Phase	None
Phase I	Excellent. Change management can be added to this Phase	None
Phase II	Excellent	None
Phase III (Excellence)	Excellent	None
Duration for multinational	Agree with your proposal	None
Duration for local	Long duration for Phase 0	None

Figure 5-2: Expert Feedback – Toyota Saudi Arabia

Validation Form

- Company: Almarai
- Position: Senior Business Excellence Manager
- Lean Role: Six Sigma Yellow and Green Belt, Kaizen, Lean
- Work Experience: 12 years; Toyota Motor Manufacturing & Almarai

Lean Transformation Level

Category	Feedback	Corrective Action
Lean Transformation Level at your company	Agree with score as we are still in the infancy of developing Lean across the business	We are in the process of developing a 5 year plan to continue our “journey”
Overall all Lean Transformation Level Multinational Companies		
Overall all Lean Transformation Level Local Companies		

Barriers Analysis

Category	Feedback	Corrective Action
Barriers List	Good detailed analysis, which is relevant today	N/A
ISM for multinational companies	Good detailed analysis, which is relevant today	N/A
ISM for local companies	Good detailed analysis, which is relevant today	N/A

Framework for Lean Transformation

Category	Feedback	Corrective Action
Framework Components	Agree	N/A
Phase 0 (Foundation)	Agree	N/A
Phase I	I do not believe we are in a suitable position to develop Lean with our suppliers within the given timeframe. We have to have a robust internal platform before this can be considered, but in the future this does need to be incorporated into strategic direction. It may be applicable generally, but may differ in specific cases	Would you need to extend time frame especially in developing countries?
Phase II	Agree	N/A
Phase III (Excellence)	Agree	N/A
Duration for multinational	As stated above, timeframe may be ambitious as I have no perspective on what Lean journey suppliers are undertaking.	As above
Duration for local	As stated above, timeframe may be ambitious as I have no perspective on what Lean journey suppliers are undertaking.	As above

Figure 5-3: Expert Feedback – Almarai Company

Validation Form

- Company: Saudi Industrial Beverage Company (PepsiCo)
- Position: Plant Manager
- Lean Role: Sponsor
- Work Experience: 12 Years.

Lean Transformation Level

Category	Feedback	Corrective Action
Lean Transformation Level at your company	Agree with your score	None
Overall all Lean Transformation Level Multinational Companies	Recommend to bench mark with US companies	None
Overall all Lean Transformation Level Local Companies	Agree with your score	None

Barriers Analysis

Category	Feedback	Corrective Action
Barriers List	Great tools	None
ISM for multinational companies	B6 is the highest cause	None
ISM for local companies	B10 is the highest cause	None

Framework for Lean Transformation

Category	Feedback	Corrective Action
Framework Components	Excellent	None
Phase 0 (Foundation)	Excellent. Change management can be added to this Phase	None
Phase I	Excellent. Change management can be added to this Phase	None
Phase II	Excellent	None
Phase III (Excellence)	Excellent	None
Duration for multinational	Agree with your proposal	None
Duration for local	Overall time should be more compare to multinational	None

Figure 5-4: Expert Feedback – PepsiCo

Validation Form

- Company: Obeikan Plastic Companies
- Position: GM
- Lean Role:
- Work Experience: 18 Years

Lean Transformation Level

Category	Feedback	Corrective Action
Lean Transformation Level at your company	The radar chart is reflecting our status as yes we are focusing on training currently in which we believe it is right focus to deliver the capability within our teams to guarantee the right implementation and this will be followed our focus on the process side to have the right standard for all our processes. Overall, the chart is reflecting our status as we are still in the middle of our journey and it is helping us also to have the right focus on the right element of the model. I want to thank the team working on this in terms of making such visibility for our status in each element with the right cause and effect which we will utilize in our actions settings and reviews to guarantee accelerating our journey progress.	I believe we need to understand more deeply the link between culture element is scoring higher than the engagement as we expect that right engagement will be delivering the right culture as an outcome while currently the chart is showing our culture is higher than the engagement
Overall all Lean Transformation Level Multinational Companies	It is very clear that multinational companies are focusing on the processes element which I believe is reflecting reality due to the big size of that companies and processes and standardization is a must to manage the right interaction between different functions across the world with the right synchronization.	I am seeing the same about the engagement element which is more clear here even with right focus on all other elements yet the engagement is not matching the progress in all other elements which needs right analysis and interaction to have more clarity for the causes and actions
Overall all Lean Transformation Level Local Companies	There is a high differences between local companies which is expected and I believe the charts are reflecting the reality with the right deep understanding of the local companies and I believe the local companies already started the journey and reached a good status. It is very clear that local companies main focus area the training element which I am fully agree according to my sense in the market as companies need to reach to final understanding that training investment is a must to move forward for excellence and it is the right investment.	I believe based on the great data base delivered for all companies during this study, the study team can provide a great help and support to the companies through identifying the right acceleration road for the companies based on their current status and also all learning's from multination companies.

