The Effect of Lean Production on Quality Engineering: An Applied Study in the Al Waha Company for Soft Drinks, Juices and Mineral Water

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The main objective of the current study is to examine the effect of lean production on quality engineering. This is a serious attempt to fill or reduce the knowledge gap in interpreting the relationship between these variables. In order to achieve this goal, the questionnaire was used as a main tool for collecting the required data through random sample distribution. The researchers distributed 150 questionnaires to a number of company staff. Of these, the researchers collected 148 questionnaires which were analysed using a number of statistical tests available in the AMOS V24. The study then reached a set of statistical results that showed a positive and significant effect of lean production on quality engineering.

Key words: *Lean Production, Quality Engineering.*

Introduction

The scope of this study was to research whether lean production is a support to quality engineering as a preparation for adopting quality engineering into the Al Waha Company for soft drinks, juices and mineral water. Al Waha is the largest company in this fiercely competitive market sector.

Based on the above, the problem of this study focussed on how to create new products and gain advantage over the competition for soft drinks, juices and mineral water companies in Iraq by adopting quality engineering which is based on lean production. This problem can be resolved through the knowledge of, "Is lean production contributing to the adoption of quality engineering?"; "Is lean production supporting quality engineering and thus leading to innovative value?" "Is quality engineering contributing to creating new products and making the competition irrelevant?"

Lean Production

Lean production can be defined as a philosophy or as a strategy which depends on a set of practices used to minimise waste in order to improve an enterprise's performance (Womack), J.P., Jones, D.T. & Roos, D., 1990.

Lean production comes from the Toyota production system, a concept adopted by many major companies across the world in an attempt to remain competitive in an in increasingly globalised market (Pérez M. P. & Sánchez A.M., 2000; Hosseini Nasab, H., et al. 2012, 73-81).

Since the first use of the concept, there have been some attempts to define the term lean conceptually (Lewis, M.A., 2000 ; Hines, P., Holweg, M. & Rich, N., 2004 ; Shah, R. & Ward, P.T., 2007).

Parker (2003) considers that, due to the so many different conceptual approaches of the term lean, it becomes difficult to identify the real benefits of its use.

The lack of a precise definition makes it difficult to establish if the changes occurring within a company are or are not in accord with the principles of lean production, which leads to a laborious evaluation of the efficiency of the concept. It is therefore necessary to estimate the success of lean production before implementing it, in order to avoid wasting time and money (Pettersen, J., 2009, 127 142).

In an attempt to define lean production conceptually, we can say that it uses 'just-in-time' practices and aims at the rational use of resources, strategies to improve the production process and the elimination of waste, and the use of scientific managerial techniques. It is, however, difficult to formulate a complete definition encompassing all the elements of lean production.

We note that most of the definitions are somewhat similar. In the same direction, Abdullah knows 'lean production' as a type of production system that uses few inputs to obtain the same amount of outputs taking into account the diversity of products offered to the customer (Abdullah F., 2003). Lean production is directly related to the removal of waste from the manufacturing system for better supply results, reduced processing time and improved quality

(Anand, G., & Kodali, R. 5, 2009). Through the above, we note that the goal of lean production is to reduce the amount of losses through effective and continuous training of workers to discover waste and seek to get rid of it, either through the discovery of work problems and solutions by knowing the strengths and weaknesses faced by workers, or during the continuous improvement in work or various activities of industrial engineering. Lack of discovery does not necessarily indicate the absence of the loss, but sometimes the inefficiency of training .

The following are the opinions of a group of researchers on the dimensions of lean production:
1. Gowland, (2005): Continuous Improvement, Cellular Manufacturing, Workplace Organisation, Team Work.
2. Austen Feld, (2005): Continuous Improvement, Cellular Manufacturing, Comprehensive Productivity Maintenance, On Time Production, Workplace Organisation.
3. Abdul Malek & Rajgopal, (2007): Continuous Improvement, Cellular Manufacturing, Comprehensive Productivity Maintenance, On Time Production.
4. Anand, G., & Kodali, R. 5, (2009): Continuous Improvement, Cellular Manufacturing, Comprehensive Productivity Maintenance, Workplace Organisation.
5. Abdullah, (2003): Continuous Improvement, Cellular Manufacturing, Comprehensive Productivity Maintenance.
6. Kootanaee (2013): Continuous Improvement, Comprehensive Productivity Maintenance, Workplace Organisation.
7. Heizer & Render, (2010): Cellular Manufacturing, Comprehensive Productivity Maintenance, On Time Production, Workplace Organisation.
8. Krajeweski, Lee J. and Ritzman, p21 (2005): Continuous Improvement, Cellular Manufacturing, Comprehensive Productivity Maintenance, On Time Production, Workplace Organisation, Team Work.
The dimensions of lean production that will be addressed are shown in (Table 1) which shows the most important dimensions addressed by the research group.

