

# Identifying the Barriers behind the Lack of Six Sigma Use in Libyan Manufacturing Companies

Osama Elgadi, Martin Birkett, Wai Ming Cheung

**Abstract**—This paper investigates the barriers behind the underutilisation of six sigma in Libyan manufacturing companies (LMCs). A mixed-method methodology is proposed, starting by conducting interviews to collect qualitative data followed by the development of a questionnaire to obtain quantitative data. The focus of this paper is on discussing the findings of the interview stage and how these can be used to further develop the questionnaire stage. The interview results showed that only four key barriers were highlighted as being encountered by LMCs. With a difference in terms of their significance, these factors were identified, and placed in descending order according to their importance, namely: “Lack of top management commitment”, “Lack of training”, “Lack of knowledge about six sigma”, and “Culture effect”. The findings also showed that some barriers which, were found in previous studies of six sigma implementation were not considered as barriers to LMCs but can, in fact, be considered as success factors or enablers for six sigma adoption. These factors were identified as: “sufficiency of time and financial resources”; “customers unsatisfied”; “good communication between all departments in the company”; “we are certain about its results and benefits to our company and unhappy with the current quality system”. These results suggest that LMCs face fewer barriers to adopting six sigma than many well-established global companies operating in other countries and could take advantage of these successful factors by developing and implementing a six sigma framework to improve their product quality and competitiveness.

**Keywords**—Six sigma, barriers, Libyan manufacturing companies, interview.

## I. INTRODUCTION

WITHIN the last decade of the 20th century, Libya realized that the manufacturing practice of the world has been rapidly changing. It is a world in which the international economy has moved from a geographical framework to a framework of virtual space. There are no political limits that can stand against these dynamic changes; these economic developments have at the present time, encouraged countries to move towards globalization where self-dependent economies are no longer feasible [1]. Libya’s total national income relies mainly on their oil industry which accounts for about 96 % of export earnings, 98 % of government revenues, and 65 % of the country’s Gross Domestic Product (GDP) [2]. The other industrial sectors in Libya including manufacturing account for a minor percentage of GDP [2]. Therefore, efforts have to be made to create valued enterprises to replace oil as a main source of income in

the future; one of these enterprises is to improve the quality of the current manufacturing system to be one of the alternative resources. Hence, six sigma has been suggested to be applied in the Libyan manufacturing industry as a tool for quality improvement. Data showed that corporate-wide six sigma deployments save an average of 2 % of total revenue per year. The use of six sigma also saved fortune 500 companies an estimated \$427 billion [3].

In theory, the benefits of six sigma could be transferred to LMCs, in order to survive the threat of the intense internal and global competition. However, to date, there is no evidence of the adoption of six sigma in the Libyan manufacturing industry. Hence, LMCs must have encountered some barriers that have prevented this technique from already being implemented. Therefore, the researcher was motivated to tackle this problem by identifying the reasons and the barriers behind the lack of six sigma in LMCs.

## II. ABOUT SIX SIGMA

Six sigma ( $6\text{-}\sigma$ ) is a set of techniques and tools for quality and processes improvement. It was first introduced in 1986 by Motorola, synchronizing with the Japanese assets price bubble, which is reflected in its terminology. Six sigma became well-known when Jack Welch made it central to his successful business strategy at General Electric in 1995. Currently, it is used in several industrial sectors worldwide [4].

Six sigma can be defined as a process improvement methodology that seeks to enhance work performance through a firm and precise business focus. Six sigma is a systematic method to achieving continuous process improvements [5]. It is a comprehensive system for achieving, maintaining and enhancing business success.

The successful implementation and deployment of six sigma will result in organisational success in terms of business improvement, customer satisfaction, and financial profits. The power of a six sigma technique is best described by proven return-on-investment (ROI) as shown below for Motorola, AlliedSignal, and General Electric (GE) [6].

### A. Motorola ROI

- ✓ Reduced in-process defect levels by a factor of 200.
- ✓ Reduced manufacturing costs by \$1.4 billion.
- ✓ Increased employee production on a dollar basis by 126 %
- ✓ Increased stockholders share value fourfold.