Barriers Analysis

Category	Feedback	Corrective Action
Barriers List	Great set up for identifying barriers with the right link as cause and effect which enable companies to identify their priorities based on that with the 80/20 role to accelerate the outcomes versus implementation	
ISM for multinational companies	The ISM outcomes is a clear proven of the model link and making sense from the model I am seeing a clear supplier issues outcomes from the model and I am fully agree with this based on my actual experience and I am seeing it is coming not only from the supplier as also the multination companies participate in this and this is coming mainly that multination companies are trying to implement their systems to suppliers with adapting the suppliers systems and taking suppliers system as part of the final interaction model. The high level of turnover is making sense due to the high level of training and standardized processes.	
ISM for local companies	Slow response to market due to demand fluctuation is a clear and very strong element as an outcome from this model and I believe this is solid right as the local companies still at the beginning of excellence journey which will help them to high the right response and on time through their excellence level.	I believe an acceleration road map and program is highly needed to be share with the local companies to adapt with the current market needs

Figure 5-5: Expert Feedback – Obeikan Plastic Company (part 1)

Framework for Lean Transformation

Category	Feedback	Corrective Action
Framework Components	This is a great step that can help all companies to have the right clarity of the approach and I am fully agree on the setup to guarantee the right sustainability before moving from one phase to the next phase otherwise if there is no sustainability in the previous phase the next phase for sure will not be successful. All companies can use this approach as this will be one of their successful journey in the excellence. Thanks for the great start of the approach of leadership and teams as these are the right setup from my previous experience to have the right start and continuous progress in the journey	
Phase 0 (Foundation)	It is the right to start by understanding the current status for any company versus the business need to develop the right master plan and also the right set up for the program, so starting with the assessment for the documented elements will be the right start of the program. Starting with the leadership and middle management is the successful start to develop the right models for all the organization and also will help leadership to learn then implement and practice and then provide the right coaching for the total organization to deliver the right set up and right progress to success the journey.	
Phase I	Right step of finalizing the action plan and start implementing the actions and it is great model in which involving the suppliers at this stage to be part of the excellence journey as suppliers are main in the this success which also was main outcomes from ISM to deliver finally end to end synchronization. I believe the time interval is making sense based on my experience of implementation.	
Phase II	It is very clear to have the right focus on HR systems to guarantee that engagement and maintain company's talents to deliver the journey with the right culture across all the organization and across all levels.	I believe there should be a period of time for correction after the evaluation phase to guarantee the right sustainability before moving to phase II to guarantee the right implementation and progress setup.
Phase III (Excellence)	It is needed as a company vision which all will have it as a vision to reach world class excellence and it will be a perfection phase needed in all functions and it is not finishing phase as it depends on the business needs changing based on market dynamic	
Duration for multinational	The duration is exactly reflecting the right set up based on my experience in local and multination companies	
Duration for local	The duration is exactly reflecting the right set up based on my experience in local and multination companies	

Figure 5-6: Expert Feedback – Obeikan Plastic Company (part 2)

In addition, two experts in ISM were contacted in order to validate the steps and the ISM-base models of the multinationals and local companies. The criteria of selecting experts for the ISM validation were:

- Work in the academic field
- Has at least two publications in ISM
- Willing and available to participate

Each expert was provided a report that included the entire procedure for developing ISM and a validation form. Figure 5-7 shows one of the expert feedback reports for the ISM-base models for the multinational and local companies.

