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Six sigma approach for identification of factors contributing to teaching learning process in higher educational institutions

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ABSTRACT: *The purpose of this paper is to discuss how the Six Sigma approach can be applied to analyse and identify factors contributing to teaching learning process of higher educational institutions. The teaching learning process in higher educational institutions is affected by student's performance, faculty performance and management involvement. In Six Sigma approach, employees should work collectively for achieving the required level of process capability. Six Sigma is a successful business model in industries. The attractiveness of Six Sigma in service organisations is growing in a tremendous rate especially in sectors like banking institutions, hospitals and other utility services. The measurement of complex service sector systems like HEIs is possible with six sigma .The application of six sigma tools and techniques could successfully improve quality of courses by identifying the root causes and major barriers.*

Key words: *Higher Educational Institutions, Six Sigma, DMAIC.*

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I. INTRODUCTION

Six Sigma originated at Motorola in early 1980s is a focused and highly effective implementation of proven quality principles and techniques. Six Sigma takes a handful of proven methods and trains a small cadre of in –house technical leaders, known as Six Sigma Black Belts .Statistical tools are applied within a simple performance improvement model known as Six sigma DMAIC or Define-Measure-Analyse-Improve-Control(Pyzdek,2003) .In Six Sigma methodology, employees are given martial arts titles like master black belts, black belts, green belts etc. These professional should work collectively for achieving the required level of Six Sigma. Six Sigma was popularised as a successful business model in industries. For ensuring customer focus and for obtaining continuous improvement in processes, the Six Sigma approach has been successfully implemented by various organizations throughout the world (Erdogan and Canatan, 2015). The quality of standards in educational services sector can be improved by taking six sigma approaches from industries to academic activities. Understanding of the key features, barriers, elements of Six Sigma methods will create appropriate opportunities for the successful implementation of Six Sigma projects (Mehrabi, 2012).

The quality of engineering graduates is a serious concern in the higher education sector. Now days the technical educational services sectors are highly affected and impacted by fastest increase in the number of educational institutions. Due to this engineering colleges are facing serious competition for their existence .The major problems those are being faced by these service sectors are poor academic performance and unemployability of graduates. Due to this stakeholders like parents and students are seeking the quality of the technical educational institutions for admissions and some employers are blacklisting the non accredited technical educational institutions for recruitment purpose.

II. LITERATURE REVIEW

2.1 ENGINEERING EDUCATION AND ITS GROWTH IN INDIA

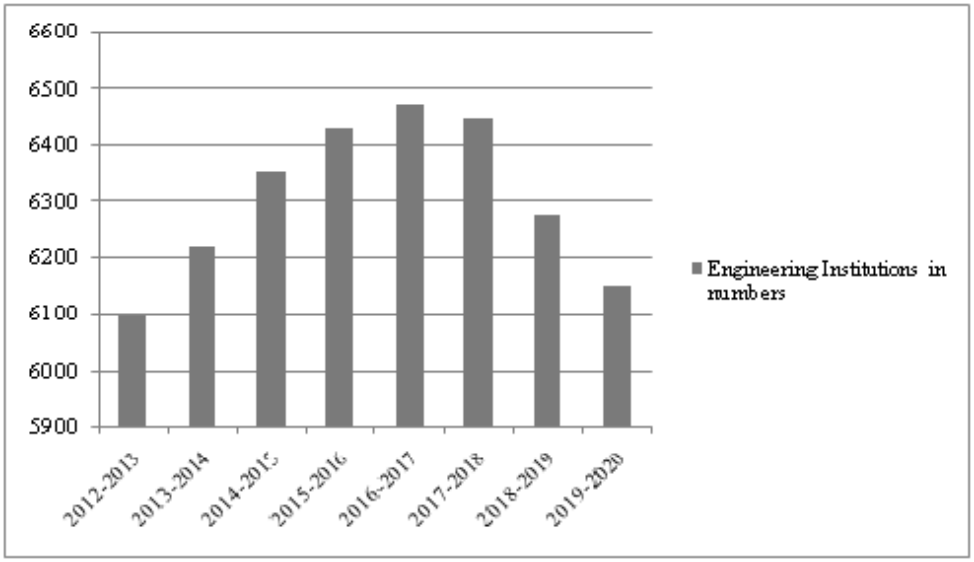
In India, the formal technical education started in the mid 19th century. Before the independence, the major policy initiatives commenced with the appointment of the Indian Universities commission in 1902.Later came the issue of the Indian Education policy resolution in 1904.1n 1913,the Governor General's policy statement came with stressing the importance of technical education. There were only a few technical educations during that period and its growth rate was really slow. The premier technical educational institutions established during this initial stage were Indian Institute of Science in Bangalore, Institute for Sugar, Textile and Leather Technology in Kanpur, N.C.E. in Bengal and industrial schools in several provinces. In 1943, a regulatory board on technical education was constituted under Central Advisory Board of Education (CABE) and in 1945 present regulatory board was constituted with the name All India Council for Technical Education.

