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Six Sigma application in the Jordanian industrial companies and its critical success factors: an exploratory study

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Abstract

This research purpose to explore and analyze the reality of applying the Six Sigma (SS) process within the Jordanian Industrial Corporate Sector, as well as determining critical success factors. A core problem which has already been identified is the gap between the practical aspects of SS and required technical and theoretical processes. Using an analytical technique, a questionnaire for data collection was developed and a number of interviews conducted to provide data for the analysis, with the intention of determining and understanding the critical success factors. This process enabled the researcher to develop the steps required to ensure both the theoretical and practical aspects of the situation were taken into consideration; the ensuing proposal was then reviewed by the stakeholders This study proposes a series of phases which could be used by managers and technicians to adapt the SS process for use within an Arab business environment, but particularly within Jordan.

Keywords: *Sigma , Core problem, Analytical technique, stakeholders, SS process.*

Introduction

SS is a strategy used to streamline production process; when instigated effectively, it increases profitability and reduces waste, while reducing production costs and increasing effectiveness of products and services. The end result is increased customer satisfaction for both customers and stakeholders, in line with the specific requirements of the targeted goods or services (Hank, 2010).

Many current studies confirm a clear relationship between SS and its applications in analyses of organizations and projects. Motorola Inc. developed the methodology, and applied it to all their technological processes, resulting in enhanced profitability and significantly reduced costs. They also noted reduced time and effort required for the production process and increased employee satisfaction, which further enhanced quality, performance and efficiency (D. Tjahjono, 2010).

The SS methodology can be adapted for use in any sector which is at risk from high costs related to financial and complex administrative operations which affect productivity. However, to take full advantage of the benefits of savings as a result of this process, an organization needs to have

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a centrally located base and effective communication between employees and decision makers, so that all steps in the process are not merely considered as theoretical knowledge base, but rather as critical requirements.

Furthermore, any requirements which are lacking or not functioning effectively will severely impact on the application of SS methodology, perhaps even resulting in failure, particularly in processes which link production objectives and ensure achievement of the goals. One of the most important requirements of the system is to conduct exploratory studies affecting supply in the business sector and to clarify the strengths and weaknesses of the labor environment within these factors The next step is to determine the 'road map' for application of methodology; each instance needs to be adapted by an organization's senior management to ensure the best fit. Success or failure is directly affected by the strength and authority of central management, and whether it is able to persuade workers to accept changes to standard practices, and to become more active in their own careers and training. In addition, development and restructuring of an organization's infrastructure needs to occur, in order to comply with possible changes in the use of statistical methods; this will ensure the success of new company strategy, which will then to reap the fruits of its results. (Vasileios, 2013), (Darshak, 2012).

Current studies provide success factors for the application of SS, he most important of which are:

1. The commitment of senior management to participate in the introduction of SS.
2. The development of infrastructure within the organization to provide systematic training and continuous improvement in the capabilities of the workers.
3. Development relies on a set of statistical methods, particularly in the decision-making processes (Siddra, 2016).

A. The study problem

To date, Jordanian industrial institutions have not received sufficient attention or analysis; therefore, no definitive studies have been undertaken to determine the reasons for its inefficiencies or failure. According to statistics provided by the Ministry of Trade and Industry, more than 4% of companies reported critical issues in 2015, which increased to 5.5% in 2016; this is extremely serious, reflecting the poor performance of the industrial sector in general and indicating that competitiveness of Jordanian industry and its ability to succeed is limited. Furthermore, its capacity to develop high quality products, while improving the general level of capability of workers is lacking. The seesaw between 'boom and bust' which continues to plague industry means it is necessary to search for solutions to its problems. Introducing the modern SS methodology to the industrial sector would be advantageous, because it is the optimum solution

which can solve problems within all segments of the industrial sector, thus enhancing competitiveness and increasing sustainability.

Both Jiju, (2007) has concluded that neglecting this methodology *per se* increases an industry's challenges overall, while neglecting the technical assistance aspects contributes to a decline in product quality. In terms of Jordanian industry as a specific case, it has also resulted in increasing costs. Since the basic objective of SS is to reduce cost while improving quality by reducing manufacturing errors, the current state of affairs, with limited use of the SS process, has reduced the chances of success for many companies, as verified by the results of this study.

