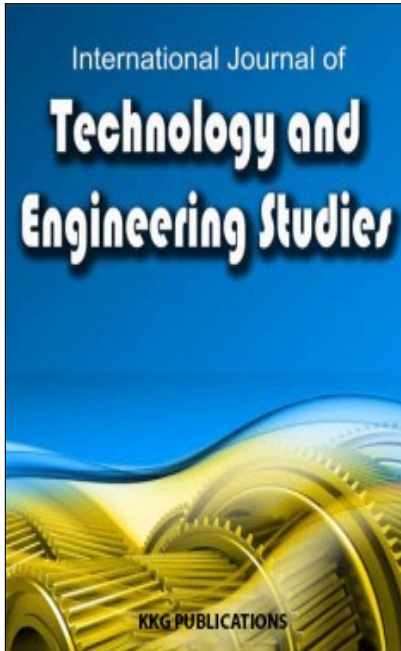
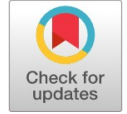


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A MIXED METHOD APPROACH TO INVESTIGATE THE LACK OF LEAN MANUFACTURING IMPLEMENTATION IN LIBYA

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Abstract. This study examines Libyan manufacturing companies' quality management processes and offers a methodology to develop a lean manufacturing framework. Also, it shows the current quality situation in Libyan manufacturing companies. The literature review identified very few studies relevant to the use of quality improvement techniques in Libya. No previous studies related specifically to waste reduction and lean systems and the barriers that prevent lean manufacturing from being implemented in Libyan manufacturing companies. The findings reveal that the manufacturing sector of Libya is suffering from mismanagement, poor infrastructure, lack of quality management, and lack of following up with the latest new quality tools and techniques. Understanding the difficulties that face the implementation of lean manufacturing systems as a new and modern system and using this to develop a suitable framework will help improve the manufacturing sector in Libya.

INTRODUCTION

In this competitive world we live in, organizations, whether they are manufacturers or service providers, are facing a growing number of different kinds of challenges in order to survive. Calls for a reduction in waste and energy and an increase in efficiency and effectiveness of organizational practices throughout industry and commerce are being made to try and meet challenges presented by the current global economy. Response to customer's demand with high levels of service and quality puts organizations under pressure to meet these needs, on time, with the required quality and at reasonable cost [1].

In Libya there is strong need from the public and the government to improve manufacturing performance. Libyan industry has to adopt new ways to improve the outputs of their manufacturing processes. Delivering higher quality while keeping costs down is the major challenge in the Libyan manufacturing industry. The practices of lean thinking have much to offer to help achieve these goals.

For instance lean thinking helps eliminate wasteful practices in an organization, and can therefore help to ensure that customers receive consistently high quality products that are fit for purpose and conform to their specific requirements. Libya is also promoting local products to assist in diversifying economic activities, in order to help accelerate the process of joining the World Trade Organization (WTO).

Lean Manufacturing and Waste Reduction

Lean can be defined as "manufacturing without waste". There are seven key categories of waste, [2]:

1. Waste from overproduction,
2. Waste of waiting time,
3. Transportation waste
4. Inventory waste,
5. Processing waste,
6. Waste of motion,
7. Waste from product defects.

In spite of the fact of the wide knowledge base and available resources, there are still many organizations striving to stay "lean". The objectives of lean manufacturing are to decrease cost and waste in inventory, and get on time products to the market, and manage manufacturing stocks that are highly reactive to customers' requirements, whilst generating products with high quality in the most effective and efficient way. The Lean Thinking concept was invented from a Toyota Production System (TPS) that determined the value of any action by analysing value-added activities or steps from non-value-added steps or activities; then removing waste so that every step adds value to the process [3]. Lean manufacturing puts emphasis on productivity, aiming to reduce the cost and produce products and services as fast as possible.