In recent years, the engineering educational services sector has grown at a tremendous rate due to the sanctioning of large number of self financing engineering colleges in the country. In 2006-2007 period, there were only 1511 Engineering and Technology institutions with an intake of 550986. Presently there are 6151 Engineering educational institutions in India with an intake of 2539063.Which includes fifteen centrally funded Indian Institute of Sciences(IISc), Indian Institute of Technology(IIT),8 Indian Institute of Information Technology(IIIT), 8 Indian Institute of Managements (IIM),20 National Institute of Technology(NIT's) to promote technical ,science and management education in the country. In addition to this, other categories of institutions are state government technical educational institutions, state government aided institutions, and state government controlled institutions and fully private self financing institutions.(AICTE,2019)

Table 1: Engineering institutions in numbers from 2012 to 2019

Year	Engineering Institution in numbers
2012-2013	6099
2013-2014	6218
2014-2015	6355
2015-2016	6431
2016-2017	6474
2017-2018	6446
2018-2019	6276
2019-2020	6151

Source: AICTE, 2020



Source: AICTE, 2020

Figure 1: Engineering institutions in numbers from 2012 to 2019

2.2 ENGINEERING EDUCATION AND EMPLOYABILITY

In India, as per the latest National Employability Report published by Aspiring minds (2019), the employability of Indian engineers continues to be painfully low with more than 80% engineer's unemployable for any job in the knowledge economy. It also states that the employability of Indian engineers has not changed on aggregate level since 2010.Only 3.84% of engineers are employable in software related jobs at start-ups. It also reveals that only 3% of engineers possess new age skills in areas such as AI, Machine learning, Data engineering and mobile technologies. The employability in this area found to be 1.5-1.7%.A systemic long term policy interventions in the next 5to 10 years in higher education sector is urgently needed to tackle the low rate of engineering employability.

As per the perspective plans of a various states submitted to All India Council for Technical Education (2018) regarding their policies, it was stated that, the liberalisation of engineering education has resulted in poor quality of graduates and resulted in low employability of outgoing graduates in institutions. The studies show that over 80 percent of engineering graduates in the country are not deemed as employable. It is also reported that the majority of engineering graduates are seeking employment that are not related to engineering and having only lower prospects.

Industry readiness of the graduates coming out of the engineering colleges must be improved to improve the employability. Employability of the engineering graduates can be improved by applying the six

sigma tools and techniques .Next generation engineering skills such as Artificial Intelligence, Data engineering and data sciences and Internet of Things (IOT) must be taught and practiced in class rooms for making the institution industry 4.0 ready and for meeting other challenges of 21st century industrial sector

2.3 SIX SIGMA IN EDUCATIONAL SERVICE SECTOR

As per the experiences around the world regarding the Six Sigma implementation in higher education, the utilization of Six Sigma methodology in educational services sector can produce great results by the constitution of a Six Sigma program implementation team. Internationally, Universities are attempting to improve the efficiency of their administrative procedures or the overall quality of student education by applying Six Sigma methods.

