Application of 'Six Sigma' in Libraries for Enhancing Service Quality

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ABSTRACT

Quality in library service has become an important aspect of today's most competitive time. Quality has been considered an important part of any service process as well as manufacturing process. It is only quality that decides the status and future growth of an institution. Quality, though, important in any process, but in libraries it is drawing attention of management, users and staff altogether because of the pressure of growing technologies, expectation of users, high maintenance costs, increasing information resources cost, and reducing budget. This paper deals with six sigma and its application in libraries. Six sigma is a method of reducing errors and improving quality. This method was developed three decades ago for manufacturing process, but now it is being implemented in service industry too and library is not an exception. This process aims to understand strategies of six sigma and its applications in libraries. This paper also covers some case studies to understand the effect of six sigma more closely.

Keywords: Six Sigma in libraries, Total Quality Management, TQM, Quality in Service.

INTRODUCTION

Global information society improves quality of life, but puts a lot of pressure on manufacturing and service organisations to cut costs, improve quality, reduce process time and floor space. Libraries are not exempted from this. Libraries are organism that has played a very important role in development of information society. With the development of information Society, the libraries have also gone through a transformation. Today's libraries are much like a service industry where user satisfaction is supreme. In management of libraries and information centres majority of the concepts and theories of are adapted from business and human resource management studies. Moreover, these days the concept of Quality Improvement is also attracting library professionals. Many industrial, research and academic libraries are looking for established and approved quality symbols, i.e. ISO, etc. For the purpose of getting accreditation from such body and to make user more satisfied new management strategies and techniques are required for the libraries. To improve the quality of library services, this paper insist to implement “Six Sigma” in libraries and information centres. Use of Six Sigma in library will help in improvement of library, maximising user's satisfaction, cut the costs involved in any library service and reduce the defect in any library service.

ORIGIN AND DEFINITION OF SIX SIGMA

'Six Sigma' is a rigorous concept made of two words, i.e. ‘Six' and 'Sigma'. Sigma (σ) is a Greek letter used in statistics and mathematics to define standard deviation. The Sigma scale of measurement shows defects per unit or probability of a failure (Kaushik et al, 2007). Six is the number of sigma measured in a process. 'Six Sigma' is highest in measurement scale and can be achieved only when the output to defect is not more than 3.4 out of one million opportunities of defect.

Six sigma was originated in 1980s at Motorola as a methodology of implementing TQM. The credit of inventing six sigma is to Bill Smith, an engineer at Motorola. Later Motorola established Motorola University with the programmes like black belt, yellow belt to train the people in six sigma methodology. Today these programmes are running worldwide through various organisations.

Six Sigma Academy (Ramasamy, 2009) defines it as “a business process that allows organisations to drastically improve their bottom line by designing and monitoring every day business activities in ways that minimize waste and resources while increasing customer satisfaction".
Antony (2004) defines it as “a strategy that seeks to improve the quality of processes through identifying and removing the causes of defects by focusing on outputs that are critical to customers”. Thus, in one way six sigma refers to a measure of process consistency and aims at achieving the same.

**ADVANTAGES OF SIX SIGMA**

- Six sigma strategies focus on client satisfaction.
- Reduces process cycle time, thus reduces costs.
- Achieve accuracy in process by reducing defects.
- Helps to work smart rather than work hard.
- Provides better decision making capacity.
- Provides better understanding of processes.

**IMPLEMENTATION OF SIX SIGMA**

An organisation has to pass through six phases before getting ready for implementation of six sigma in the organisation. Phases one to four are for establishment of six sigma, and phases five and six are for realisation of six sigma. The following model explains six sigma implementation phases.

1. Establishing management commitment
2. Information gathering
3. Training
4. Developing monitoring systems
5. Process to be improved are chosen
6. Conducting six sigma projects

![Figure 1. Six Sigma Implementation Model (Sharma, 2004)](image)

The first phase is establishment of commitment within management and library staff towards implementation of six sigma. This requires training to the senior library staff about principles and tools of six sigma and development of management infrastructure to support six sigma.

The second phase deals with information gathering. This could be realised through communication with users, vendors and library staff. For example, information on acquisition and issue is obtained from users and suppliers. Analysis of the information helps identify blockages in these processes.

Training of the library staff brings the third phase of six sigma. Training from the librarian to the library clerk is required. Black belt and Green belt are levels of training. Black Belt training is meant for top management and Green Belt for team members engaged in the project. Opting help of six sigma experts is also an option.

Next or fourth phase of six sigma implementation is to develop a monitoring system. First three phases build up a framework of the management and development of monitoring system completes fourth phase. Adequate measures should be created for strategic goals and key processes. Measures can be internal or external, e.g., user satisfaction survey, balance score card, etc.

The application of six sigma starts from phase five where library processes to be improved are elected. Current processes are mapped and problems within these identified followed by setting up six sigma project. One six sigma project concept is DMAIC where the problems of the process that need improvement are first defined and then the goals that should be achieved during the project are determined (Sharma, 2004). Establish valid and reliable measures and carry out a research. Analyze the findings and define the gap between “as-is” and “should-be”.