Validation Feedback Form

- **Organization:** Department of Industrial Engineering, King Abdulaziz University, KSA
- **Position:** Associate Professor, Department Chairman
- **Recent Publications:**
    - Alidrisi, H. (2015). Development of a Study Plan for Industrial Engineering Program Using Interpretive Structural Modeling Technique. INTERNATIONAL JOURNAL OF ENGINEERING EDUCATION, 31(5), 1410-1418. (ISI)
    - Alidrisi, H. (2014). Prioritization of non-technical barriers for geothermal energy utilization using fuzzy analytic hierarchy process: The case of Saudi Arabia. Energy Education Science and Technology Part A: Energy Science and Research. 32(6): 7485-7494
    - Alidrisi, H. (2014). Prioritizing Critical Success Factors for Six Sigma Implementation Using Interpretive Structural Modeling. American Journal of Industrial and Business Management, 4-(12, 697)
    - Alidrisi, H. (2014). "An ANP-Based Multi Criteria Decision Making Model for Supplier Selection" In Industrial Engineering and Engineering Management, 2014 IEEE International Conference on. 9-12 December, 2014, Selangor, Malaysia (ISI).
    - Alidrisi, H. and Mohamed, S. (2012) "An ANP-Based Goal Programming Model for Quality Management: An Innovative Approach toward Strategic Quality Management", *Proceedings of International Conference on Industrial Engineering, World Academy of Science, Engineering and Technology (WASET 2012), Issue 70 October8-9, 2012, Dubai, UAE.*
    - Alidrisi, H. and Mohamed, S. (2009). "Resource Allocation for Strategic Quality Management: An Analytic Network Process (ANP) Model." *Proceedings of the Fifth International Conference on Construction in the 21st Century (CITC-V)*, May 20-22, 2009, Istanbul, Turkey, 789-795.

Barriers Identification and Analysis (ISM)

Category	Feedback	Corrective Action
Barriers Contents	The barriers have been identified through critical review of the literature. However, it would be better if barriers were limited around 15 barriers. Although some of the identified barriers can be grouped into 1 barrier, the current list can be considerably acceptable.	None
Structural Self-Interaction Matrix	It seems acceptable	None
Initial Reachability Matrix	It seems acceptable	None
Final Reachability Matrix	It seems acceptable	None
Level Partitions	It seems acceptable	None
ISM for multinational companies	It seems acceptable	None
ISM for local companies	It seems acceptable	None

Figure 5-7: Expert Feedback for the ISM-base models

CHAPTER 6 CONCLUSIONS AND FUTURE RESEARCH

6.1 Introduction

Due to a lack in the literature of a framework of lean transformation in developing countries, the primary objective of this research was to develop a roadmap for a successful and sustainable lean transformation in developing countries. Other objectives and research questions were addressed to attain the primary objective. This concluding chapter summarizes how these research objectives and research questions were achieved. In addition, it discusses the limitations and future research recommendations.

6.2 Conclusions

Organizations in developing countries are required to be on par with competitors - or even superior - in order to be successful and compete in today's economy. Furthermore, they are required to fulfill their customers' needs, which include high-quality products with a discounted cost in a short time frame. Transformation of their current systems to lean is the most desirable method, which contributes to efficient and effective procedures and practices; combined, these lead to a highly competitive position and excellence business performance. Nonetheless, the literature specified that there is a shortage of lean implementation in developing countries as a philosophy for managing the businesses as well as a lack of experience and knowledge in adopting the lean system. Therefore, there is a need to design a roadmap for organizations in developing countries to move toward achieving a successful transformation to lean.

Lean assessments were conducted in eight multinational and ten local Saudi Arabian companies to investigate the current level of lean transformation in developing countries. The assessment result showed that, similar to the literature findings which indicated that the level of successful lean transformation in developing countries is low, the lean transformation level of local companies in Saudi Arabia is between 30%-40%, and in multinational companies the level is between 50%-60%. In addition, it was concluded that there is no significant difference between the lean transformation level in multinational and local companies.