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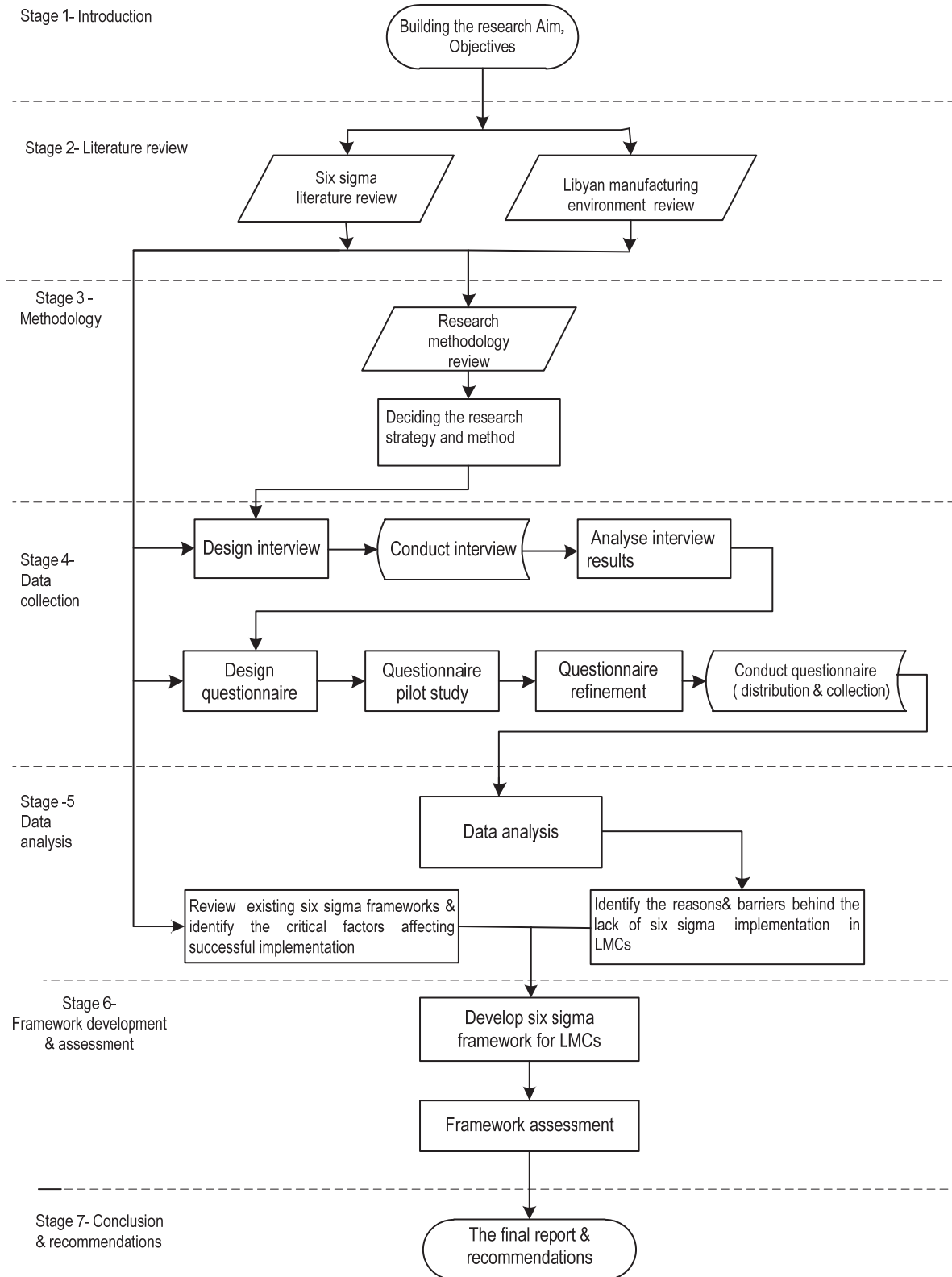


Fig. 1 Research flow chart

### B. AlliedSignal ROI

- ✓ \$1.4 Billion cost reduction.
- ✓ 14 % growth per quarter.
- ✓ 520 % price/share growth.
- ✓ Reduced new product introduction time by 16 %.
- ✓ 24 % bill/cycle reduction.

### C. General Electric ROI

- ✓ Companywide savings of over \$1 Billion.
- ✓ Estimated annual savings to be \$6.6 Billion.