Table 1: Dimensions of Lean production

Researcher	**Dimensions of Lean Production**					
	Continuous Improvement	**Cellular Manufacturing**	**Comprehensive Productivity Maintenance**	**On Time Production**	**Workplace Organisation**	**Team Work**
Gowland, (2005): 17	*	*			*	*
Austen Feld (2005): 7	*	*	*	*	*	
Abdul Malek & Rajgopal, (2007): 224	*	*	*	*		

Anand, G., & Kodali, R. 5, (2009)	*	*	*		*	
Abdullah, (2003): 21	*	*	*			
(Kootanaee (2013), 7-8	*		*		*	
Heizer & Render, 510 (2010):		*	*	*	*	
Krajeweski, Lee J. and Ritzman, Larry, p21 (2005)	*	*	*	*	*	*

The researchers sought to address the common elements in the table above, which benefit the areas covered and were as follows:

a) Organisation of the workplace.
b) On time production.
c) Comprehensive productivity maintenance.
d) Continuous improvement.

Quality Engineering

Quality Engineering focusses on ensuring that goods and services are designed, developed and refined to suit or exceed customer expectations and requirements, and includes all activities related to analysis of good and sophisticated designs. Quality Engineering also ensures that the manufacturer produces goods according to specifications. (Vining et al., 2015).

The definition of (Hassan et al., 2000) is a model of practical and engineering procedures through which to obtain the best production, and covers all technical aspects from raw materials to be purchased by consumers using appropriate techniques to control, improve and control the quality process at all stages, and to ensure a good product and distinct service at the lowest cost, because the traditional quality is no longer sufficient to deal with the growing needs characterised by quality and quality, through the amount of production required, and automatic processing of any variables of production processes, to prevent defects and defects before they occur, through stimulation and encouragement of workers at all stages of production. (Hassan et al., 2000).

Quality engineers focus not only on product quality and the production process, but also on reducing wastes without having any negative aspects or environmental impact. Quality engineers design and monitor the quality of operations, and work as a unified team to play a vital role in the correction or repair. Design resources (time and cost) can be improved through a consensual model with time, methods and resources allocated to design (Németh, 2008).

The aim of quality engineering is to make several points that can be presented as follows Karlsson & Luttropp (2006), Rahimifard & Clegg (2007):

a) Give customers and the community confidence in products and services.
b) Quality engineering is related to product development from the planning stage to the selection (hardware, materials, cost, programming and human relations.
c) The subject is looking forward to a broad and insightful systematic view and a strong relationship with development teams, management and customers.

Moreover, the advances in the use of quality engineering tools (why quality engineering?) (Andtetsuo, 21, 2007)

a) The deployment of the emerging quality engineering model calls for quality to be designed into the product, rather than inspected and controlled on the product.
b) The deployment of the quality engineering function is a powerful methodology to translate customer requirements into product design requirements, has attracted a lot of attention from researchers and has seen great progress in recent years, being the first technology to provide a way to run concurrent engineering, and unanimously obtained that the product and process production requirements be effective in a short time when meeting and applying quality engineering requirements, where the application of quality engineering technology has expanded beyond the traditional manufacturing industries to various fields.
c) The application of quality engineering specification tools was limited to the expansion of the manufacturing industry but is now being extended to service industries, in accordance with the requirements of the ISO 9000 quality system which requires organisations to use statistical methods

However, the quality engineering requirements are as follows: (Németh, 2008)
a) Integrate high-quality engineering techniques into the design process, evaluate specific engineering techniques and apply these techniques by examining some design projects.
b) Require quality engineering requirements to be appropriate to achieve a systematic, efficient and economical design process.
c) Ensure the effectiveness of the design process through quality engineering management tools that must conform to the development steps.