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Implementation of Lean

The Lean manufacturing system is a powerful systematic methodology aimed at discovering, solving and avoiding performance troubles through tracking-back methodologies in order to find out the fundamental unseen roots of actual wastes. Implementation of lean philosophy can create more operational and financial progresses within all organizations. The lean philosophy was invented by and is associated with the manufacturing

industry. However lean practice has been applied successfully within different organizations worldwide achieving amazing results regardless of type, size, and mission of the candidate system. According to [4] and [5], all these different organizations have been shown to share the same common incorporated characteristics which can be summarised as input, process and output, see Figure 1.

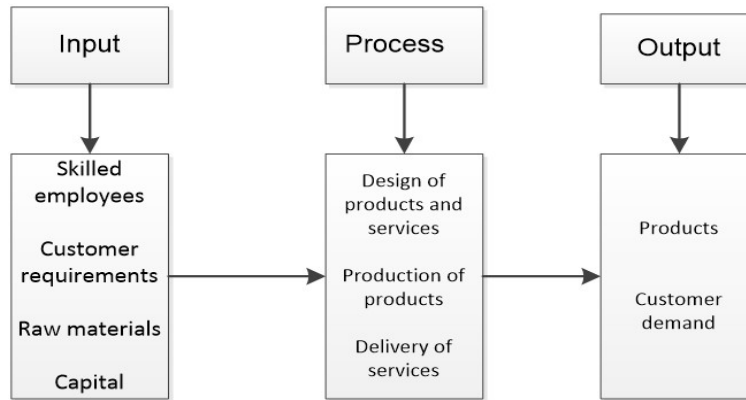


Fig. 1. Implementation of lean

Inputs can mean resources such as machinery, materials, capital, and employment. The second component is processes; a suitable sequence of actions and steps must be accomplished providing a product or service that meets Customers' demands and expectations. Organizations are categorised according to their outputs. Organizations that produce intangible products are named service organizations such as education, health care, and insurance firms. Whereas organizations that produce tangible items are identified as manufacturing organizations.

Benefits of Lean Manufacturing

The benefits of lean techniques are apparent where the principles of lean have been implemented successfully. Lean techniques are typically known to give the following reductions, [6]:

- Lead time by at least 90%.
- Saving of floor space around 30% (sometimes more than 50%).
- Increased productivity by 50% (even more than 100% in some cases).
- Quality improvement.
- Whole cost saving.

Barriers to Lean Manufacturing Implementation

The Lean manufacturing concept may look relatively simplistic; however, its implementation is not a straightforward task. The introduction of lean manufacturing into an industrial organization tends to alter its working culture. These alterations are considered to be obstacles and impediments to its implementation. Changes occurring within the organization tend to change the employees in the organization. Much hard effort has to be done to understand and cope with these changes in the organization [7], [8]. To implement lean manufacturing, there are three main barriers; lack of commitment from top and middle management, and misunderstanding of lean manufacturing concepts and benefits [9], [10]. Also lack of financial resources is identified as barrier to lean implementations in small industries and has a direct effect on training and prevents organizations from implementing lean practices [11], [12].

Present Status of Libyan Manufacturing Companies

The literature review produced very few studies relevant to quality improvement techniques in Libya. Libyan organizations have started to consider that it is vital to invest current resources into the use of quality improvement programmes, such as the adoption of the quality management systems of ISO 9000 standards. According to an ISO survey in 2014, the number of certified organizations in Libya was only 51, while

the number of organizations in the United Kingdom (UK) was 40,200. Based on the survey, the number of UK industrial companies was 11,655, whereas the number of certificated Libyan

industrial companies was 45 and the number of manufacturing companies was only 5, see Figure 2.