## III. SIX SIGMA BARRIERS

Despite its reputation as a powerful technique, six sigma has faced some challenges and barriers. Raghunath and Jayathirtha [7] specified a number of barriers to six sigma implementation such as lack of resources, internal resistance, lack of leadership from top management and poor training and coaching. While Kreisler Buch and Tolentino [8] stated that a lack of knowledge about six sigma and insufficient time to work on six sigma projects are considered as barriers facing the implementation of six sigma by some organizations. Chakrabarty and Kay Chuan [9] also presented some reasons and barriers for not implementation six sigma by some organizations, which are “unknown to us, not relevant, not interested, time-consuming, insufficient resources, difficulty in collecting data, and too complex to use”.

## IV. RESEARCH FLOW CHART

Fig. 1 shows the research flow chart which consists of seven stages, starting in stage one by building the research aim which is to develop a six sigma framework for deployment in LMCs. This will be achieved by reviewing six sigma literature as well as the Libyan manufacturing environment as shown in

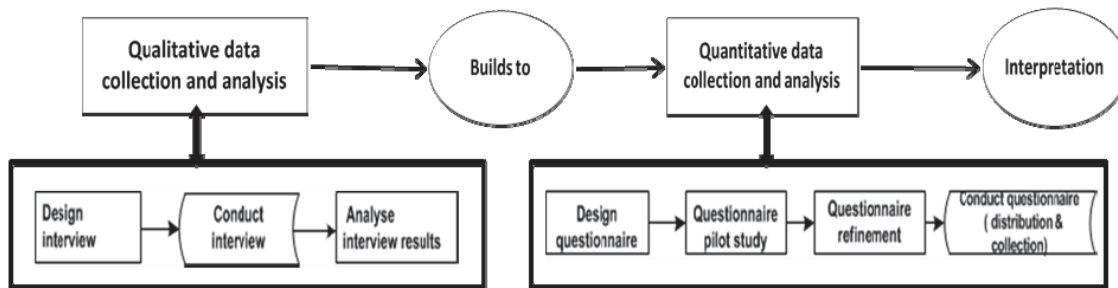


Fig. 2 The exploratory sequential design for data collection

## VII. INTERVIEW FINDINGS

The data collected from the interviews revealed that none of the LMCs have ever implemented six sigma, and this supports the researcher's claim mentioned earlier, which states that “*To date, there is no evidence of the use of six sigma in the Libyan manufacturing industry*”. However, in analyzing the interview data, factors were categorized into two themes, factors that impede the adoption of six sigma in LMCs (barriers), and factors that could enable the adoption of six sigma in LMCs (enablers).

stage two. Then the reasons and barriers behind the lack of six sigma implementation in LMCs will be identified using a survey which has been chosen as the main research strategy for data collection.

## V. RESEARCH STRATEGY AND DATA COLLECTION

A survey has been chosen as the main strategy, starting by conducting interviews to collect qualitative data followed by the development of a questionnaire to obtain quantitative data, this mixed data collection method is known as ‘the exploratory sequential design’ as shown in Fig. 2 [10].

Once data collection has been completed, the research will move to the next stage to analyze and interpret the collected data to identify the barriers behind the lack of six sigma use in LMCs. The survey findings will be used to develop a novel six sigma framework to be implemented in LMCs to improve the quality and competitiveness of such companies.

## VI. INTERVIEW PROCESSES

Semi-structured interviews were chosen for conducting the interviews. Seventeen open-ended questions were largely designed and generated from the literature review; including four questions which were developed by the researcher. The main targeting interviewees were those who are responsible for quality management systems in their firms such as quality managers and technical managers and also managers who are responsible for decision making, such as executives and chairmen. Ten interviewees were randomly selected from different LMCs to allow more varied and comprehensive feedback to be obtained regarding the barriers behind the lack of six sigma use in LMCs.

### A. Factors Impeding the Adoption of Six Sigma in LMCs (Barriers)

The data collected from interviewees was quantitatively analyzed and revealed the barriers and reasons for not implementing in LMCs, see Fig. 3. The frequency of respondents who mentioned each barrier was recorded, where, for example, (100%) indicates that all ten respondents mentioned that particular barrier. The findings revealed that there are four main barriers to the adoption of six sigma in LMCs, which are:

- 1) Lack of top management commitment (100 %).
- 2) Lack of training “trained professionals (100 %), courses (90 %), and providers (90 %).
- 3) Lack of knowledge and awareness about six sigma (80 %).
- 4) Cultural effect (resistance to change) (70 %).