B. The importance of the study:

The importance of this study has been validated by the industrial sector itself. Industry constituted only 24% of the GDP in 2015 JoD as a result of severe instability and insecurity in the countries surrounding Jordan to the north and east. However, at the same time, investment significantly increased, as refugees desiring resettlement in Jordan contributed a further 1615 million the industrial sector, to GDP in fixed prices affordably priced to about 3% only during 2015. The limited development and poor administrative and industrial processes highlighted above, which have plagued Jordanian industry, have increased the importance of introducing SS methodology, which has proven its universality and effective impact, and has been successful in administrative operations in many different situations around the world. Hence, investment in this methodology within the private industrial sector would be returned quickly, with a flow-on effect for other sectors within the Jordanian economy.

Establishing a standard proposal to introduce SS methodology will act as a first step to promoting the application of this methodology and contribute to its inclusion within private business, particularly within the industrial sector, by strengthening a company's competitive position and its ability to develop and remain sustainable in today's volatile and variable environment.

C. Objectives of the study:

The objectives of this study are:

1. To identify the reality of applying SS methodology in Jordanian industrial companies, by determining the degree of success, and exploring reasons for failure in companies where it is already operating.
2. To identify and analyze success factors which would assist companies to apply the SS process during production.
3. To develop standard practice or procedure which would enable companies to assimilate SS within the industrial sector, and to promote investment of in the methodology.

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D. The study questions:

D.1 The process of setting targets

It's possible to define the primary essential components of SS as the follows:

a. The commitment and utmost support of senior management when adopting this methodology.

b. Substantial financial support for the methodology in the initial stages; which will be positively returned to the organization after the methodology has been applied.

c. Practical inclusion of SS within the organization's strategy.

d. Inclusion of SS methodology within Human Resources applications.

e. Integration of SS operations within the supply chain

f. Use of technology and SS methodology for statistical tools which integrate the requirements of the market and the desires of the customers.

D.2 Enhancement:

a. Are there any standard proposals /procedures whereby the basic principles of SS could be applied, which detail how a company's administration should operate?

b. What are the real barriers which could prevent a company from applying the SS methodology??

c. What are the main recommendations which will support applying SS methodology in those companies?

E. Theoretical framework:

Establishing a clear understanding of the principles and elements of SS methodology is one of the most important criteria in any proposal of application, keeping in mind that there is both a theoretical and an academic basis for this process. Many existing studies are of benefit, particularly with regard to multiple dimensions, such as a discussion on the subject of the use of sigma (Σ), which is used to refer to and clarify any contrast or deviation within the standard deviation, whether positive or negative, compared with the planned goals of SS.

SS provides a strategy for the development and constant improvement of production processes, so as to reduce the level of waste over all aspects of productivity, including material and financial resources, in addition to enhancing timeliness, which results in a significant increase in quality and reducing the percentage of error to less than 0.00044%; that is, ensuring accuracy of a product

or service to 99.99966%. At the same time, continuous improvements to procedure and training will result in a highly skilled workforce which is self-motivated and in tune with the overall goals of the company. SS methodology proposes solutions to address the immediate issues facing a company, leading to continuous improvement in production procedures and processes, which ultimately achieve an ideal commodity or service. (Guajan, 2016).

In terms of service provision, SS depends on an integrated system of administrative and technical operations to develop and improve effectiveness, and to upgrade efficiency and effectiveness while removing any activities or actions which have no value through an Operations Review. The process does not concentrate on errors, but addresses them by means of standardized steps in operations (Yahia, 2011).

Rubea believes that a systematic system such as SS is a radical change in procedure for most companies. It is also a comprehensive change in the order of operations, from forward to reverse and vice versa, and is thereby aimed at sustainability, particularly in communication with clients, and achieving desired expectations for both goods and services, which will positively reflect on a company and provide them with a competitive advantage (Rubea, 2012).