ISM is an effective method to locate the relationships between the barriers and prioritize them in a hierarchical way. The ISM analysis of the barriers of both local and multinational companies in the case of Saudi Arabian industry considered the lack of suppliers' involvement, lack of cooperation from suppliers, lack of good quality suppliers, and the slow response to market due to demand fluctuations as the root barriers that need to be addressed at the primary stages of lean transformation. Moreover, a second level of the barriers in multinational companies included lack of awareness about lean and a high employee turnover. Similarly, the second and third levels in local companies included poor work styles, a lack of technical knowledge of lean (know-how), high employee turnover, a lack of strategic planning systems, a lack of top and middle management involvement, and a lack of resources to invest. Also, ISM-base models showed that barriers in the top levels have strong relationships with each other, meaning that if one barrier is addressed then the other barriers will be influenced.

The resulting framework was developed by conducting a thorough literature review analysis and interviewing key personnel in ten local and eight multinational Saudi Arabian companies. The framework reacted to general data about lean transformation in developing countries, assessed a lean transformation level, and constructed an Interpretive Structure Molding (ISM) for barriers to achieve a successful lean transformation.

For the framework validation, construct validity was achieved by including multiple sources of evidence, which included the interview and supplementary documents, and having experts from the case study companies to review a draft report of the case study. Internal validity also was accomplished by using pattern matching to compare the lean transformation levels among case study companies and also by using explanation building in the data analysis. The replication logic of a multiple case study analysis helped to achieve external validity. Lastly, reliability was achieved by including a database for each case study, as well as by utilizing case study protocol to confirm that the case study could be repeated by a different researcher. Feedback from experts included using a timeline for local companies, adding an evaluation step, and considering management change theory.

The resulting framework provides clear phases with an estimated timeline for each phase, from the foundation phase to the excellence-level phase. In addition, it involves an executive leader and cross-functional team to mentor and assess the transformation after each phase. The framework is comprised of several methods and tools that can be considered critical success factors for lean transformation, which will further help companies to identify their weaknesses and opportunities for improvement as well as prepare them to reach an excellent level of performance. As well, it will enable companies in developing countries to move toward achieving a successful lean transformation and sustainability as well as reaching higher and more persistent levels of growth.

6.3 Recommendations

Based on the findings of this study, the following are recommendations that will certainly lead organizations in developing countries to attain a successful and sustainable lean transformation:

1. Consider lean as a philosophy for managing the company. Utilize lean in the company's strategy, manufacturing, and non-manufacturing areas to obtain the full benefits. Transformation to lean must be derived from the top down in order to be sustained.

2. Create a multi-functional and multi-departmental team, and include executive leaders in the team to build the foundation for the paradigm shift.

3. Seek and hire external consultants/senseis. The consultants can help to coach executive leaders on lean, develop lean learning and training plan, set the measurements or metrics for the transformation, and guide to set up the reward system.

4. Invest in lean training for everyone in the organization from the top level to the shop floor. Utilize on-the-job training, which is very important for employees' motivation and for faster learning.

5. Address the issue of high employee turnover, particularly in multinational companies since they invest more in training. This issue was evident in the multinational Saudi Arabian companies.

6. Seek good quality suppliers that can cooperate and be involved in the transformation. Extending the program to the suppliers is very important in lean transformation to attain successful results.

7. Let customers customize their own lean program based upon their company's and county's cultures. Case study companies that created their own lean program attained good level of lean transformation, such as P&G Saudi Arabia and Albaik.

8. Set up full-time resources in the lean transformation processes. These resources can

be internal or external, and the consultants should contribute in both the election of the program as well as training initiatives.

9. Implement continues improvement method; namely, Kaizen. Start Kaizen by training, creating Kaizen groups, setting up reward systems, announcing the winners, and preparing a showroom for the best projects to be seen by all employees.

10. Identify Value Stream Mapping (VSM), which is a powerful diagnostic and planning tool for a successful lean implementation.

11. Develop proper metrics and visual management. Implement the lean 6S method, which is also called 5S+1 or 5S+Safety. It was observed from the interviews with Saudi Arabian companies that 5S is one of the most used lean tools, and some people shorten lean concept to 5S.

12. Afford systematic communications regarding lean all over the company. Monthly, quarterly, and yearly meetings with executive leaders are important to review and assess the transformation. This is obvious in the proposed framework by having a transformation team follow up, review, solve problems, and deliver regular communications between top, middle, and shop floor employees. In addition, communications success is attained by having the three platforms included in assessment.

13. VOC should be considered in lean transformation. Though most of the interviewing

companies have both a customer service and complaint system, limited companies have involved these features in their strategy to focus on the transformation.

