

## Isomorphic Factors for the Adoption of Lean Six Sigma in Malaysia

<sup>1</sup>Mohamad Reeduan Mustapha, <sup>2</sup>Fauziah Abu Hasan and <sup>1</sup>Mohd. Shaladdin Muda

<sup>1</sup>School of Marine Business and Management,

<sup>2</sup>Centre for Transformation, Strategic Planning and Risks,

Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Malaysia

---

**Abstract:** This study is to investigate the adoption of Lean Six Sigma (LSS) using institutional theory as a conceptual framework. The rationale for this study is to provide a complete understanding of LSS adoption, moving beyond the traditional technical and economic perspectives. This study was conducted through interviews, meetings and observations which were based on the researcher's findings and experiences. Qualitative interviews were carried out with four Black Belts and one Master Black Belt practitioners at global companies across a range of industries which operate in Malaysia. From the interview, the mimetic and normative pressure was found to be the motivation behind LSS adoption. Though, the normative mechanism also played its part during the implementation of LSS. The research has been carried out through multiple case studies which contribute to a better understanding of the whole process of LSS adoption using institutional isomorphic theory.

**Key words:** Lean Six Sigma, isomorphism, qualitative, Engineering management, Malaysia

---

### INTRODUCTION

Six Sigma and Lean are well-known methodologies in industrial engineering technology and have a complementary relationship that is widely accepted today, especially after the proven capability of Six Sigma and Lean in leading companies like GE and Toyota (Salah *et al.*, 2010). However, there are some fundamental differences between both approaches to process management and improvement such as the application of Six Sigma methodology requiring more intense training compared to Lean methodology. Also, Lean is fundamentally used to tackle process inefficiency issues whereas; Six Sigma is primarily used to tackle process effectiveness issues (Antony, 2011).

It is evident, therefore, that Six Sigma and Lean present similarities and differences, complementary and confrontational depending on which aspect is considered (Rathilall, 2014). Though a ground for similarities and differences between Six Sigma and Lean, Anonymous (2014) perceived Lean as a smaller entity as opposed to Six Sigma. This categorization can be attributed to the core focus and nature of the two approaches to improving business operations. According to Grayson (2002), the nature of lean is more focused on the process by which the business operates. This is in

contrast with the focus of Six Sigma which is more aligned or focused with the efficiency of the end result of the business operations.

According to Grayson (2002), the emphasis on the strategic actions of the company is more reliant on the visible factors influencing production such as those that affect lead times, slow inventory turnover, transportation costs and so on. The focus of Lean on the smoother flow of operations was re-echoed in the five essential steps of Lean mentioned by Nave (2002). In his research, Nave (2002) mentioned that there are five essential steps in Lean. These involved the identification of the features of operations that create value, identification of the sequence of activities in the operations, conducting efforts in making the activities flow, allowing customers to pull products or services through the process and conducting efforts in perfecting the process. In totality, the notion of quality in Lean relies on the perfection and assurance of a smooth production process.

In contrast while some of the focus of Lean might also be manifested in Six Sigma as Rathilall (2014) asserted, the variation would lie on the perspective by which Six Sigma attempts to improve the operations of the company. While Lean focuses more on the process or on the assurance of a smooth operation flow which decreases the possibility of productivity issues and problems in the

**Table 1: Element, definition and characteristics of institutional isomorphism**

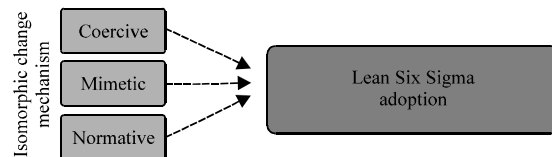
Element	Definition	Characteristics
Coercive	Both formal and informal pressures exerted on an organization by other parties upon which it is dependent and by the expectations of the society within which it operates	The environment acts over the organizational structure through the imposition of structures Rule setting; monitoring; recompense and punishment
Mimetic	When an organization attempts to imitate a more successful referent organization	Form a culturally based and conceptually correct support of legitimacy that becomes unquestioned
Normative	Professionalization, i.e., the collective struggle of members of an occupation to define the conditions and methods of work	Focus on values and norms that could be applicable to all members of the collective or to specific actors

long run, Six Sigma attempts to focus on the problem first and then conduct various strategies in going back to the entire process and resolving the root of the problem.