None states that the basic objective of SS is to increase profitability, by increasing market share and competitiveness, using the 'black-' and 'green belt' method, which guarantees ideal operations and a miniscule ratio of error, according to customer expectations (None, 2003). To achieve this, the SS methodology must be incorporated within the vision and strategy of the company.

SS is primarily knowledge-based for the solution of problems facing an organization, relying on statistical tools to address mistakes and deviations, resulting in continual development and improvement, to ensure that what is accomplished equates with what was planned (Florian, 2009).

Lauriani points out that one of the basic pivots of SS is "no errors in record time", thus reducing time-consuming financial and productivity losses by avoiding mistakes and shortcomings in productive and service operations. These goals can only be achieved by innovative management, which depends on strategies designed to be flexible, and provide exact standards for each process within the philosophy of the Action Team (Lauriani, 2013).

F. Applying the requirements of SS:

There are numerous dimensions for SS requirements, the most important of which, according to Salah, is a committed administration which is working towards developing a balanced, flexible and sustainable process, while maximizing profitability and successful operations. This is achieved by understanding the needs of the customer and designing a set of standards within a philosophy of sustainable management which addresses errors based on facts. The first step is

analysis, followed by development and control, especially in the management of a project (Salah, 2009).

Regarding the above, both Ghuni and Dinesh declare that SS does not refer only to operations systems; it is also essential to develop production processes and to promote the culture of a company. This requires administrative leaders who have both knowledge and specialized training in SS in order to lead the separate departments to a full implementation of SS according to what was planned, thus achieving a genuine revolution in the principles of action within the company, to reach an integrated perfect process for every part of the system as a whole. By stimulating the company to work in teams using gathered information, actions are processed very effectively (Ghuni, 2009; Dinesh, 2007).

Djoko, states in his study that the Σ deviation compares effective performance with deviations which need to be redressed, thus preparing operations to implement the methodology by establishing standards of effective performance, then confirming that the ideal organizational standards are achieved by means of clear objectives. Company success in implementing SS methodology will result in sustainable continuity of production over all aspects, including cost and effectiveness of profits, and achieve positive results in realizing the expectations of customers (Djoko, 2007).

G. Applied Proposal:

The application of SS methodology in any company is dependent on a series of steps to achieve the desired results, including:

a. Provide an indicative plan, consistent with the literature on this methodology (known as the introduction of Road Map) within the organization. Known as DMAIC, it entails a process of Define, Measure, Analyze, Improve, and Control, (Mehmet, 2012).

b. The aim of this methodology is to promote the application of high quality standards using the Road Map to integrate SS within the company and assist decision makers in the organization in the follow-up process, to measure success of the draft methodology.

c. SS methodology assists decision-makers in an organization to identify and determine a series of successive steps, which will improve operational systems. (Anupama, 2014).

d. Jiju believes that such steps should be preceded by the identification of qualitative objectives and values of achievement. The next step is to determine work teams, especially at the functional level of a project, and to establish measurable quality targets. Then prepare an operational plan, (including a training plan and a mechanism for the collection of data) and develop a mechanism for the maintenance and coordination of the plan, which relies primarily on communication and information management, as well

as its role in achieving consumer satisfaction. These steps will have a comprehensive impact on accuracy and speed of implementation.

G.1 A proposed mechanism to apply SS methodology in Jordan:

Design Stage

In this stage, SS methodology and the required instruments to establish a positive image are introduced to senior management. The main aim is to clarify potential impact, determine willingness to accept the methodology, and prepare a working group for the project. An instrument panel to define dimensions for the project is prepared at this point (Polytip, 2014).

1. The Working Group defines the parameters of the project, how the methodology will be applied, procedures to improve process, and how production operations and management will be developed overall. The emphasis at this stage of the operation is to decide how best to enhance the success of meeting the requirements and expectations of clients.
2. The Working Group focuses on priorities, particularly to establish where most errors occur, and determine the most appropriate solution, which would promote the values of SS and its application within the organization. There are many digital techniques to choose from which will assist in this stage of the project.
3. The Working Group will establish the following baselines:
    a. Target improvement and the scientific vision of the project.
    b. Set the work plan and broad guidelines which will govern the work of the project.
    c. Institute the project culture, based on adoption of the above points.
4. At this formation stage, the entire working group, whether administrative or technical, will establish a harmonious methodology consistent with the strategies of the parent organization.