After analysis, the system starts to create new ways of doing things. Improve the processes and validate them with statistical methods. A proper documentation is also required.

**SIX SIGMA PROCESS MODELS**

As a disciplined process, six sigma provides two standard process models, i.e. DMAIC (Define, Measure, Analyse, Improve, and Control) and DMADV (Define, Measure, Analyse, Design, and Verify).

**DMAIC**

The first six sigma method is DMAIC. It has a 5 process improvement model as explained following.

- **Step 1: Define**- DMAIC first asks librarian to define the core process. It is important to define the selected project scope, expectations, resources and timelines. Feedback of users and vendors called Critical to Quality (CTQ) to the product or service, are the key measurable characteristics to define the project and set a target. Everything at this step requires documenting, i.e. existing process, CTQs, set objective, etc.

- **Step 2: Measure**- This step is “where to where” step. The project leader at this step requires to quantify and benchmarking using the data available. The leader also need to measure current performance level and identify the defect level by matching with the targeted performance level. Once the defects have been measured, the six sigma level for the process may be calculated and used as a baseline to compare against improved process.

- **Step 3: Analyse**- Once the defects have been and all critical data collected, it is time to investigate what is causing the problems. For this project leader, i.e. requires to develop a hypotheses about the causes of problem followed by analysis of data with statistical or non statistical methods. On the basis of analysis hypotheses is approved or disapproved. If it is correct add it to list of causes, if not, refine it.

- **Step 4: Improve**- This is the phase of improvement. In this phase team improves key factors confirmed in the proceeding Analysis process and follow a method to improve realistic problems to be ultimately resolved. It is the phase to explore the method to fix, modify, and change the process. Pilot plans can be used before final application to the process. If result found unsatisfactory, additional plans can be carried out.

- **Step 5: Control**- This stage helps you review and update the process. This keeps control on all steps discussed above. In this
phase project leader must determine the effectiveness of process after implementation of the plan. This step proves the saying “prevention is better than cure”. In this phase controlling the system and policies prevent the repetition of the problems. Controlling teaches us to how to tackle the threat and the danger in the future.

**DMADV**

DMADV, on the contrary of DMAIC, is applied to for the design of new products, which aims to achieving 6 $\sigma$ quality. This methodology is as following.

Step 1: Define- This phase is similar to DMAIC.

Step 2: Measure- During this phase, measurement is done using Quality Function Deployment or House of Quality. Quality of House enable the six sigma team to convert the voice of the users to a prioritized requirement, While Quality Function Deployment helps in identifying measures for each requirement. Here, defining expected performance standards of the process is also necessary.

Step 3: Analyze- This phase leads six sigma team to design the concept or the top level design for the new project. The team should generate various design options and the right one can be selected after evaluation through a brainstorming session.

Step 4: Detailed Design- In this step the detail design of the process is carried out. Detailed design includes identifying micro details and process to carry out the design. The six sigma team will evaluate available option before finalising an appropriate process. Lastly it is integrated to the system. In this step pilot plans can be carried out.

Step 5: Verify- Verification is the last step of DMADV. The functionality of the process needs to verify. All the processes required to be documented and process can be transferred to regular process.

Thus DMADV is aimed at development of a new product or process, while DMAIC is for improvement of existing process or product. Thus, appropriate strategy to be chosen by the six sigma team.

**LEVELS IN SIX SIGMA**

As discussed earlier sigma is symbol and six is scale of measurement. A process may have one sigma, two sigma till six sigma where six sigma denotes higher quality of product or service.

The full six sigma conversion table is as following.

<table>
<thead>
<tr>
<th>Sigma</th>
<th>Quality in %</th>
<th>Defects Per Million Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 Sigma</td>
<td>99.99999998</td>
<td>3.4</td>
</tr>
<tr>
<td>5 Sigma</td>
<td>99.999943</td>
<td>233</td>
</tr>
<tr>
<td>4 Sigma</td>
<td>99.9937</td>
<td>6210</td>
</tr>
<tr>
<td>3 Sigma</td>
<td>99.73</td>
<td>66807</td>
</tr>
<tr>
<td>2 Sigma</td>
<td>69.1</td>
<td>308537</td>
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<tr>
<td>1 Sigma</td>
<td>30.1</td>
<td>691462</td>
</tr>
</tbody>
</table>

**NEED OF SIX SIGMA IN LIBRARIES**

In the IT influenced environment, libraries are extremely under-pressure to justify their existence as well as their importance for the organisation. For this, libraries must satisfy user's need as well as meet their expectation. Moreover, libraries should constantly strive to provide quality services to users by cutting the costs.

Six sigma is a method for improving quality by reducing errors that result in quality service with reducing costs. Using six sigma libraries can improve their service to users by reducing defects and minimising cost involved in library services. This will satisfy users as well as the funding organisation.