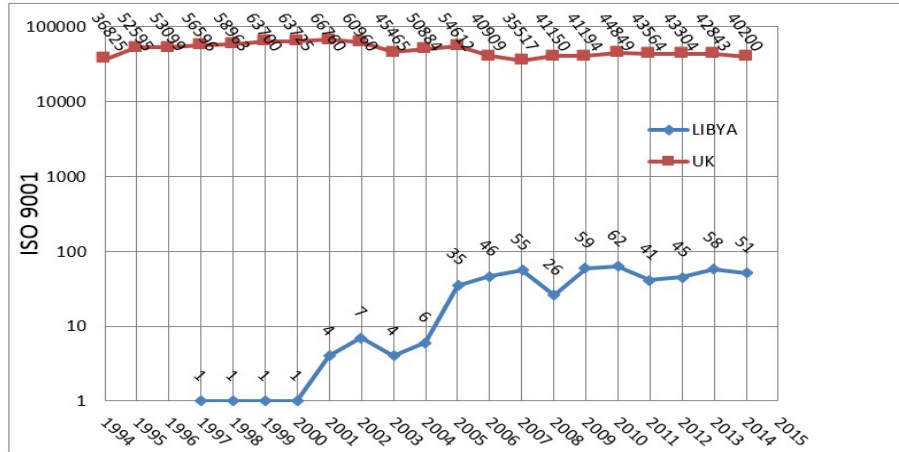


Fig. 2. Total ISO certified companies in the UK and Libya

In Libya, the manufacturing sector contributes noticeably to local employment and increases the Libyan total amount of income. In 2006, this sector contributed 9% of the total labour force employing 158,000 people which was a growth from 2005, of 7%. In this time period exports also grew 15% from 2005 (a total of 1,179,000 Million Libyan Dinner (MLD)) to 2006 (a total of 1,283.800 MLD). Of this volume, industrial exports contributed 3.55% but, the major contribution was by the oil sector which was 96.4% Libyan Central Bank, 2007 [13]. In Africa, Libya state is the second largest oil producer and the main single oil exporter to Europe and so the development of manufacturing industries has received a great amount of attention from a number of Libyan government agents. In its effort to enhance the manufacturing sector, the Libyan state is encouraging the manufacturing sector to invest in new technology industries and has also been considerably

active in endeavouring to improve the appropriate climate for the manufacturing sector. Hence manufacturing in Libya is facing serious quality problems. Also manufacturing processes in Libya are poorly designed and there is a lot of waste leading to poor product quality, long waiting times and delays. Hence waste elimination is the key to the improvement of the Libyan manufacturing sector.

Types of Mixed Methods Designs

According to [14] there are three major types of mixed methods designs, the first of which is the convergent parallel design. In this type of mixed methods design, researchers combine quantitative and qualitative data together in order to get comprehensive analysis of the research question, see Figure 3.

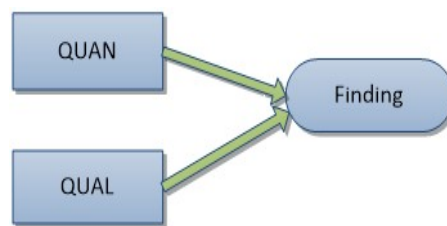


Fig. 3. Mixed method convergent parallel design

On other hand, exploratory sequential design is used as an initial investigation into relatively little or unknown areas of research, see Figure 4. It has been highlighted to be a helpful method to discover what is happening and observing for new

understandings. It can be used to build new instruments, modify an existing instrument or to identify appropriate instruments to use in the quantitative phase [15].

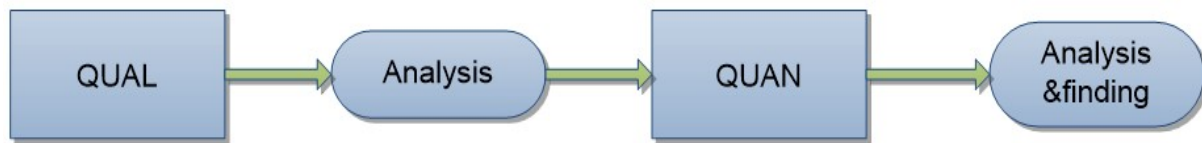


Fig. 4. Mixed method explanatory sequential design

While in the explanatory sequential design, first the researcher starts with collecting quantitative data, then uses the obtained results data to build the qualitative part of the data collection, then analyses this to come out with the final outcomes, see Figure 5. The explanatory sequential design aims

to provide explanations of phenomena and how and why there is relationship between two or more parts of phenomenon or a situation. It helps elaborate and enhance the explanation of theories.