G.2 Measurement Stage:

The measurement stage is considered the basis of the assessment process; basic indicators to determine capacity of the project, based on the requirements of customers and their needs, are established (Peter, 2012).

The instrument cluster which will be used as the basis for assessment of main goals is adopted, founded on numeric, specific time, and limited cost attributes, to indicate clear goals for each stage of implementation, and to ensure that the working group understands the instrument cluster indicators. They are presented to the Working Group, and accepted or amended as required.

Road maps or network scrutiny are both appropriate tools which can be used for this; the team needs to choose the appropriate tool which will measure consistently and accurately for the project situation, and ensure credibility for measurement of project capacity-building (Paul, 2010; Djoko, 2008).

Measurement of the capacity-building processes and procedures must be compatible with the characteristics of the product measured, so as to ensure there is instrument cluster consensus between the process of defining the operations and actual standards. Capacity must coincide with the level of SS methodology required; this is done by measuring the capacity of the operations, reducing average deviation to a minimum level, and reducing fluctuation of standards according to an equation called the Capability Index Process (Peter,2012)

G.3 Performance phase analysis:

In this stage, current performance is analyzed, and compared with performance in the previous year. Any changes in performance, both negative or positive, are followed up, to determine best performance and a better understanding of how to design the SS process. The optimal process, which will satisfy all requirements, will be designed by analysis of all data, ascertaining the cause of each problem by examining previous results, and establishing whether independent or joint operations would be most useful. Once the analysis has been completed, and corrections designed for the production processes, the next step is to link production with human resources, and design a training course for SS methodology required (Rodney, 2009; Daniel, 2010).

G.4 Improvement:

While the specific SS methodology required for the project is being developed, the problems, errors, and difficulties which were analyzed during preparation of the operational plan, are dealt with. At this point, alternative procedures or processes are evaluated, and those which would be most effective in reducing errors, or most effective in financial terms for the company and its stakeholders are adopted.

The next step in the process is to design performance operations by undergoing the first pilot; this will test the proposed procedure to see if it enhances response to the needs of customers, is capable of addressing errors, raises the level of effectiveness, and reaches the standards expected from the prior assessment for similar circumstances in the simulation (Pramtima, 2014). An important factor which needs to be addressed at this point is known as the 'refusal of change', particularly in terms of rehabilitation and training of personnel involved in the process of transition, not only in the production line, but in all operations where the company is committed to establishing specified standards and procedures.

It is essential that personnel adapt to the necessity of change; it is the responsibility of the working group to ensure this, in accordance with the baselines agreed upon in the Design Stage. All aspects of the operation must be examined and analyzed, even the minor details which in general do not affect ongoing operations, so that future operations will confirm the impact and value of the design. (Lauyo, 2003).

G.5 Supervision Control:

The last step in the application of the methodology is to ensure that the evaluation processes and implementation for each activity respond to the processing operations, by conducting a digital statistical assessment for each activity, compiling the relevant statistics, and designing a curve which illustrates operations development and improvement according to the norms and standards adopted previously. The process should verify the desired standards for cost control, and be consistent with the Design Stage. (Kushadi, 2016).

A Control System should be established, which consolidates and strengthens ongoing development of the operations, introduce coping mechanisms for any deviations which may emerge, and adjust the process based on stakeholder feedback (Dambhare, 2013).

The evaluation process must include a Test System, to ensure reliability and credibility, as well as to introduce any additional materials or tools which might be necessary for the operation. In addition, non-standard capacities and benchmarks need to be identified, in order to test and implement the evaluation process.

This will ensure that the improvements to the processes or operations have been completed, together with the measurement process. (Srinivasan, 2016).