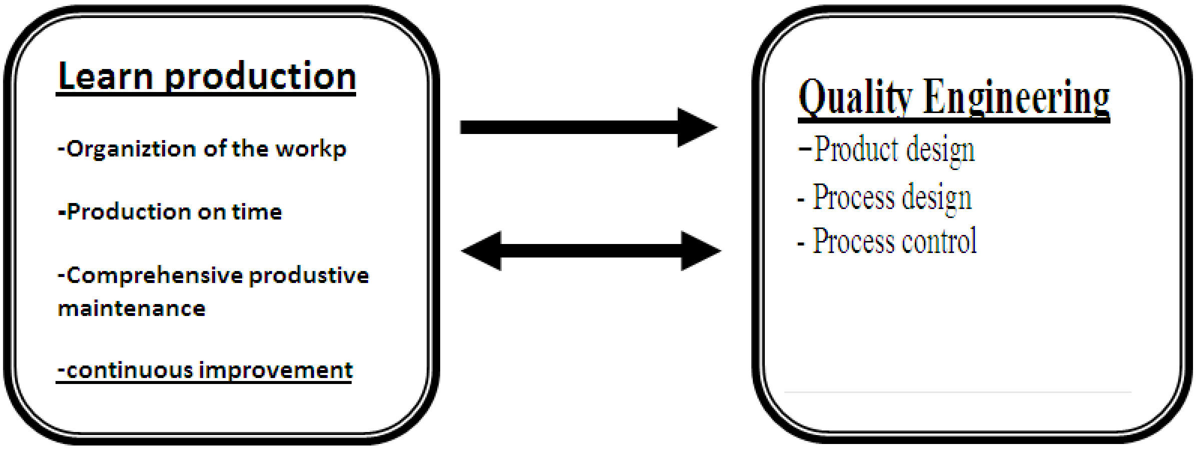
d) Develop the cost-effectiveness of the design process, and establish a design methodology that ensures an appropriate profit during the product delivery period.
e) Requires that risk analysis techniques be integrated into the design process in order to achieve market support and technical design result.
f) In order to improve the applicability of the model, an important role for the application of quality requirements should be through a self-learning system that uses completed design data.
g) It should be possible to use quality engineering requirements within the scope of the design methodology project.

Accordingly, any product, whether tangible or intangible (service), needs to emerge and its appearance determines its position in the administrative organisation and the economy of the organisation and its quality engineering, and focus on the practice of high-quality engineering methods. As a result of the advantages of quality engineering and the qualitative measures of analysis generally used in this specific area, the methods and tools used in the field of quality engineering have been developed with distinction to be applied to subsequent phases involving environmental aspects (Internal and External Environment of the Organisation).

Research Framework and Hypotheses

Based on the above research motives and relevant references in the literature, the research framework of this study, as shown in Figure 1, is an attempt to investigate the effect of lean production on quality engineering to innovative value.

Figure 1. Research Framework



According to the theoretical framework of this research, formulation of the hypotheses is as follows:

H1: lean production has a significant and positive relationship to quality engineering.
H2: lean production has a significant and positive effect on quality engineering.