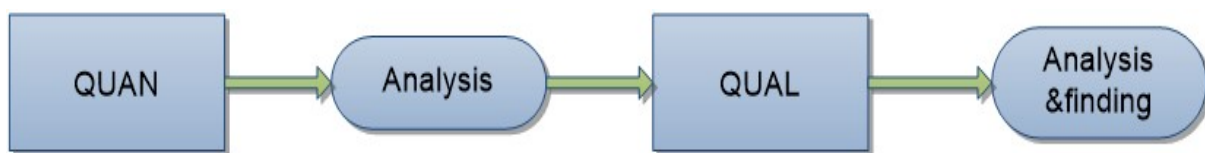


Fig. 5. Mixed method explanatory sequential design

It's therefore clear that researchers need to prioritise between quantitative and qualitative methods, where the research approach can lead to prioritisation, based on the purpose of the study. [14] suggested that a design starting with quantitative methods is most suitable for research which aims to explore a phenomenon, especially when the researcher wants to identify unknown variables or to build new instruments, then the quantitative outcomes will be used as a guide to the qualitative instruments development.

DETERMINATION OF RESEARCH METHODOLOGY

Figure 6 shows the proposed methodology for this research, beginning in stage 1 which started by defining the research aim and objectives to develop a lean manufacturing framework for deployment in the Libyan manufacturing sector. This was then followed in stage 2 by a review of lean manufacturing literature as well as an investigation into the current Libyan manufacturing sector. After that, stage 3 focuses on reviewing appropriate methodology to select a suitable research philosophy and strategy.

The researcher then utilized a mixed-method approach in stages 4 and 5, which included both quantitative and qualitative research methods. In stage 4, a questionnaire was distributed to 65 Libyan industrial companies to collect quantitative data; the

data were collected from many sectors (cement, electrical, food, iron and steel, oil and gas). The next stage 5 of the research was to analyse these data to investigate and identify the barriers that face the Libyan manufacturing sector to implement the lean system. Following this, extra qualitative data will be collected by conducting interviews. According to [16], semi-structured interview can offer a unique opportunity for respondents to shed light on other factors that have not been mentioned in the survey.

The research will then move to stage 6 to analyse the data collected and identify the barriers and obstacles that are facing the Libyan manufacturing industry, which will be fed into stage 7 to develop a preliminary framework of lean manufacturing which will be designed specifically to meet the requirements of the Libyan manufacturing industry. The developed framework will then be tested and assessed in stage 8 by distributing it to manufacturing companies in Libya and then analysing their feedback to make further improvements.

The last stage of this research, stage 9, will be results and recommendations; based on outcomes and research findings. The researcher will provide a number of recommendations for successful implementation of the developed framework and future work in the area of lean manufacturing in Libya.