H. Primary principles for the application of SS methodology:

Many researchers have explained the most important scientific principles required; it has been established that SS methodology will not succeed without the following:

1. **Knowledge of customer requirements and customer care.**

It is clear that the focus of SS methodology is the client, not only as mere agents or stakeholders, so it is imperative to understand their needs, identify and meet their expectations for goods and services, and make sure they continue to be included in subsequent processes and changes.

2. **Formulate resolutions based on data, information and facts:**

Fu-Kwan declares there is a strategic element in SS methodology, with a focus on decision-making based on data. Only this will provide an exact system with appropriate decision-making. An emphasis on all data compiled during the pilot operation during follow-up will clarify if

desired changes for cost and quality have occurred, together with the required reduction of defects (Fu-Kwan, 2014).

3. **Applying SS methodology to the internal operations of the activity:**

Dela clarifies that the success of productive processes depends on procedural operations adopted for a specific situation, which are designed to increase effectiveness according to set standards commensurate with customer requirements. To achieve ongoing satisfaction, it is necessary to instigate sustained improvement in production processes. It is not possible to achieve a competitive advantage for an organization through comprehensive operations only; it is necessary to ensure implementation of the complete SS methodology, with all processes and procedures linked to the product or service. If this is achieved, it is possible to maintain high standards and customer satisfaction (Dela, 2013).

4. **Successful Management is Planning Management:**

Cheg explains that effective management is proactive, based on the construction of future scenarios, valid assumptions, and preparedness to develop appropriate solutions, which can be strengthened to solve problems before they occur, not only prevent them from happening. These plans can only work through collaboration between the various teams in an organization, creating synergy between them to support the process of development and continuous improvement, while reducing errors and processing deviations (insert reference using family name not first name).

5. **Optimization at work:**

Asafuddoula confirms in his study that SS methodology is based on the organization's arrival at stage two of the process, which involves optimization through continuation, continued development and improvement in performance, and making any modifications required so that operations meet the required standards for deviation, and have the ability to recognize and resolve any errors which occur during implementation of the process (Asafuddoula, 2015).

I. The role of statistics in SS methodology:

There is a real scientific relationship between SS methodology and applied statistics benchmarks, especially those associated with the application of this technique, which work as a radar to measure any differences between the mean effective functioning and any deviation that may occur which are contrary to the requirements of the methodology, alert personnel the deviation has occurred, and follow-up to ensure a corrected procedure or process ensues (Calia, 2012).

Statistical decisions which are made by referring to scientific databases continuously determine the appropriate standard deviation within the time period for completion, so that consolidation

between positive and negative deviations results in an optimization of performance for each process and task, so as to reach a zero level of deviation, depending on a scale which is both credible and realistic (La Longo, 2016).

SS methodology is based on statistical dimensions, with normal distribution of values which turn numbers that reflect the digital dimension into real concepts for the completion of work. Dimensions which have been applied in international companies such as Toyota and Motorola, among others, emphasize that all movements during the application the methodology must first be calculated and measured, in order to measure the standard of quality, and then developed to optimize the situation (Cohklin, 2013).

The statistical methods which have been developed systematically for SS methodology are known as Statistical Process Control, which basically maximizes the principle of control over executive processes, while developing metrics and standards to prevent fluctuation in performance on an ongoing basis, through statistical curves and graphs.

Moreover, design trends and courses, which lead to the establishment of a pattern of effective performance based on statistically significant digital and working hypotheses are developed, which are tested using statistical constants and independents, such as the link and deviation between variable methods. Gaining access to relationships and decisions strengthens the process of controlling deviation (Connaughton, 2016).

J. The role of the Green and Black Belts in SS methodology:

One of the most systematic essences of SS is the belt system, which is similar to those in the martial art of Karate, where participants obtain belts for achievement in dealing with resources. The black belt symbolizes the best level of performance, while the green belt reflects the level of commitment within the company to the system required by the objectives of SS methodology (Anthony, 2015).

An organization or company initially prepares the personnel to work for the Green Belt, which is fundamental to success factors for personnel who have lower levels of training, or are less involved in operations. Acceptance of the system contributes to better development of processes and procedures such as data collection and analysis. Black Belt holders contribute assistance to those working towards the Green Belt (Chad, 2015).