According to Nave (2002), the overlap between Six Sigma and Lean exist because problems and variations related to Six Sigma could be linked to the presence of wastes which affect the flow of the production process with which Lean is concerned. Once wastes affect and create unnecessary variations in the production process, it will become a point of concern in Six Sigma and appropriate actions will be taken to control it all for the same goal of improving the operations of the company. These strategies undertaken for both Lean methodologies and Six Sigma techniques are also referred to as Lean Six Sigma (LSS). The question is now, ‘what are the effects of adoption and implementation of LSS on organizational performance?’

**Literature review:** Braunscheidel *et al.* (2011) and Khurshid (2012) used institutional theory to assess the motivation for the adoption of Six Sigma. They analyzed the whole process of Six Sigma adoption using institutional isomorphic theory and concluded that coercive and mimetic pressures are the main factors behind Six Sigma adoption. Whereas, Khurshid (2012) found that normative pressure was found to be the only motivation behind Six Sigma adoption and that financial gains were not the main objective of the adoption.

Exploring the facts which relate to LSS adoption and its effect on performance within Malaysia was a key objective of this study. This focus was developed through the understanding of the mechanism of institutional isomorphic change as it was described by DiMaggio and Powell (1983), who argued that the world of organizations is heavily influenced by institutional isomorphism which infers that the dynamic nature of organizational environments has a significant role in how an organization makes its decisions (Johnston, 2013). This concept of institutional isomorphism developed by DiMaggio and Powell is still commonly referred to in the field of organization behavior and motivation (Christiansen, 1993; Gunaratne and Samanthi, 2010; Braunscheidel *et al.*, 2011; Khurshid, 2012).



**Fig. 1: Motivational factors for LSS adoption**

The concept of institutional theory, isomorphism, takes center stage in this study and it can present itself as three types of pressure: coercive, mimetic and normative. These pressures can operate alone or together to bring about change within a company (DiMaggio and Powell, 1983). As described by Khurshid (2012), these three mechanisms can influence the organization independently or in concert with each other. According to Lounsbury and Zhao (2013), new institutionalism in organization theory or neo-institutional theory is one of the main theoretical perspectives used to understand organizational behavior as situated in and influenced by other organizations and wider social forces, especially broader cultural rules and beliefs. Table 1 shows a summary of these key institutional elements within the neo-institutional theory.

To assess the LSS adoption process in Malaysia (Fig. 1), an analysis of the above-mentioned isomorphic processes will help to understand the actual mechanism and the possible motivational factors involved in making the decision to adopt LSS.

To explain each mechanism, start with coercive; this type of influence can include, sector-specific partnerships like industrial associations, chambers of commerce and even the government and its legislation (e.g., the regulatory environment set by government’s policy and/or customers demanding their suppliers to be certified). Mimetic mechanisms are primarily a result of uncertainties within the sector that trigger the organization to mimic the strategies of other successful companies and this creates a tendency for companies to adopt similar practices such as many companies adopting the ISO 9001 standard to imitate other organizations that have successfully gained certification for their quality management systems (Nair and Prajogo, 2009). In contrast to this, normative mechanisms are formed from the

knowledge base of the employees of that company a wholesome growth through training, education and professional courses. These are the fundamentals of an isomorphic process and they have contributed significantly to the conceptual framework of this study.

In providing examples of these elements of institutional isomorphism such as in the case of LSS application, the coercive element may apply to government regulations or agreements enforcing the application of LSS in its partner company's operation. The mimetic element, on the other hand applies to those who adapted LSS due to the success of the company that first applied it. The normative element can be manifested by companies that initiated the LSS even before the notion of LSS had been conceived.