According to Ramasubramanian.P (2012) the six sigma is the best strategy for quality education system for the quality improvement. Many institutions and universities are throughout the world are preparing for marketing their educational products and services. The six sigma methodology can be applied in multiple activities of teaching such as course plan design, curriculum development, and learning objectives of individual courses, classroom instruction, laboratory exercises and student learning assessment. In order to apply Six Sigma in educational services sector it is essential to form a Six Sigma program team with clearly defining the routine functions and responsibilities of the team members. The deployment of Six Sigma involves Team Members(TM), Green Belts (GB), Black Belts (BB), Master Black Belts (MBB) and Champions. For a technical Institute, the Principal of the institute can be designated as the champion of Six Sigma team. The champion has to promote and direct activities for the overall development of the institute. The champion will approve all Six Sigma projects. Head of Departments, Placement officers can act as the Process Owner. A senior professor with sufficient knowledge in Six Sigma tools and techniques can be designated as Master Black Belts to train all the stake holders. They act as internal coaches to Black Belts to achieve the project goals. Senior faculty members can be trained as Black Belts and other faculty as Green Belts to support Black Belts .Black belts are real change agents in Six Sigma team as they turn Six Sigma vision into reality. The black belts should provide leadership and create a vision. The fresh faculties and senior students can be designated as Team Members to support specific projects.

Gokhan Sontay,Orhan Karamustafafaoglu (2017) have reported that the six sigma DMAIC methodology can be utilized in teaching to solve problems that students experience during the course.

Majid, S and Elmira, Z. (2015) have stated the role of six sigma in improving the quality of higher educational institutions. To be successful in universities and colleges, six sigma and other improvement initiatives should be aligned with accreditation efforts and institutional effectiveness departments which are responsible for data analysis and report submissions. A genuine quality culture supported by well functioning quality assurance processes should be developed for the success of higher educational services sector,

Pavel Adina –Petruta and Sarbu Roxana. (2014) have stated integration of six sigma and quality management systems like ISO can play important role in the development and success of higher educational institution. Higher educational institutions must consider six sigma as a success strategy in maintaining academic quality at high standards.

Amrutha Kulkami and Jamison.V.Kavach (2016) have demonstrated with a case study that the application of the DMAIC methodology within an academic environment can reduce time for scheduling a room for special events, meeting and other academic functions. In define phase, problem statement and mission statement are done to describe the projects purpose and goal in detail. In Measure phase, SIPOC diagram and flow diagram are used. In Analyse phase, Cause and effect diagram are used to analyse the causes.

Narayanamoorthy.S (2013) has described that, for achieving Six Sigma quality in organizations, each category must be trained based on their requirements. Training must be given in some of the topics like basic concept of Six Sigma, Six Sigma tools and techniques, motivational procedures, project identification tools etc. Six Sigma methodologies can be applied in activities like design of course plan, development of curriculum, learning objectives of individual courses, class room instruction, laboratory exercises and student learning assessment for the establishment of a good quality culture in institutions. Each activity can be treated as a Six Sigma project for improvement. Two major activities to be improved in technical educational sector are improvement of passing rate of students and employability of students. The academic excellence can be achieved by reducing the defects or failure in subject by ensuring first attempt pass by the application of six sigma in educational services sector. Six Sigma reduces variations by improving class average marks. Six can reduce student's absenteeism by ensuring proper academic discipline

Virender Narula and Sandeep Grover(,2015) have identified the key factors for successful implementation of Six Sigma in service organizations as strong leadership and management commitment, organizational cultural change, selection of six sigma team members and teamwork, Six Sigma training

Nadeau (2017) has described the major challenges that are faced by the educational services sector in recent years as improvement of pass percentage and employability of graduates. Successful deployment of Six

Sigma in educational services sector can enhance the academic performance of students as well as employability of graduates. In educational services sector, Six Sigma can be utilized as organizational change agent and motivational tool, thereby improving the quality of services.

Kaushik and Khanduja (2010) has described that the Six Sigma project implementation in educational services sector depends on the factors like top management commitment, education and training to understand tools and techniques of Six Sigma, the ability of management to overcome resistance of employees against Six Sigma implementation to change the culture. The management as well as senior faculties must have confidence in Six Sigma for the successful implementation of Six Sigma in educational services sector

III.METHODOLOGY AND DATA ANALYSIS

The primary objective of the paper is to identify the factors that can either directly or indirectly affects the performance of technical educational institution based on the analysis of performances of stakeholders like students, faculties and management of engineering educational institutions.The Define phase of Six Sigma DMAIC is habitually omitted but it is vital to overall success of any Six Sigma project. Define phase can be used to determine the area of improvement in any technical educational institution. A clear project definition is vital to the success of Six Sigma project implementation. The common deliverables for this phase are: 1) the team formation,2) the preliminary Process map, 3) the Voice of customer (VOC) and 4) the project charter. The measure phase is to measure the data and understand the existing problems if any and for finding the solutions for the same (M.Arafez,2016).In order to observe the factors that affect performance of engineering educational institution , the paper is going to identify and analyse the factors that can directly or indirectly affect the performances technical educational institutions. The major stakeholders of technical educational institutions are students, parents, faculty and other staff, administration, employers, alumni, AICTE, University and other sponsoring agencies.