14. Apply Hoshin Kanri, which is a policy or strategy deployment method. In the Japanese language, *Hoshin* means compass/direction, and *Kanri* means management. Most of the interviewing companies were not familiar with the Hoshin Kanri method.

15. Restructure the company's HR policies to be supportive of the lean program. Involving the HR department and company policy in the lean transformation procedures is very important to achieve a successful level of lean.

16. Expand company goals to achieve an excellent performance level. This perhaps is an advanced level for companies in developing countries to reach. However, it is highly recommended for organizations in developing countries.

6.4 Limitations and Future Research

The scope of the research was for companies in developing countries, and includes case studies from India, Egypt, the United Arab Emirates, and Saudi Arabia. However, due to limitations of resourses and time, case studies from the Saudi Arabian industry were selected. In addition, the study was intended to cover service industries such as healthcare, but many issues limited that research direction. The main reasons were an absence of lean systems in the healthcare industry in Saudi Arabia, and the lack of availability in reaching key personnel who were willing to participate or to grant access to data.

Another limitation was that there were was a variety of types of companies in Saudi Arabia; for example, pure manufacturing companies, pure service companies, companies that offer manufacturing and services, private companies, and companies that owned totally or partially by government, among others. The delimitation method, which identifies the boundaries and scope of the study, was approached. Case studies were Saudi Arabian companies from the private sector who offered mix of manufacturing and service areas.

Transformation to lean in developing countries is not an easy task and is associated with several barriers that require more effort, not only from the companies' leaders but from governments and societies. For example, one of the barriers was the issue of high employee turnover, particularly in multinational companies as they invest more in training. This research only provided general recommendations to address this issue; nonetheless, to overcome with this issue it is essential to study the turnover issue in depth to be able to provide radical solutions.

Accordingly, there are many opportunities for future research related to lean transformation in developing countries. Similar studies could be conducted in other developing countries in the same areas; such as the United Arab Emirates and Kuwait; or in different regions in Asia such as China, India, and Malaysia; or in South America such as Argentina and Brazil. Comparisons between the findings can be investigated. Testing the framework in pure service industries such as the healthcare or food industries would be another potential opportunity for future research. This research can be a baseline for researchers to study lean transformation in governmental or non-profit sectors such as universities, public transportation division, charities, and so on,, which require more focus on reducing cost and increasing productivity than for-profit companies.

One of the future research opportunities could be extending this research and interviewing more people in different levels in each company, and/or using different data collection methods such as observation and surveys. Moreover, applying this framework in two or three organizations in developing countries and comparing the major results as well as bridging any gaps that exist. Perhaps a study of the correlations among organizations that have ISO certification versus non-ISO certified organizations in order to determine which organization category would be more prepared and eligible for lean transformation.

Approaching different models to conduct the assessment for lean transformation in developing countries would give a different direction and more a customized framework. Similar concepts are applicable for the barriers identification and analysis using ISM. In addition, using similar approach to ISM such as Analytical Hierarchy

Process or Analytic Network Process to study the relationship among the proposed lean tools of this framework and prioritize them would be beneficial idea for future research. Also, exploring Return On Investment (ROI) to organizations in developing countries that have implemented lean is a potential for future research.

APPENDIX A: DEVEL OING COUNTRIES BY REGION

Developing economies by region[a]

Africa

North Africa
- Algeria
- Egypt
- Libya[b]
- Mauritania
- Morocco
- Sudan
- Tunisia

Central Africa
- Cameroon
- Central African Republic
- Chad
- Congo
- Equatorial Guinea
- Gabon
- Sao Tome and Prinicipe

East Africa
- Burundi
- Comoros
- Democratic Republic of the Congo
- Djibouti
- Eritrea
- Ethiopia
- Kenya
- Madagascar
- Rwanda
- Somalia
- Uganda
- United Republic of Tanzania

Southern Africa
- Angola
- Botswana
- Lesotho
- Malawi
- Mauritius
- Mozambique
- Namibia
- South Africa
- Zambia
- Zimbabwe

West Africa
- Benin
- Burkina Faso
- Cabo Verde
- Côte d'Ivoire
- Gambia
- Ghana
- Guinea
- Guinea-Bissau
- Liberia
- Mali
- Niger
- Nigeria
- Senegal
- Sierra Leone
- Togo