Black Belt holders are at a much higher level than green belt holders; they have more training and are supported by a much more advanced knowledge of SS methodology; it is these who lead the real operations of development and change. Black Belts have the ability to lead a project or even the organization itself through the process of perfection in performance, and have strong capacity to absorb and apply the training and change which is the basis of the methodology. They usually

have prior experience in leading successful projects in SS methodology, and are able to offer advice regarding the operations. An incremental number of Black Belt holders in an organization indicates efficiency of operations (Jiju, 2016). Black Belt holders bear responsibility within the project team, overseeing resources and providing support for the working group, with regards to information and time management, in order to safeguard effective reductions in cost and increased efficiency of the product. They also raise the level of the permanent performance renovation (Jiju, 2016).

The Black Belt Master has the highest status, and is responsible for training other black belt holders and monitoring their work. In particular, they are responsible for the successful performance of senior administration. The Black Belt Master gives instructions and serves as a consultant for the organization. His/her primary personal feature is to have run at least twenty previously successful projects, with strong capabilities in developing action strategies. A Black Belt Master must be able to take control of a project, train other personnel to develop and implement methodologies and process, and provide encouragement to others for achievement. Finally, he/she is responsible for leading the project to the final stage (K.Narasinham, 2005).

Conclusion

As indicated by Yahia and Florian, it is clear that SS methodology is more advanced than TQM, by providing an advanced philosophy of application which focuses on addressing problems without consideration of cost, and it is in this aspect that SS methodology differs most strongly from other where tools, systems and principles, because its methods of application are totally different. The main focus is on trouble shooting, and the differential formation of the working group supports the training methodology despite the high cost. This focus on developing new measurement tools which rely on the establishment of new operations, while developing a distinct culture for the organization based on linking an individual's skills to production processes and how they might be developed enhances leadership development, individual capabilities, and enables personnel to accept change within the workplace, thereby increasing quality of production (Yahia, 2011; Florian, 2009).

References

Antony, J. & Karaminas, H. (2015), "Critical Assessment on the Six Sigma Black Belt. Roles/responsibilities, skills and training", *International Journal of Quality and Reliability Management*, Vol. 33 No. 5, pp. 558-573.

Asafuddoula, M. (et al.) (2015) "Six-Sigma Robust Design Optimization using a Many-Objective Decomposition-Based Evolutionary Algorithm". *IEEE Transactions on Evolutionary Computation*, Vol. 19 Iss: 4, pp. 490-507

Calia, Rogério Cerávolo; (et al.) (2012) "A Matrix Structure For Six Sigma Projects and Management Skills in a Cleaner Production (CP) Program". LA ESTRUCTURA

MATRICIAL PARA PROYECTOS SEIS SIGMA Y LAS HABILIDADES GERENCIALES EN UN PROGRAMA DE PRODUCCIÓN MÁS LIMPIA (P+L). Vol. 19, Iss: 2, pp. 222-240

Chang, S. (et al.) (2012) "Applying Six Sigma to the Management and Improvement of Production Planning Procedure's Performance". *Total Quality Management & Business Excellence*. Vol. 23 Iss: 3/4, pp. 291-308

Conklin, J. (2013) "Roundabout Estimation". *Quality Progress* Vol. 46 Iss: 5, pp. 54-56

Connaughton, S. (2016) "Statistical Quality Control in Manufacturing". *Statistical Quality Control in Manufacturing*. pp.1 - 13 Database: Research Starters – Business

Dambhare, S. (et al.) (2013) "Productivity Improvement of a Special Purpose Machine Using DMAIC Principles: A Case Study". *Journal of Quality & Reliability Engineering*, pp. 1-13. DOI: 10.1155/2013/752164. Database: Computers & Applied Sciences Complete