Students Performance: The major factors affecting student's performance in technical educational institutions are performance in external and internal examinations, attendance and participation in teaching learning process, submission of mandatory assignments as per curriculum, ability of student and attitude towards the teaching and learning process.

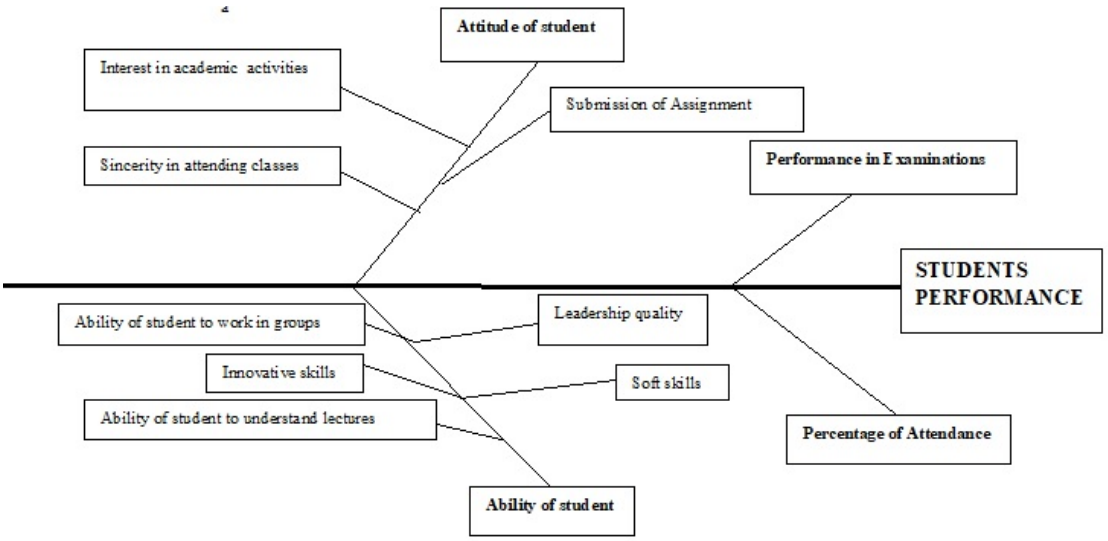


Figure 2: Ishikawa diagram –Students Performance

The ability of student is affected by knowledge in subject and soft skills and leadership. Attitude of students depends on various factors like self motivation, involvement and dedication and interest in studies. Figure 2 shows the Ishikawa diagram of performance of students

Faculty Performance: Faculty performance in engineering educational institutions are affected by skills earned like soft skills, presentation and use of teaching aids and subject delivery.