Asia

East Asia
- Brunei Darussalam
- China
- Hong Kong SAR[c]
- Indonesia
- Malaysia
- Myanmar
- Papua New Guinea
- Philippines
- Republic of Korea
- Singapore
- Taiwan Province of China
- Thailand
- Viet Nam

South Asia
- Bangladesh
- India
- Iran (Islamic Republic of)
- Nepal
- Pakistan
- Sri Lanka

Western Asia
- Bahrain
- Iraq
- Israel
- Jordan
- Kuwait
- Lebanon
- Oman
- Qatar
- Saudi Arabia
- Syrian Arab Repuplic
- Turkey
- United Arab Emirates
- Yemen

Latin America and the Caribbean

Caribbean
- Barbados
- Cuba
- Dominican Republic
- Guyana
- Haiti
- Jamaica
- Trinidad and Tobago

Mexico and Central America
- Costa Rica
- El Salvador
- Guatemala
- Honduras
- Mexico
- Nicaragua
- Panama

South America
- Argentina
- Bolivia (Plurinational State of)
- Brazil
- Chile
- Colombia
- Ecuador
- Paraguay
- Peru
- Uruguay
- Venezuela (Bolivarian Republic of)

a Economies systematically monitored by the Global Economic Monitoring Unit of DPAD.
b The name of the Libyan Arab Jamahiriya was officially changed to Libya on 16 September 2011.
c Special Administrative Region of China.

Source:

World Economic Situation and Prospects 2015 – United Nations, retrieved from: http://www.un.org/en/development/desa/policy/wesp/wesp_archive/2015wesp_full_en.pdf

APPENDIX B: IRB APPROVAL LETTER

University of Central Florida

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
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Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Murad Andejany, PhD**

Date: **September 28, 2016**

Dear Researcher:

On 09/28/2016, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review:	Exempt Determination
Project Title:	A Framework for Lean Transformation in Developing Countries: The Case of Saudi Arabian Industry
Investigator:	Murad Andejany, PhD
IRB Number:	SBE-16-12502
Funding Agency:	
Grant Title:	
Research ID:	n/a

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Kanielle Chap

IRB Coordinator

APPENDIX C: SUMMARY EXPLANATION FOR EXEMPT RESEARCH

Version 1.0 10-21-2009

University of Central Florida

EXPLANATION OF RESEARCH

Title of Project: *A Framework for Lean Transformation in Developing Countries: The Case of Saudi Arabian Industry*

Principal Investigator: *Murad Andejany*

Faculty Supervisor: *Prof. Ahmad Elshennawy*

You are being invited to take part in a research study. Whether you take part is up to you.

The purpose of this research is to develop a framework for sustainable transformation through lean implementation in developing countries. The interview will include three parts: general questions about lean, questions for assessment, and questions for barrier analysis.

The interview will take one hour.

To take part in this research study you must be 18 years of age or older. Applicaple participants should be key personnel at Saudi Arabian case study companies who are currently in his position or were previously employed in the same position or who are consulted from them.

The interviews will be conducted via Skype, or by phone. Any necessary files will be sent by email.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints please contact: *Murad Andejany Graduate Student, College of Engineering and Computer Science, Department of Industrial Engineering and Management Systems at +1(305)7933242 or +966555594547, or by email at mbazzar@knights.ucf.edu*

Or the advisor Dr. Ahmad Elshennawy at Ahmad.Elshennawy@ucf.edu

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

1 of 1

APPENDIX D: SUPPORTIVE LETTER FROM UNIVERSITY OF JEDDAH

Kingdom of Saudi Arabia
Ministry of Education
University of Jeddah
Faculty of Engineering

المملكة العربية السعودية
وزارة التعليم
جامعة جدة
كلية الهندسة

June 23, 2016

To Whom It May Concern

The University of Jeddah's Industrial Engineering Department issues this authorization letter to Mr. Murad Andejany to collect data which include interviews and survey questioners in Saudi Arabia. Mr. Andejany is a faculty member at our department and a PhD candidate at the Department Industrial Engineering and Management System in the University of Central Florida, Orlando, USA. Mr. Andejany's dissertation focuses on lean transformation in developing countries.

This letter issued upon his request to present to whom may concern without any responsibility upon the University of Jeddah.