In terms of the normative application of LSS, the perfect example would be the developments in the production system of Toyota. According to Pepper and Spedding (2010), the company experienced issues in terms of capital and resources after the second world war. In order to survive the situation, Taiichi Ohno and his associates constructed ways of assuring that the resources of the company are used productively through the elimination of wastes in the production process. This is normative in nature because the idea was born out of the determined need of the company even before the term LSS was derived.

With the continuous success of Toyota in terms of its applications of LSS, other companies followed suit in hopes of improving business operations (coercive isomorphism). This includes competitor car companies of Toyota in the global market (Pepper and Spedding, 2010). Soon, the use of LSS attracted companies from other industries leading to the wide adoption of LSS, like in engineering and technology businesses like Lockheed Martin (Pesc *et al.*, 2011; Siddh *et al.*, 2013) and companies in the health industries (Schweikhart and Dembe, 2009).

In terms of coercive isomorphism, the most common coercive applications of LSS would be by the governments themselves. For example, according to Maleyeff and Campus (2007), after determining the impacts of LSS, the Department of Defense of the United States followed and imposed the increase of LSS in its offices like the Secretary of Defense, US Army, US Air Force and US Navy all of which are geared towards improving the service of government offices to the citizens of a particular nation.

Looking at companies that have adopted LSS, improving customer satisfaction is one of the main reasons a company decides to adopt LSS because without

customers no company can survive. In many ways, the goals of Six Sigma and Lean are similar with Lean having a broader scope while Six Sigma primarily focuses on eliminating errors and improving quality. However, both are based on a foundation of having a customer focus (Hudgik, 2015). The two different-yet-similar methods complement each other by looking at the issue or goal in a different way, working together to identify errors and waste more efficiently than using just one method (Hudgik, 2015).

A business may decide to hire a consultant to implement a marketing strategy to bring in new customers but the company has to pay the extra cost for someone to find the issues and root causes of how the company can run more efficiently by identifying errors and waste. With LSS, a company can instead use the resources it currently has; its employees. LSS systematically looks at the entire company's operating picture and determines where it can effectively eliminate or change, the products, processes or equipment; all in an effort to ensure better customer satisfaction is achieved. Thus, adoption of LSS can provide the necessary tools and techniques for quantitative analysis to make decisions, no matter what size or type of business.

LSS is not just for companies that are creating and/or selling a product, it works for any industry and any type of business (Patel, 2012). LSS can work for improving customer satisfaction in an industry that does not necessarily sell or produce any product the healthcare industry. Hospitals and healthcare facilities place patient care as the most valuable variable in their business process and finding ways to improve patient care in such a high-performing fast-paced site as a hospital can be a difficult task that requires the ability to discern minute quantifiable opportunities for change (Furterer, 2014). Therefore, adopting LSS into an organization is not only to reduce cost and save money but it means a measure of quality that strives for near perfection.

## **MATERIALS AND METHODS**

This paper draws on the researcher's experience in the area of LSS. The findings come from primary and secondary sources as well as through in-person interviews with four Black Belts (Black Belts lead problem-solving projects. Train and coach project teams) and one Master Black Belt (Master Black Belt trains and coaches Black Belts. Functions more at the LSS programme level by developing key metrics and the strategic direction. Acts as an organisation's LSS technologist and internal consultant) practitioners at global companies across a range of industries which operate in Malaysia.

**Table 2: A summary of the interviewees**

Participant	Company label	Industry/Business	No. of employees	Annual financial turnover
Black Belt-01	A	Chemicals	150 +	Over RM150 million
Black Belt -02	B	Semiconductors	5,000 +	OverRM 4.5 billion
Black Belt -03	C	Electronics manufacturing services	500 +	OverRM 200 million
Mater Black Belt -01	D	Computer storage devices	1,500 +	OverRM 15 billion
Black Belt -04	E	Plantation	30,000 +	OverRM 10 billion

The research in the field of value administration has likewise been prevalently qualitative in nature. Aboelmaged (2010) found that the qualitative research methodology is widely used to conduct research in the field of LSS. Subsequently, this study utilizes qualitative research methodology as the preferred method for information gathering because it offers adaptability to the researcher in distinguishing critical concealed facts which could not be uncovered through quantitative methods (Silverman, 2009). Qualitative research methodology is well understood to be exploratory in nature (Neuman, 2003). Creswell (2008) states that this technique is fundamental when there is a need for a detailed understanding of the issue.