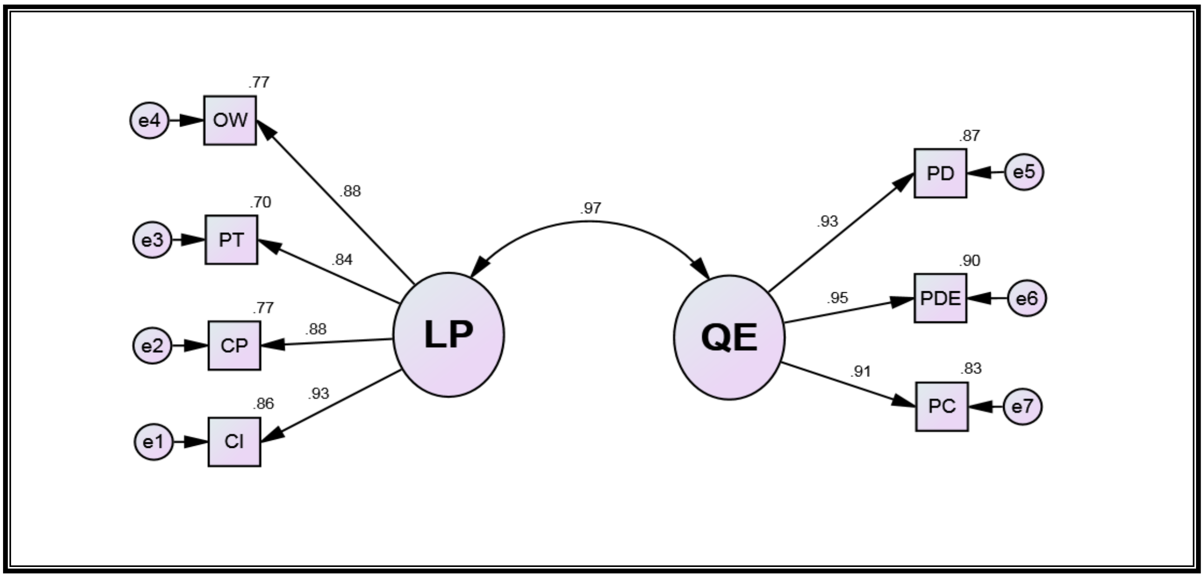
Population and Sample Research

Due to the nature of the current study and its focus on a number of contemporary variables, which represent a fundamental pillar for the advancement of companies if adopted on a high level of craftsmanship and precision level, the community of this study will include a number of workers in the Al Waha Company for soft drinks, juices and mineral water. The total number of employees has reached 240, and depending on the ideal sample selection table of Sekaran & Bougie for 2016, the ideal sample for this population is 148 workers, and to ensure access to or on top of them researchers distributed 150 questionnaires.

Test Hypotheses

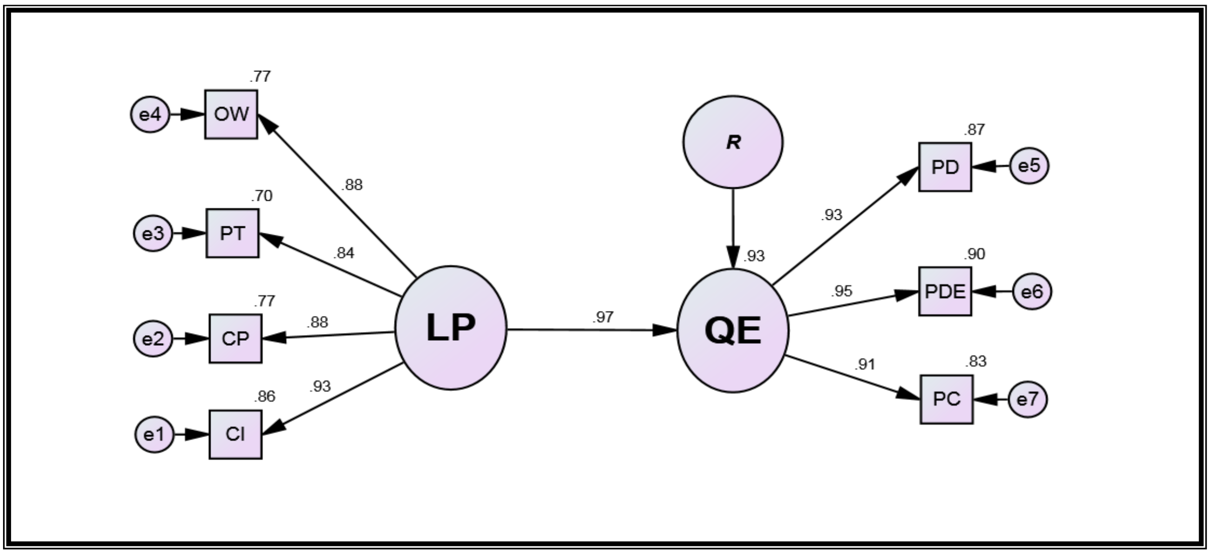
The verification of the hypotheses' influence of all kinds between the variables of the current study, according to the views of the respondents in the Al Waha Company for soft drinks, juices and mineral water. Hence, it can be concluded that these conditions meet the requirement of an acceptable model. The structural model of H1 is shown in (Figure 2).

Figure 2. Model test correlation hypothesis of the study



According to, Hair et al. (2016) the result in (Figure 2) are matching Goodness of Fit Index namely which are: (Ratio of less than 3, and greater than .90 GFI, and RMSEA less than .08). The results in (Figure 2) shows that the standardised path coefficient of .973 seems to indicate that lean production has a significant and positive relation to quality engineering use (H1). Furthermore, results in (Figure 3) show that the standardised path coefficient of .973 seems to indicate that organisational architecture has a significant and positive effect on quality engineering use (H2). Thus, these hypotheses were accepted.