Darshak A. (et al.) (2012) "An Assessment of the Critical Success Factors for Six Sigma Implementation in Indian Industries". *International Journal of Productivity and Performance Management*, Vol. 61 Iss: 4, pp. 426 - 444

de Koning, H. (et al.) (2010) "Generic Lean Six Sigma Project Definitions in Publishing". *International Journal of Lean Six Sigma*, Vol. 1 Iss: 1, pp. 39 – 55

de la Lama, J. (et al.) (2013) "Using Six Sigma Tools to Improve Internal Processes in a Hospital Center through Three Pilot Projects". *International Journal of Healthcare Management*, Vol. 6 Iss: 3, pp. 158-167

Gibbons, P. & Burgess, C. (2010) "Introducing OEE as a Measure of Lean Six Sigma Capability". *International Journal of Lean Six Sigma*, Vol. 1 Iss: 2, pp. 134 - 156

Hamza, S. (2009) "Monitoring and Controlling Design Process Using Control Charts and Process Sigma". *Business Process Management Journal*, Vol. 15 Iss: 3, pp. 358 – 370

Ialongo, C. (et al.) (2016) "Timeliness 'at a glance': Assessing the Turnaround Time through the six Sigma Metrics". *Biochemia Medica* Vol. 26 Iss: 1, pp. 98-102. DOI: 10.11613/BM.2016.010.

Ismyrlis, V. & Moschidis, O (2013) "Six Sigma's Critical Success Factors and Toolbox". *International Journal of Lean Six Sigma*, Vol. 4 Iss: 2, pp .108 – 117

Jiju, A. (et al.) (2012) "Application of Six Sigma DMAIC Methodology in a Transactional Environment". *International Journal of Quality & Reliability Management*, Vol. 29 Iss: 1, pp. 31 – 53

Jiju, A. (2008) "Can Six Sigma be Effectively Implemented in SMEs?" *International Journal of Productivity and Performance Management*, Vol. 57 Iss: 5, pp. 420 – 423

Jiju, A. & Karaminas, H. (2016) "Critical Assessment on the Six Sigma Black Belt Roles/Responsibilities, Skills and Training: A global empirical study". *International Journal of Quality & Reliability Management*, Vol. 33 Iss: 5, pp. 558 - 573

Jiju, A. (et al.) (2007) "Six Sigma in Service Organizations: Benefits, challenges and difficulties, common myths, empirical observations and success factors". *International Journal of Quality & Reliability Management*, Vol. 24 Iss: 3, pp. 294 – 311

Jirasukprasert, P. (et al.) (2014) "A Six Sigma and DMAIC Application for the Reduction of Defects in a Rubber Gloves Manufacturing Process". *International Journal of Lean Six Sigma*, Vol. 5 Iss: 1, pp. 2 - 21

Johannsen, F. & Leist, S. (2009) "A Six Sigma Approach for Integrated Solutions". *Managing Service Quality: An International Journal*, Vol. 19 Iss: 5, pp. 558 - 580

Kenyon, G. (et al.) (2016) "Development of the Yield-Based Process Capability Index, Cpy, to Flexibly and Accurately Measure Conformance". *International Journal of Quality & Reliability Management*, Vol. 33 Iss: 7, pp. 882 – 899

Kumar, U. (et al.) (2009) "Six Sigma Project Selection Using Data Envelopment Analysis". *TQM Magazine*, Vol. 19 Iss: 5, pp. 419 - 441

Kusnadi, A. & Yudoko, G. (2016) "Enhancement of Sigma Level in the Manufacturing of Furnace Nozzle through DMAIC Approach of Six Sigma: A case study". *South East Asian Journal of Management*, Vol. 10 Iss: 1, pp. 1-29. Database: Business Source Complete

Laux, C. (et al.) (2015) "Project Barriers to Green Belts through Critical Success Factors". *International Journal of Lean Six Sigma*, Vol. 6 Iss: 2, pp. 138 – 160

Lanyon, S. (2003) "At Raytheon Six Sigma Works, Too, to Improve HR Management Processes". *Journal of Organizational Excellence* 22(4), pp. 29–42.