Qualitative information can be gathered through diverse strategies. For example, interviews, contextual analysis, perceptions and documents are all intended to investigate certain phenomena and concealed facts (Neuman, 2003). Therefore, the result of qualitative research brings about producing textual sort of information. Also, it gives the chance for respondents to express their perspectives on distinctive issues. Along these lines, the significance of qualitative research in portraying social and administration sciences theory is well understood (Moriarty, 2011).

Twenty companies located in Johor, Penang and Klang Valley were identified in the major industrial areas in Malaysia. From the chosen companies, Black Belt and/or Master Black Belt practitioners were contacted to participate. Out of that, only four Black Belt and one Master Black Belt were interested in participating in the study.

In this study, the primary interview was carried out with the Black Belt and/or Master Black Belt practitioners. Yin described interviews that are open ended and conversational in nature but follow a certain line of questioning derived from case study protocol and the interview guide. The deliberate methodology of setting up the conventions for open-ended questions for semi-structured interviews demonstrates the objectivity of the exploratory nature of the study. The structured method for information gathering is through semi-structured interviews that helped the analyst to understand the method and its consecutive steps.

Interviews were conducted in English and Malay languages as most of the participants preferred to do so. For face-to-face interviews, all respondents allowed the interviews to be recorded. Due to confidentiality, the names of the companies cannot be disclosed and therefore, several codes were subsequently developed from interviewee’s responses (Table 2).

As indicated by Creswell (2008), qualitative research is interpretive in nature: thus, the biases, values and judgment of the researcher must be clearly stated in the research report. Therefore, it is essential to mention that the researcher is a professional with designation of “IASSC Certified Black Belt” (ICBB®) from the International Association for Six Sigma Certification (IASSC) and has experience in providing consultancy to organizations. Based on his own experience, the researcher had the perception that Malaysian companies are resource-deficient and the majority of them cannot adopt the Six Sigma or LSS methodology. Perhaps this is due to an absence of leadership skills, employee resistance or their ownership to the company. Nonetheless, the researcher took exceptional consideration while conducting the research to avoid such biases affecting the findings of the study. The measures taken by the researcher were: verification of data by presenting the results of the research to interviewees for authentication and use of existing literature to determine whether the literature supported or did not support the findings of the research.

**RESULTS AND DISCUSSION**

The data was gathered from the interview sessions with the LSS Black Belt and Master Black Belt practitioners. The interview questions at this study sought to identify the crucial issues involved with the LSS adoption. This research focused on the following questions: What was the motivation to implement LSS? Why LSS methodology from amongst other quality management methodologies was selected? Is there any external assistance for implementing LSS?

**The motivation to implement LSS:** The journey towards LSS adoption for Company-A began recently with the

vision of BB-01 as a plant manager whose role was to lead the manufacturing team in improving process variation and cost reduction. The credit goes to the visionary capabilities and leadership skills of the plant manager that resulted in the initiation of the transformation of the mindset of the employees from the traditional style of working to the high quality, efficient way of completing tasks. It is also noted that Company-A had launched LSS the first time but it had never been understood correctly. This was mentioned by the BB-01 in the following words:

Black Belt-01 explained that during the company award presentation: [...] Only one of the judges understood whereas the rest did not really understand what it was all about (Black Belt-01). The motivation to implement and adopt LSS in Company-B, D and E was derived from their company principals. This was explained by BB-02:

We (at Company-B) have five principals; the first principal is related to our customer so we are in line with our customer needs. The second principal is about velocity; it's about value through mapping and creating the flow into our production. The third one is on our Build-In-Quality. Build-In-Quality is where we don't receive a defect, we don't make a defect and we don't pass a defect. The fourth is on our continuous improvement and the last is Cultural Enablers. This means that we have a roadmap for our staff to develop themselves, not only for the benefit of the company but also for sustaining self-learning... so, there are five principals that are motivational to us (Black Belt-02)

BB-04 explained that the quality department at Company-E had initiated a blueprint for LSS whereas the company targeted LSS projects with the estimated benefits of RM 245 million over 5 years. It is clearly underlined that the company has practiced LSS and LSS policy is one of the operational policies established by the company.