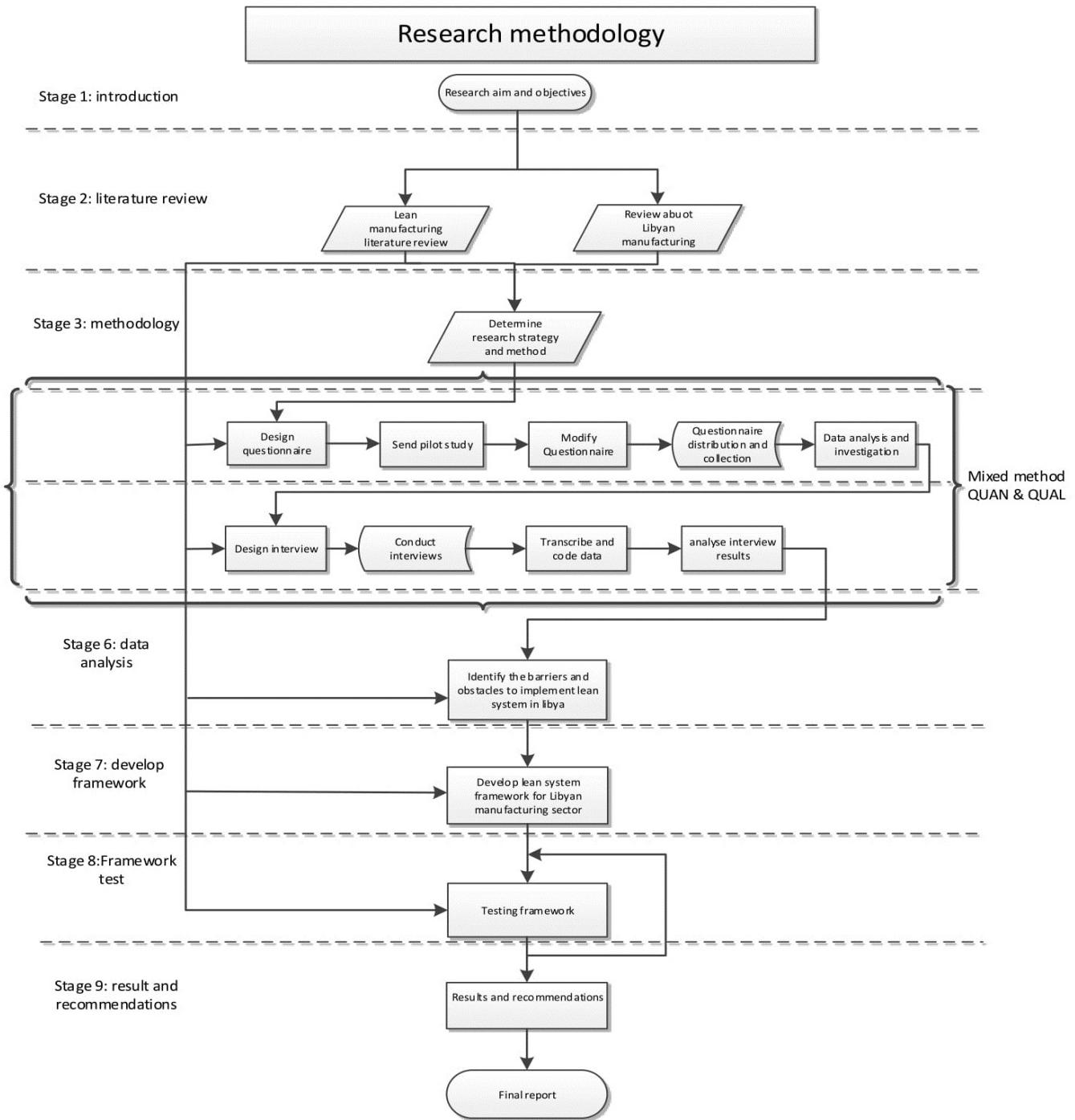


Fig. 6. A proposed research methodology for lean implementation for Libyan manufacturing companies

DISCUSSION

This paper highlights the benefits and obstacles of lean manufacturing which have been considered in the proposed research methodology of the lean manufacturing framework for Libyan manufacturing companies. Also shows the current quality situation in Libyan manufacturing companies which reveals that they are suffering from mismanagement, poor in-

frastructure, lack of quality management, and lack of following up with latest new quality tools and techniques. Therefore, it is believed that the manufacturing sector in Libya needs a modernization process that will upgrade the quality level of its manufacturing companies, increasing the overall efficiency and reducing costs, to allow them to achieve the highest possible quality level to compete globally.

CONCLUSION AND RECOMMENDATIONS

This paper has discussed the benefits and barriers of the lean manufacturing system, and the determination of a research methodology for its implementation in Libyan manufacturing companies. It has also presented the benefits of combining quantitative and qualitative approaches that could help the researcher to have a better understanding of the research aim and objectives than when using one method alone. The paper also highlights the current quality level of Libyan manufacturing companies, which exposes how this sector is suffering from inadequate economic systems and infrastructure, absence of training programmes about quality techniques, and a lack of

financial resources.

Future work will analyse and investigate the data collected from the questionnaire which will provide a wealth of information about the participants from the Libyan manufacturing sector, after which, extra data will be collected by conducting semi-structured interviews. Based on the result data from the questionnaires and interviews, the researcher will use these findings to develop a framework of lean manufacturing for the Libyan industrial sector.

Declaration of Conflicting Interests

No conflicts of interest are present.

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