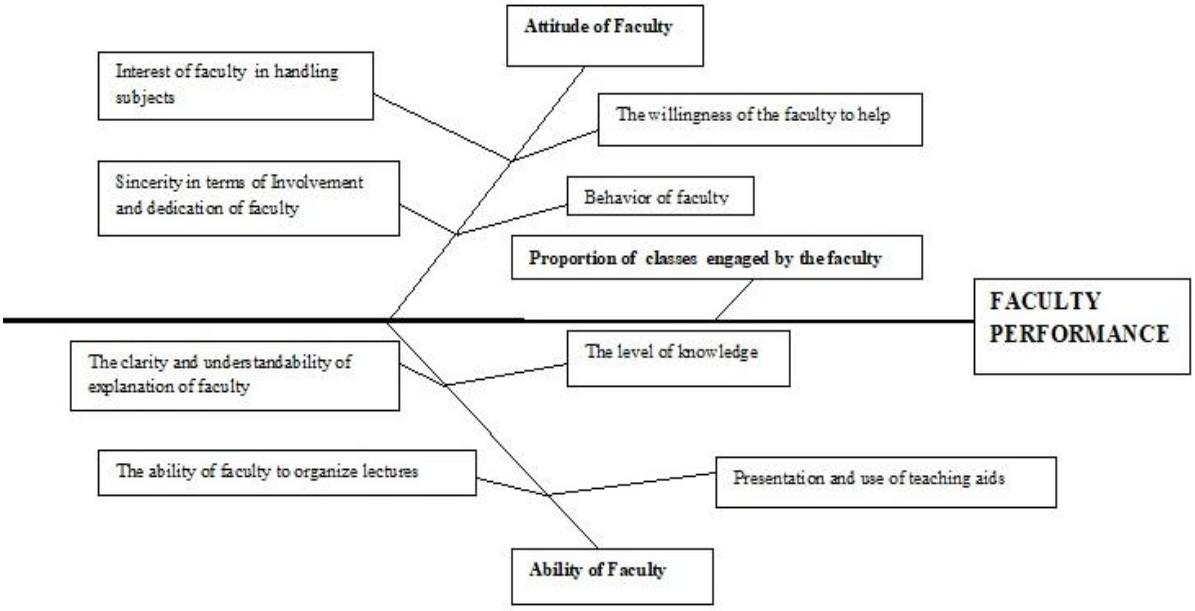


Figure 3: Ishikawa diagram –Faculty Performance

Ability of faculty depends on the capacity to learn, management of courses, Attitude of faculty depends on various factors like self motivation, involvement and dedication and interest in handling studies. Figure 3 shows the Ishikawa diagram of faculty performance.

Management Involvement: Management involvement is affected by factors like management of human resources, maintenance and management of assets, Attitude of management is affected by interest shown by the firm in infrastructural development, motivation of employees and students. The ability of the management depends the capacity to invest and availability of funds for future development. Figure 4 shows the ishikawa diagram for Management involvement.

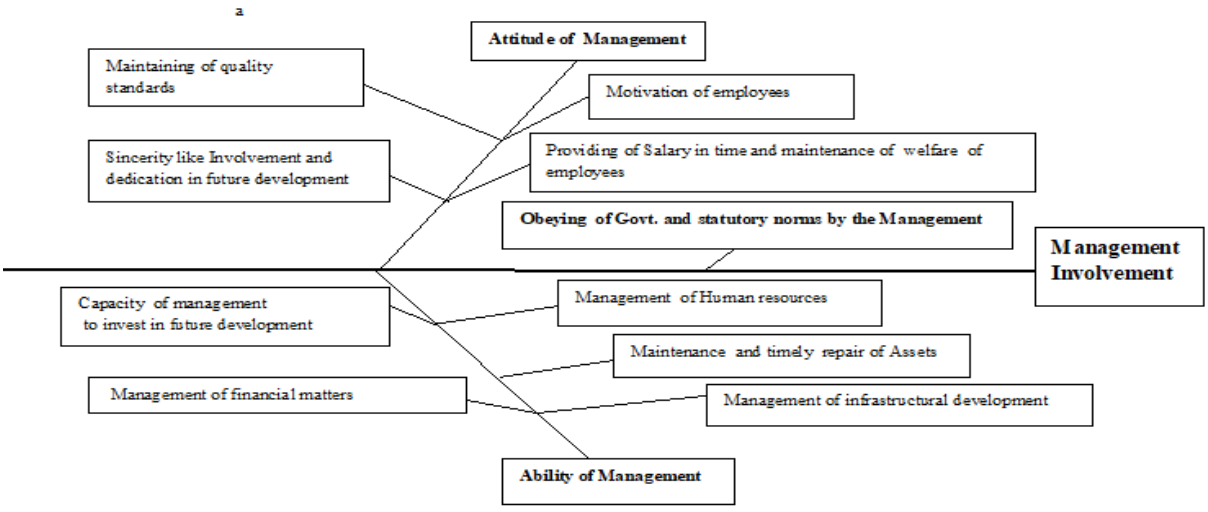


Figure 4: Ishikawa diagram –Management Involvement

In order to measure the perceptions of major stakeholders of engineering educational institutes,three different sets of questionnaire are to be designed to study the perceptions of management, faculties and students. The result of survey will indicate current status of the institution and the scope for improvement. The student performance is to be evaluated by the faculty handling the classes. The faculty performance is to be evaluated by

students attending the classes and the management functions are to be evaluated by stakeholders such as faculty, students and parents.