These interviewee's words provide a glimpse of the working style at the time. The shift in the mindset from a reactive mode to proactive is considered a foundation for fundamental change in the culture of the traditional way of running operations.

On the other hand, BB-03 introduced LSS at Company-C according to his experience with his previous company. He said that Company-C's direction on LSS adoption is not there yet but he is trying to adopt LSS as an efficient and effective strategy in order to become

more competitive. BB-03 also explained that LSS has been adopted more by very big companies with very big puzzling situations and ROI potential, as opposed to small companies where the processes are easier to understand fully.

**LSS methodology was selected from amongst other quality management methodologies:** Company-A, B, D and E had already tried almost all quality management initiatives, mostly by quality professionals and consultants and had melded them into a comprehensive approach to achieving their strategic goals. According to MBB-01, Six Sigma was the primary methodology across Company-E business while Lean constituted a significant effort on the supply chain, warehousing, etc. While BB-02 opined that:

"I think why we select LSS rather than just Lean or Six Sigma by itself is that we have the best of both sides. Lean is practical where we 'go to gemba' (i.e., go and see what is really happening) and eliminate waste. Six Sigma is where the company drives the improvement through the step-by-step DMAIC (DMAIC (an abbreviation for Define, Measure, Analyse, Improve and Control) is a process defined by Motorola as part of their Six Sigma management philosophy) methodology. It also uses actual data in overseeing, analyzing and data crunching. So in any company, now a days, the best practice is to have both not only for practicality but also once you reach that level of practicality you can also switch the emphasis on both systems which is a systematic approach to Six Sigma methodology" (BB-02. Line 135-141)

As mentioned earlier, LSS methodology was selected by BB-03 to be applied at Company-C due to his previous experience as a LSS practitioner.

**External assistance for implementing LSS:** The final interview question in this section sought to identify any external assistance for implementing LSS which at Company-A, a consultant was hired at company group level where team members have to go to training at group level before they can implement a LSS project.

Company B-E, currently did not appoint external consultants for LSS implementation. BB-02 explained that when there is high impact project or if there are multiple projects to be executed; the internal consultant from the regional side such as in China, Vietnam, Singapore or India will communicate and the Regional Manager will come in.

It is understood that Black Belts and Master Black Belts play a consultant role to train LSS team members. According to MBB-01, consultants or outside training agencies were used to educate a core group who then internally developed training programs for the company.

## CONCLUSION

As a developing country, Malaysia has achieved success in many fields. The adoption of LSS is however quite discouraging in Malaysia and as such, this is a point of concern as to why organizations in general are not adopting the LSS methodology. Recent studies in UK manufacturing companies identified various reasons behind the lack of LSS implementation but the motivational aspects towards LSS adoption require more attention (Braunscheidel *et al.*, 2011). Braunscheidel *et al.* (2011) and Khurshid (2012) used institutional theory to determine the motivation behind Six Sigma adoption but their findings were not about LSS and the study was not exclusive to a company located in Malaysia. However, the question remains as to what motivates an organization to make the decision to adopt or practice Six Sigma or LSS. The literature presents various theoretical foundations and rationales for the adoption of various quality management methodologies such as TQM (Odoh, 2015) and ISO standards but for the LSS methodology, very little is discussed as to how the adoption process is initiated (Braunscheidel *et al.*, 2011).