Laureani, A. (et al.) (2013) "Applications of Lean Six Sigma in an Irish Hospital". *Leadership in Health Services*, Vol. 26 Iss: 4, pp. 322 – 337

McAdam, R. (et al.) (2009) "Customer-Orientated Six Sigma in Call Centre Performance Measurement". *International Journal of Quality & Reliability Management*, Vol. 26 Iss: 6, pp. 516 – 545

Mehrjerdi, Y. (2011) "Six Sigma: Methodology, tools and its future". *Assembly Automation*, Vol. 31 Iss: 1, pp. 79 - 88

Mishra, P. & Sharma, R. (2014) "A Hybrid Framework Based on SIPOC and Six Sigma DMAIC for Improving Process Dimensions in Supply Chain Network". *International Journal of Quality & Reliability Management*, Vol. 31 Iss: 5, pp. 522 - 546

Nakhai, B. & Neves, J. (2009) "The Challenges of Six Sigma in Improving Service Quality". *International Journal of Quality & Reliability Management*, Vol. 26 Iss: 7, pp. 663 - 684

Narasimhan, K. (2005) "The Six Sigma Black Belt Handbook Results". *The TQM Magazine*, Vol. 19 Iss: 5, pp. 520 - 521

Pinedo-Cuenca, R. (2012) "Linking Six Sigma's Critical Success/Hindering Factors and Organizational Change (Development): A framework and a pilot study". *International Journal of Lean Six Sigma*, Vol. 3 Iss: 4, pp. 284 – 298

Prashar, A. (2016) "A Conceptual Hybrid Framework for Industrial Process Improvement: Integrating Taguchi methods, Shainin System and Six Sigma". *Production Planning & Control*. Vol. 27 Iss: 16, pp. 1389-1404. DOI: 10.1080/09537287.2016.1225999. Database: Business Source Complete

Prashar, A. (2014) "Adoption of Six Sigma DMAIC to Reduce Cost of Poor Quality". *International Journal of Productivity and Performance Management*, Vol. 63 Iss: 1, pp. 103 - 126

Ray, S. & Das, P. (2010) "Six Sigma Project Selection Methodology". *International Journal of Lean Six Sigma*, Vol. 1 Iss: 4, pp. 293 – 309

Setijono, D. & Dahlgaard, J. (2007) "The Added-Value Metric - A complementary performance measure for Six Sigma and lean production". *Asian Journal on Quality*, Vol. 8 Iss: 1, pp. 1 - 14

Setijono, D. (2008) "DisPMO and DePMO as Six Sigma-Based Forward-Looking Quality Performance Measures". *The TQM Journal*, Vol. 20 Iss: 6, pp. 588 - 598

Siddiqui, S. (et al.) (2016) "Six Sigma in Construction: A review of critical success factors". *International Journal of Lean Six Sigma*, Vol. 7 Iss: 2, p. 171

Southard, P. (et al.) "RFID in Healthcare: A Six Sigma DMAIC and simulation case study". *International Journal of Health Care Quality Assurance*, Vol. 25 Iss: 4, pp. 291 - 321

Srinivasan, K. (et al.) (2016) "Enhancement of Sigma Level in the Manufacturing of Furnace Nozzle through DMAIC Approach of Six Sigma: A case study". *Production Planning & Control*, Vol. 27 Iss: 10, pp. 810-822

Tjahjono, B. (et al.) (2010) "Six Sigma: A literature review". *International Journal of Lean Six Sigma*, Vol. 1 Iss: 3, pp. 216 - 233

Wang, F. (et al.) (2014) "Applying a Hybrid MCDM Model for Six Sigma Project Selection". *Mathematical Problems in Engineering*, pp. 1-13

Wheat, B. (et al.) (2003) *Leaning into Six Sigma: A parable of the journey to Six Sigma and a lean enterprise*. McGraw-Hill, New York, NY.

Wu, C. & Lin, C. (2009) "Case Study of Knowledge Creation Facilitated by Six Sigma". *International Journal of Quality & Reliability Management*, Vol. 26 Iss: 9, pp. 911 – 932

Yadaf, Y. & Desai, T. (2016) "Lean Six Sigma: A categorized review of the literature". *International Journal of Lean Six Sigma*, Vol. 7 Iss: 1, pp. 2 – 24