IV. CONCLUSIONS

The paper has identified the factors that can either directly or indirectly affect the performances of major stakeholders like students, faculties and management of technical educational institutions. The paper reveals and identifies the factors and the areas to be focussed for the successful implementation of Six Sigma in higher educational institutions. The methodology could help improving the quality of teaching learning process by reducing the existing problems and identifying root causes that affect the quality of higher educational institutions. The paper also concludes that student's performance, faculty performance and management involvement are the major factors contributing to performance of higher educational institutions. Hence management must be more committed and ensure their involvement in the institution for the successful implementation of six sigma DMAIC.

REFERENCES

[1]. AICTE. (n.d). Retrieved from https://www.aicte-india.org/sites/default/files/PERSPECTIVE%20PLAN%20FOR%20SETTING%20UP%20NEW%20ENGINEERING%20INSTITUTIONS_28012018.pdf

[2]. Aminudin Omar and Zainol Mustafa (2014) "Implementation of six sigma in service industry',*JQMA*10(2);77-86

[3]. Amrutha Kulkami and Jamison.V.Kavach(2016).Improving Room scheduling for special events in academic environments-A lean six sigma case study. *Quality Approaches in Education ASQ Education Division.*7(2),22-29

[4]. Anderson R.,Erricson H.,and Torstensson.H(2006).Similarities and differences between TQM,Six sigma and Lean,*TQM magazine.*18(3),282-296

[5]. Antony, J. (2004) 'Some pros and cons of Six Sigma: an academic perspective', *The TQM Magazine,* Vol. 6, No. 4, 303–306pp

[6]. Arafeth, M. (2016).Leveraging six sigma tools and methodology to improve student English language performance at elementary school. *American Journal of Operations Research.6.*261-274. Retrieved from http://dx.doi.org/10.4236/ajor.2016.64026

[7]. Erdogan, A. &Canatan, H. (2015).*Literature search consisting of the areas of six sigma's usage.* Proceedings of the World conference on Technology, Innovation and Entrepreneurship (pp.695-704).Turkey.doi.10.1016/j.sbspro.2015.06.160

[8]. Gokhan Sontay, Orhan Karamustafafaoglu (2017). Anew method for the science teaching: 6-sigma method. *Journal of Education and Practice* 8(32) ,13-19

[9]. Kaushik, P., &Khanduja, D. (2010).Utilising six sigma for improving pass percentage of students. A technical Institute case study. *Educational Research and Review, 5*(9), 471-483.

[10]. Majid, S., & Elmira, Z. (2015).The role of six sigma in improving the quality of higher education institutions. *The SIJ Transactions on Industrial, Financial Business Management (IFBM),* 3(6), 93-98.

[11]. Mehrabi, J. (2012).*Application of six-sigma in educational quality management*. Proceedings of CY-ICER2012(p.p.1358-1362).Iran.doi: 10.1016/j.sbspro.2012.06.826

[12]. Nadeau, S. (2017).Lean, six sigma and lean six sigma. In higher education: A review of experiences around the world. *American Journal of Industrial and Business Management,* 7,59-60.doi:10.4236/ajibm.2017.75044

[13]. Narayanamoorthi, S. (2013).*Investigations on the implementation of six sigma concept in Indian engineering colleges*. (Doctoral dissertation, the faculty of Mechanical Engineering, Anna University, Chennai, India).Retrieved from https://www. shodhganga.inflibnet.ac.in/ handle/10603/17392.

[14]. National Employability Annual report (2016) DOI:www..aspirigminds.com

[15]. Pavel Adina-Petruta,Sarbu Roxana.(2014).Integrating six sigma with quality management systems for the development and continuous improvement of higher education institutions Science Direct Procedia –social and behavioral sciences, 143,643-648

[16]. Pyzdek, T. (2003).*The six sigma handbook* (rev.ed.).McGraw-Hill.

[17]. Ramasubramanian, P. (2012).Six Sigma in educational institutions. *International Journal of Engineering Practical Research, 1*(1), 1-15.

[18]. Virender Narula,Sandeep Grover (2015).Six Sigma :Literature Review and Implications for Future Research. *International Journal of Industrial Engineering &Production Research,* 26(1), 13-26

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