The foundation of the current study is the institutional theory presented by DiMaggio and Powell (1983). This theory involves three isomorphic change mechanisms labeled coercive, mimetic and normative. In the literature, Braunscheidel *et al.* (2011) used institutional theory to determine the motivation behind Six Sigma adoption in the United States (US), regardless of the size of the organization. Khurshid (2012) argued that it is important to highlight that out of the seven organizations in their study; only one fell under the category of Small and Medium Enterprise (SME) according to the definition criteria of the Australian Bureau of Statistics (ABS). Therefore, he concluded that the judgment regarding coercive and mimetic mechanisms may only be valid for large organizations. On the other hand, Braunscheidel *et al.* (2011) determined that for Six Sigma adoption, only coercive and mimetic mechanisms are involved while the normative mechanism is only active during the implementation phase. Conversely, Kurshid (2012) found that normative pressure was the only motivation behind LSS adoption for manufacturing small and medium companies.

Contrary to the findings by Braunscheidel *et al.* (2011) and Khurshid (2012) in the current case, the companies under study followed the mimetic and normative mechanisms to instigate change when asked specifically about the motivations behind the LSS adoption. Therefore, the whole adoption process was started by the LSS practitioner who was “process driven” with the pre-qualification of LSS Black Belt. It was his/her visionary and strategic skills that resulted in the transformation of the employee’s mindsets from the traditional style of working to the high quality efficient way of completing tasks.

Therefore, mimetic and normative mechanisms played a fundamental part in the adoption of LSS in Malaysia while this finding excluded the involvement of any coercive factors as a motivation to adopt LSS practices. Because this finding is based on several companies’ cases, it may be an important contribution to the current body of knowledge. Hence, the current study strongly suggests that mimetic and normative isomorphic mechanisms are responsible for the successful adoption of LSS practices.

After comparing the findings by Braunscheidel *et al.* (2011) and Khurshid (2012) and those of the current study, it appears that the reason why many companies are not adopting the LSS application is because there are currently no coercive pressures in Malaysia. For instance, manufacturing companies experience more coercive pressures from their industry to become ISO 9000 certified that services do (Castka *et al.*, 2006). Therefore, the absence of coercive isomorphic change mechanisms from the company has a great influence on its motivation to adopt LSS application. Consequently, the current study strongly suggests that mimetic and normative isomorphic mechanisms are responsible for the successful adoption of LSS practices, though the normative mechanism also played its part during the implementation of LSS.

## REFERENCES

- Aboelmaged, M.G., 2010. Six sigma quality: A structured review and implications for future research. *Intl. J. Qual. Reliab. Manage.*, 27: 268-317.
- Anonymous, 2014. Improving project management skills with lean six sigma. International Institute for Learning, Inc., New York City, New York, USA.
- Antony, J., 2011. Six sigma vs lean: Some perspectives from leading academics and practitioners. *Intl. J. Productivity Perform. Manage.*, 60: 185-190.
- Braunscheidel, M.J., J.W. Hamister, N.C. Suresh and H. Star, 2011. An institutional theory perspective on six sigma adoption. *Intl. J. Oper. Prod. Manage.*, 31: 423-451.