**MEASURING SIGMA LEVEL OF A PROCESS**

The following is a small example of six sigma calculation for a process. We here take book issue as a process in a closed access library system. In general, book issue depends upon five to six steps that may affect the book issuing process i.e. cataloguing, stacking, electricity (automated library), condition of barcode, system error etc. Thus keeping in consideration we may calculate six sigma level of circulation process of a library.

The circulation of books as per the above description have five steps and suppose each part of this process has two chances to have defects, i.e. electricity failure may be from the electricity department or due to short circuit, or system error may be due to hardware or software, and so on.

- Thus Total defect opportunity is 5 x 2 = 10
- If 3 circulations out of 100 circulations are taking more time than expected or facing problem or can say are defective,
- Then defects per issue 3/100 = 0.03
- Defects Per Opportunity (DPO) = 3/ (10 x 100) = 0.003
- Defects Per Million Opportunities (DPMO) = 0.003 x 1000000 = 3000
- Thus the Sigma Level of this book issuing process is 4.25 $\sigma$

**CASE STUDIES ON SIX SIGMA IN LIBRARIES**

**Jayakar Library, University of Pune, India:** The study of six sigma implementation in Jayakar library of Pune University was done by Ujvala Sudhir Ulhe and S.K. Patil (2011). Six sigma at Pune University was implemented in 2007 and was applied in every section of library. In defect determination phase, they grouped the defects in three groups i.e. in context of quality, in context of management, and in context of other departments. After identification of defects or errors they choose to go for phase wise improvement and could rectify more than 25 defects out of 86 defects. Though they could not achieved the level of 3.4 DPM but improved a lot. The library
is still working on it and expects to achieve 3.4 level of six sigma for the library process more in near future.

**Sungkyunkwan University, Seoul, South Korea:** A detailed case study done by Dong-Sug Kim (2010) on advantages and disadvantages of Six Sigma implementation in Sungkyunkwan University. Sungkyunkwan University has applied 'six sigma' in every department of university and library of this university was one of them. Researcher collected data through interview and questionnaire and analysed it using qualitative as well as quantitative techniques. Researcher observed some positive opinion of six sigma implementation, i.e. making work method scientific, increasing process capacity, turning subjective knowledge into a formal format, etc. while the negative opinions include lack of time of participation, lack of interest in employees, poor standardization, and difficulty with defining work process. The researcher, on the basis of his research, concludes that there are many advantages of implementation of six sigma in a library, but at present it is too early to expect great results from it. There is a great need of organisational support and to change the mindset of the participant in six sigma. Moreover, a high-level of transiency is required for successful implementation of six sigma project.

**University of Arizona Library, Arizona, US:** In University of Arizona Library, Six sigma was implemented as a seven month project with the purpose to improve the Document Delivery Service (DDS) which includes ILL (Interlibrary loan), scanning, printing, and photocopying services. It is a case study of DMAIC implementation process over a period of seven months done by Jeanne F. Voyles, Linda Dols, and Ellen Knight (2009). To apply the plan library took the help of six sigma specialist from Raytheon Missile Systems that is a manufacturing company. During the application only they could identify the problems in the process of DDS. Implementation of six sigma resulted reduction of turnaround time for requested articles to 70%, appropriate staffing could be done to increase the output, etc. Researchers observed that “as more libraries utilize Six Sigma DMAIC and similar process improvement approaches, the result can only be positive for all current and future customers.” On the basis of their research they concluded six sigma as, “a data based analysis of current processes, identification of the gaps in service expectations and actually delivery of service, and a team approach to discovering and designing process improvements can ensure that the libraries “know what they are doing.”

**Newcastle University Library, Newcastle, UK:** This was another six sigma implementation at Newcastle University Library, UK with the purpose to improve the self-service at the library. Pre-implementation statistics shown that satisfaction rating for self-service were high, i.e. 89.6% among students and 72% among staff, but total rate of self-issue was quite lower, i.e. 35% of total circulation. Library had invested a great amount on self-circulation system and there was a need to justify this expenditure. Six sigma plan was implemented for a period of six months and observed results were; reduction of staff at circulation desk, moving the self-issue units to more appropriate location, encouraging self-issue by increasing the loan period for self-issue, allocation of more time in user training of self-issue system, maximum resources of the library made self-issuable, i.e. CD ROMs. Susan Kumi and John Morrow (2006) observed that six sigma suggested the defects in self-service at Newcastle University Library. The library benefited from six sigma not only in that it achieved its goal of increasing self-service percentage, but it also provided them with a strong method of addressing a problem accurately and speedily in a systematic way.

**CONCLUSION**

Six sigma was introduced for manufacturing process, but for more than two decades its implementation is also seen in service industries. Though, it is not applied in Indian libraries on a wide scale, it would not be justifiable to say that this process in not applicable in libraries. The past case studies show that it has a good applicability in libraries also and can produce good results. However, requirement of experts is a big necessity for the application of six sigma. The issue of six sigma training is also becoming negligible as more and more training institutions are starting worldwide.

**REFERENCES**