Figure 3. Model test regression hypothesis of the study



All estimates of the models, which appear in (Figure 2) and (Figure 3) are at the level of significant .001> p, it has been CR values greater than 1.96 and all Regression Weights values, which fall within the limits of acceptance identified most than or equal to 0.50, as shown in (Table 2).

Table 2: Model test hypotheses of the study estimates

Item	Estimate	S.E.	C.R.	P
PDE	.948	.011	7.448	***
PC	.909	.009	6.445	***
CI	.926	.013	8.081	***
CP	.876	.011	7.008	***
PT	.838	.014	8.308	***
OW	.875	.020	8.615	***
PDE	.948	.018	8.166	***

Conclusions

This research has required investigating the relationship between lean production and quality engineering. Certainly, it augments the understanding that lean production improves the quality engineering at the Al Waha Company for soft drinks, juices and mineral water. The results provided evidence that lean production has a significant and positive relation to quality engineering. Additionally, the results indicated that lean production has a significant and positive effect on quality engineering. Accordingly, the present research has contributed to the investigation of the relationship between lean production and quality engineering fields. The findings of this research have theoretical, methodological and practical contributions. As such, the current attempt has managed to fill in gaps that existed in the relationship between lean production and quality engineering literature. However, this research faced methodological and generalisability limitations. Then, further empirical research is needed to understand how these issues vary from culture to culture.

REFERENCE

Abdullah, F. (2003). Lean manufacturing and techniques in the processing industry with A focus on steel. Dissertation for doctoral, university of Pittsburgh,

Anand, G., & Kodali, R. (2009). Selection of lean manufacturing systems using the analytic network process-a case study. Journal of Manufacturing Technology Management, 20 (2), 258 - 289.

Gowland, E. (2005). Lean manufacturing and the theory of constraints focusing lean.

Austenfeld, R. B. (2005). A research of the use of lean manufacturing techniques by Japanese small and medium enterprises.

Abdulmalek, F.& Rajgopal, J. (2007). Analyzing the benefits of lean manufacturing and value stream mapping via simulation. A process sector case research.

Abdullah, F. (2003). Lean manufacturing and techniques in the process industry with A focus on steel", dissertation for doctoral, university of Pittsburgh.

Kootanaee, A. J. & Babu, K. & Talari, H. F. (2013). Just-in-time manufacturing system: from introduction to implement international journal of economics. Business and Finance Vol. 1, No. 2, www.ijebf.com.

Krajeweski, L. J. and Ritzman, L. P. (2005). Operation management: Process and value chains. 7th ed., Prentice -Hall Inc., New York.

Németh-Erdődi, K. (2008). Risk Management and Loss Optimisation at Design Process of Products. Acta Polytechnica Hungarica, 5(3), 105-115.

Karlsson, R., & Luttropp, C. (2006). EcoDesign: what's happening? An overview of the subject area of EcoDesign and of the papers in this special issue. Journal of cleaner production, 14(15-16), 1291-1298.

Karlsson, R., & Luttropp, C. (2006). EcoDesign: what's happening? An overview of the subject area of EcoDesign and of the papers in this special issue. Journal of cleaner production, 14(15-16), 1291-1298.

Vining, G. Kulahci, M. Pedersen, S. (2015). Publishedin quality and reliability engineering international publication date

Womack, J.P., Jones, D.T. & Roos, D., (1990). The machine that changed the world. New York: Harper Collins.

Pérez, M. P., & Sánchez, A. M. (2000). Lean production and supplier relations: a survey of practices in the Aragonese automotive industry. Technovation, 20(12), 665-676.

Lewis, M. A. (2000). Lean production and sustainable competitive advantage. International Journal of Operations & Production Management, 20(8), 959-978.

Hines, P., Holweg, M. & Rich, N., (2004). Learning to evolve: Areview of contemporary lean thinking. International Journal of Operations & Production Management. 24 (10), 994-1011.

Shah, R. & Ward, P.T. (2007). Defining and developing measures of lean production. Journal of Operations Management. 25 (4), 785-805.

Parker, S.K., (2003), Longitudinal effects of lean production on employee outcomes and the mediating role of work characteristics. The Journal of Applied Psychology. 88 (4), 620-634.

Pettersen, J. (2009). Defining lean production: Some conceptual and practical issues. The TQM Journal. 21 (2), 127-142.