- Castka, P., M.A. Balzarova and J. Kenny, 2006. Survey of ISO 9000 users in New Zealand: Drivers and benefits; A descriptive analysis. Master Thesis, University of Canterbury, Christchurch, New Zealand.
- Christiansen, D.L., 1993. An empirical investigation of dimaggio and powell's coercive, mimetic, and normative isomorphic change processes: A case study in higher education. Ph.D Thesis, Scientific Electronic Library, Sao Paulo, Brazil.
- Creswell, J.W., 2008. Research Design: Qualitative, Quantitative and Mixed Methods Approaches. 3rd Edn., Sage Publications, Los Angeles, California, ISBN:978-1-4129-6557-6, Pages: 251.
- DiMaggio, P.J. and W.W. Powell, 1983. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *Am. Sociol. Rev.*, 48: 147-160.
- Furterer, S.L., 2014. Lean Six Sigma Case Studies in the Healthcare Enterprise. Springer, London, England, ISBN:978-1-4471-5582-9, Pages: 387.
- Grayson, K., 2002. Are six sigma and lean manufacturing really different? Are they synergistic or in conflict?. American Society for Quality inc, Wisconsin, USA.
- Gunarathne, A.D.N. and S. Samanthi, 2010. A case of an accountancy study programme in Sri Lanka to improve relevance and quality of undergraduate education; A new dimension on institutional view. Proceedings of the 1st International Conference on Business and Information, July 04-06, 2010, University of Kelaniya, Colombo, Sri Lanka, pp: 1-20.
- Hudgik, S., 2015. Applying Lean Six Sigma Methodology. Noria Corporation, Tulsa, Oklahoma,.
- Johnston, M., 2013. Mimetic, coercive and normative influences and the decision of national sport organisations to bid for world championship events. Ph.D Thesis, Auckland University of Technology, Auckland CBD, New Zealand.
- Khurshid, K.K., M. Kumar and D. Waddell, 2012. Status of quality management in Australian manufacturing SMEs. Proceedings of the International Conference on Industrial Engineering and Operations Management, July 3-6, 2012, Istanbul University, Istanbul, Turkey, ISBN:978-1-62993-911-7, pp: 1266-1275.
- Lounsbury, M. and E.Y. Zhao, 2013. Neo-Institutional Theory. In: Oxford Bibliographies in Management, Griffin, R. (Ed.). Oxford University Press, Oxford, England, ISBN:9780199846740, pp: 1-37.
- Maleyeff, J. and H. Campus, 2007. Improving Service Delivery in Government with Lean Six Sigma. IBM Press, Indianapolis, Indiana,.
- Moriarty, J., 2011. Qualitative methods overview school for social care research improving the evidence base for adult social care practice. National Institute for Health Research, London, England.
- Nair, A. and D. Prajogo, 2009. Internalisation of ISO 9000 standards: The antecedent role of functionalist and institution a list drivers and performance implications. *Intl. J. Prod. Res.*, 47: 4545-4568.
- Nave, D., 2002. How to compare six sigma, lean and the theory of constraints: A framework for choosing what's best for your organisation. *Qual. Prog.*, 35: 73-78.
- Neuman, L.W., 2003. Social Research Methods: Qualitative and Quantitative Approaches. 5th Edn., Allyn & Bacon, Boston, Massachusetts, ISBN:9780205374076, Pages: 584.
- Odoh, M., 2015. Application of information technology in total quality management. *J. Software Eng. Simul.*, 2: 9-15.
- Patel, R., 2012. Modeling lean six sigma in the small packaging industry in India. Master Thesis, Rochester Institute of Technology, Rochester, New York.
- Pepper, M.P.J. and T.A. Spedding, 2010. The evolution of lean Six Sigma. *Int. J. Quality Reliability Manage.*, 27: 138-155.
- Pesc, M.A., V. Lepojevic and V. Zlavic, 2011. Six sigma vs total quality management-presence in world and Serbian economy. *Econ. Organ.*, 8: 221-233.
- Rathilall, R., 2014. A lean six sigma framework to enhance the competitiveness in selected automotive component manufacturing organisations. Ph.D Thesis, University of Maryland, College Park, Maryland.
- Salah, S., A. Rahim and J.A. Carretero, 2010. The integration of Six Sigma and lean management. *Int. J. Lean Six Sigma*, 1: 249-274.
- Schweikhart, S.A. and A.E. Dembe, 2009. The applicability of lean and six sigma techniques to clinical and translational research. *J. Invest. Med.*, 57: 748-755.
- Siddh, M.M., G. Gadekar, G. Soni and R. Jain, 2013. Lean six sigma approach for quality and business performance. *Global J. Manage. Bus. Stud.*, 3: 589-594.
- Silverman, D., 2009. Doing Qualitative Research. 3rd Edn., SAGE Publications, Thousand Oaks, California, ISBN:978-1-84860-033-1, Pages: 455.