Sincerely,

Anas Ahmed, Ph.D.
Chairman of Industrial Engineering Department
University of Jeddah
Aaahmed5@uj.edu.sa

جامعة جدة
كلية الهندسة

Encl.: ____________ المرفقات: Date: ____________ التاريخ: Ref.: ____________ الرقم:

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APPENDIX E: COPYRIGHT PERMISSIONS

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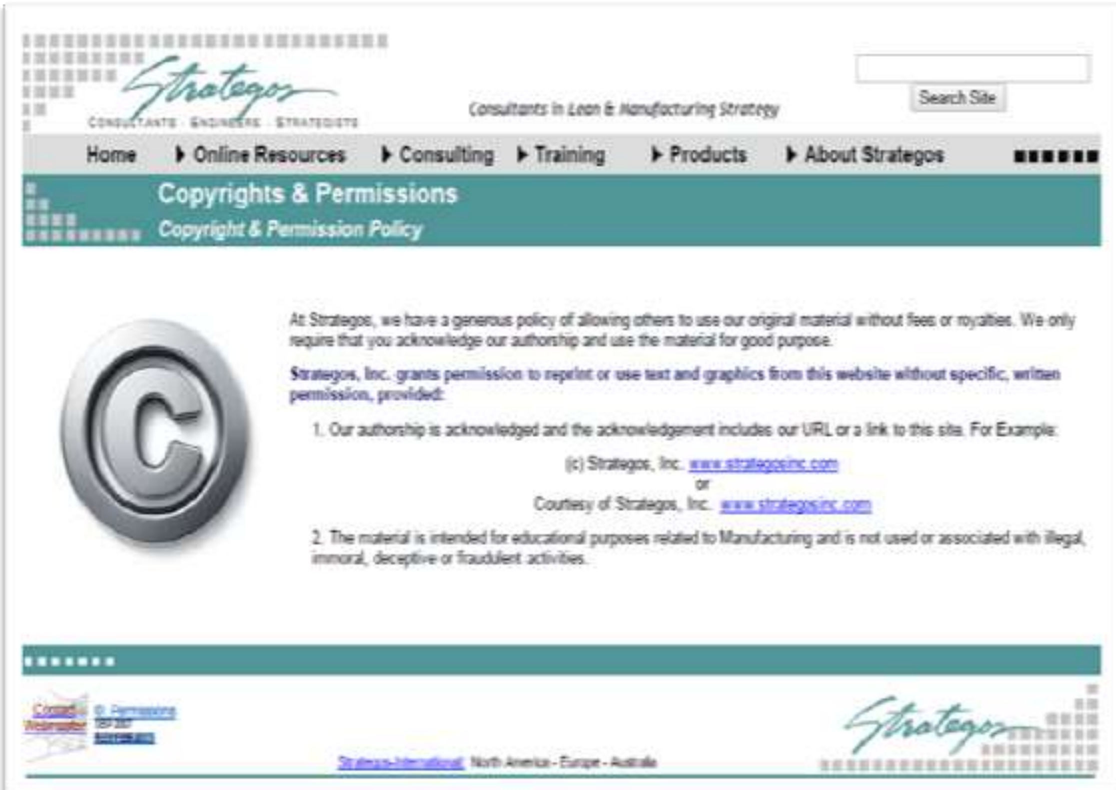
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Review the influence of lean tools and its performance against the index of manufacturing sustainability

Jeanette Brooks <jrb@inderscience.com>
Today, 5:15 AM

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Kind regards

Jeanette

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PhD

Review the influence of lean tools and its performance against the index of manufacturing sustainability

by Muhamad Zaki Yusup; Wan Hasrulnizzam Wan Mahmood; Mohd Rizal Salleh; Azrul Shahimy Mohd Yusof
International Journal of Agile Systems and Management (IJASM), Vol. 8, No. 2, 2015

Hi,

I am a PhD candidate and I want the permission to use figure 2 of the above article in my dissertation.

I was wondering what are the procedures.

Best Regards ...
Murad Andejany
President, ASQ UCF Chapter | Ph.D Candidate, UCF Industrial Engineering & Management Systems | Lecturer, UJ Industrial Engineering Department
Cell: +1(305)793-3242 | Saudi Cell: +966555594547

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