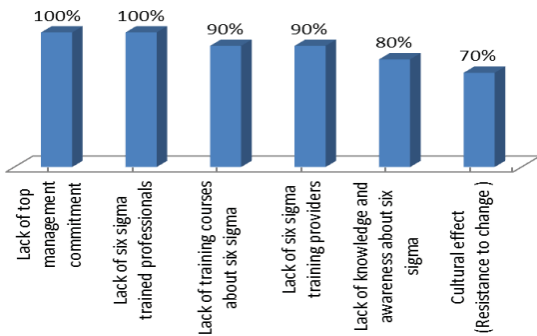


Fig. 3 Factors impeding the adoption of six sigma in LMCs

These factors are perceived to be the predominant barriers and reasons for the adoption of six sigma in LMCs.

These results are consistent with other studies in six sigma, such as; [7], [8], [11]-[19], who all found that a lack of top management commitment, lack of six sigma training, a lack of

knowledge and awareness about six sigma, and resistance to change, are impeding factors to the adoption of six sigma.

#### B. Factors Enabling the Adoption of Six Sigma in LMCs (Enablers)

The data collected also showed that some barriers which were found in the six sigma literature review were not considered as barriers to LMCs, but can, in fact, be considered as enablers for six sigma adoption. The findings revealed that there are nine factors already existing and available in LMCs to help and support the adoption of successful implementation of six sigma as enablers as shown in Fig. 4. These factors are:

- 1) Sufficiency of time to implement six sigma (100 %).
- 2) Customers unsatisfied (90 %).
- 3) Most heard about six sigma (90 %).
- 4) We are certain about six sigma results and its benefits to our company (80 %).
- 5) Unhappy with the current quality system (70 %)
- 6) Six sigma is not costly to our company (70 %).
- 7) Sufficiency of financial resources (70 %).
- 8) Good communication between all departments in the company (60 %).
- 9) There is an interest in adopting six sigma (60 %).

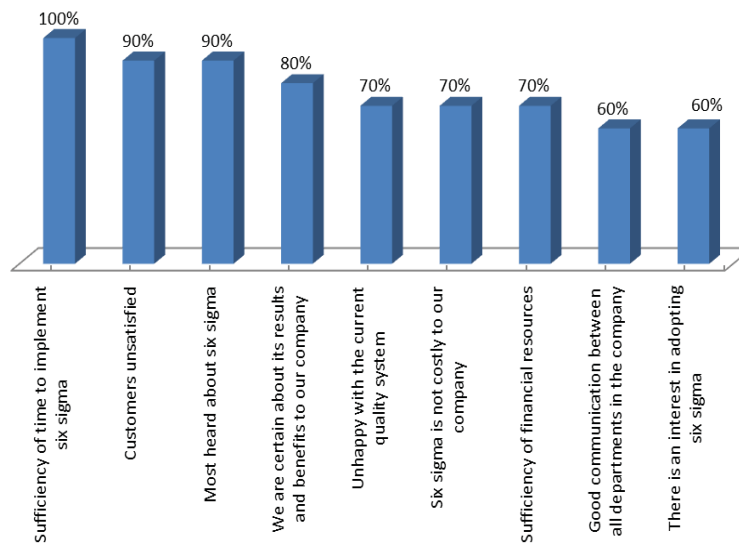


Fig. 4 Factors enabling the adoption of six sigma in LMCs

These factors will play a big role as enablers to help and support LMCs in implementing six sigma, although in previous studies in global companies operating in other countries such as [8], [9], [18], [20], [17], [13], [12], these factors were found as barriers in six sigma implementation. So LMCs could potentially take advantage of these enablers by developing and implementing a six sigma framework to improve their product quality and competitiveness.

#### VIII. CONCLUSION

This paper revealed the main impeding factors behind the

lack of six sigma implementation in LMCs. The paper also highlighted the success factors that are already available in LMCs which could help them in the adoption of six sigma. All of these factors were obtained by conducting interviews with the relevant people at LMCs. It worth mentioning that some barriers which were found in the literature review do not face LMCs as reasons for not adopting six sigma, but they can, in fact, be considered as success factors or enablers for six sigma adoption

These findings will be used together with the outcomes of the literature review to develop a questionnaire for distribution

to LMCs to obtain the quantitative data, and then this data will be used to develop a framework for implementation of six sigma in LMCs to improve the quality and competitiveness of such companies.

- [20] Dubey, R., et al., Enablers of Six Sigma: contextual framework and its empirical validation. *Total Quality Management & Business Excellence*, 2015: p. 1-27.

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#### REFERENCES

- [1] Otman, W. and E. Karlberg, *The Libyan economy: economic diversification and international repositioning*, 2007: Springer.
- [2] Khan, M. and S. Milbert. *Libya: Facing Economic Collapse in 2014* (cited 2014); Available from: <http://www.atlanticcouncil.org/blogs/menasource/libya-facing-economic-collapse-in-2014>.
- [3] Noria Corporation, Report finds Six Sigma has saved Fortune 500 \$427B, in *iSixSigma Magazine* 2007, Ideal Media LLC.
- [4] MOTOROLA. *The Inventors of Six Sigma*. 2006; Available from: <http://web.archive.org/web/20051106025733/http://www.motorola.com/content/0,,3079,00.html>.
- [5] Six sigma in action: overcoming barriers to organizational change. *Development and learning in organizations*, 2008. 22(1): p. 32-35.
- [6] Six sigma for manufacturing and non manufacturing processes. (cited 2014); Available from: <http://www.bxlnc.com/download/six-sigma-for-manufacturing-and-non-manufacturing.pdf>.
- [7] Raghunath, A. and R. Jayathirtha, Barriers for implementation of Six Sigma by Small and Medium Enterprises. *International Journal of Advancements in Research & Technology*, 2013. 2(2): p. 1-7.
- [8] Kreisler Buch, K. and A. Tolentino, Employee expectancies for six sigma success. *Leadership & Organization Development Journal*, 2006. 27(1): p. 28-37.
- [9] Chakrabarty, A. and T. Kay Chuan, An exploratory qualitative and quantitative analysis of Six Sigma in service organizations in Singapore. *Management Research News*, 2009. 32(7): p. 614-632.
- [10] Saunders, M.N., et al., *Research methods for business students*, sixth edition. 2012: Pearson Education India.
- [11] Mi Dahlgaard-Park, S., J.J. Dahlgaard, and S. Mi Dahlgaard-Park, Lean production, six sigma quality, TQM and company culture. *The TQM magazine*, 2006. 18(3): p. 263-281.
- [12] Gamal Aboelmaged, M., Reconstructing Six Sigma barriers in manufacturing and service organizations: The effects of organizational parameters. *International Journal of Quality & Reliability Management*, 2011. 28(5): p. 519-541.
- [13] Kundi, M.O.H.K. A study of Six Sigma implementation and critical success factors. in *Pakistan's 9th International Convention on Quality Improvement*. 2005.
- [14] Nonthaleerak, P. and L. Hendry, Exploring the Six Sigma phenomenon using multiple case study evidence. *International Journal of Operations & Production Management*, 2008. 28(3): p. 279-303.
- [15] Kwak, Y.H. and F.T. Anbari, Benefits, obstacles, and future of six sigma approach. *Technovation*, 2006. 26(5): p. 708-715.
- [16] Mallick, D.Z., M.S. Ahmad, and L.S. Bisht, Barriers and enablers in implementation of lean six sigma in Indian manufacturing industries. *International Journal of Advanced Research in Management (IJARM)*, 2012. 3(1): p. 11-19.
- [17] Anthony, J., M. Kumar, and C. Madu, Six Sigma in small and medium-sized UK manufacturing enterprises. *International Journal of Quality & Reliability Management*, 2005. 22(8): p. 860-874.
- [18] Feng, Q. and C.M. Manuel, Under the knife: a national survey of six sigma programs in US healthcare organizations. *International Journal of Health Care Quality Assurance*, 2008. 21(6): p. 535-547.
- [19] Kokkrankal, J., et al., Barriers and challenges in the application of Six Sigma in the hospitality industry: Some observations and findings. *International Journal of Productivity and Performance Management*, 2013. 62(3): p. 317-322.