Service Excellence Library Project: Improving student and researcher access to teaching and learning resources

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Abstract

This paper describes a project aimed at making library book management processes more efficient in terms of time and staff resources. The ultimate aim was to improve access to a university library's teaching and learning resources for students and academics alike while maintaining the high levels of library service already established. The paper describes how the Lean Six Sigma approach to process improvement was applied at the main library of a major Australian research university, a large library of over two million items.

Advocates of the Lean Six Sigma approach to process reengineering have wondered whether it is applicable to the complex educational sector or whether it would be feasible to implement the approach in the sector. The success of this first completed Lean Six Sigma project at a major Australian research university shows that Lean Six Sigma approaches to process improvement can work in a university setting, leading to lasting improvements in efficiency. This paper describes the research used to measure and analyse the pre-existing process used for library returns and demonstrates how a 52% reduction in the number of individual process steps involved was achieved. This means that library books and journals are now returned to shelves, on average, point eight (0.8) of a day earlier than they previously were. With a book cycle of about ten days, from initial lending to final return to shelves, this roughly equates to an eight percent improvement in the availability of these teaching and learning resources.

It is interesting to speculate that to achieve the same eight percent increase in availability of resources through an acquisitions program would involve buying 160,000 extra copies of books and journal issues. At an average book cost of $30 each this would be a substantial total. A conclusion of this project is that applying a business oriented philosophy involving Lean Six Sigma techniques to a university is a viable and effective strategy to improve the pace and quality of efficiency improvements in such settings.

Introduction

A stated objective of the Australian research university concerned in the study is to increase its ranking in the Shanghai Jiao Tong index of the research ratings of universities around the world, from its current ranking of in the two hundreds (Healy, 2009) to a rating within the top 150 by 2012 (i.e. within three years). Making the learning and research resources of the library more accessible was seen as being helpful to this objective. A Service Excellence team was charged with assisting in the improvement of service delivery and support systems necessary to deliver these research aims. This involved looking at and analysing aspects of the university's management processes, including, as a small but important part of these

management processes, some of the management processes of its library staff. The aim of the project was to make processes more efficient in terms of time and manpower and thus facilitate access to resources for students and academics alike.

The library function of any university is an important aspect of teaching and learning as it is integral to both a student's education and a researcher's endeavours. Without a reference and resource centre much teaching and learning activity would not be possible. The ready availability of books and journals to users is a direct input into the overall success of student learning. The "business" of libraries is thus to act as resource facilitators, with a large emphasis on students and researchers borrowing, and externally removing books and journals and also perusing books and journals internally—i.e. without externally borrowing them. Despite the enormous shift to digital access, particularly for journals, the library concerned still regularly and frequently lends out more than one thousand books, periodicals and other learning materials per day.

A broad issue that the library faced was that books and journals within the library were perceived by its management as not being as readily available as customers (library users) sometimes wanted. A project was launched aimed at delivering improved availability to books and journals for students and academics and other users of the library.

Books and journals that had been returned after being borrowed from the library were not being put back on the correct shelves within an acceptable timeframe. Similarly, books and journals taken off shelves and read and perused within the library by library users, and then left internally around the library, were also not being returned to the correct shelves in a timely fashion. The time lapsed was defined as being from when a book or journal was brought back to the library, or was left on a table after use within the library, to when it was returned to its correct position on the shelves by the library staff.

The aim of the project was to improve efficiency within the University's library, to improve the productivity of staff and to minimise the amount of re-work involved in terms of the number of steps taken to complete the process of returning books. The aim was to significantly decrease the time lapsed between a book's return and its re-appearance on the shelves for renewed borrowing. Specifically this was defined as aiming to have 90% of all books and journals returned to the shelves in their correct position within 24 hours and to have 100% of all books and journals returned to the shelves in their correct position within 48 hours. This would improve the availability to books and journals for academics and students and facilitate their learning and research efforts.

The Lean Six Sigma Approach to Process Improvement

The Lean Six Sigma approach to process improvement combines the Lean approach to process management with the Six Sigma philosophy of reducing wasted effort and errors in processes (Bossert, 2003; Caulcutt, 2001).

Lean

Designing or modifying processes so that they are 'lean' processes (also called Lean Manufacturing) aims to optimise and continuously improve process flows so that waste is eliminated and efficiency is maximised (Comm & Mathaisel, 2005). This commonly involves reducing waste, including waste of worker movement, of making defective products or services, of overproduction, of transportation, and waste of processing (Raifsnider & Kurt, 2004). This is achieved by: analysing the steps of a process and working out which steps are

redundant or do not add value to the outcome; determining what resources are needed to support value added steps and to remove the steps which do not add value to a process, and then calculating whether the costs associated with removing those steps are less than the expected benefits (Raifsnider et al., 2004).

Six Sigma

Six Sigma is a structured, evidence based and disciplined approach to process re-engineering that seeks to identify and reduce causes of delays, errors and other defects in process outcomes (Jiju, 2004). Engineers at Motorola in the 1980s calculated that for Motorola at that time, the cost of improving defects was greater than the benefit gained by improving defects at the level of six standard deviations from the mean (sigma is the Greek letter denoting standard deviation). This gave the name, Six Sigma to this approach. Operating at a level of Six Sigma then, is literally operating at a defect rate of 3.4 errors per million opportunities.

This Six Sigma approach was adopted by other manufacturers and is characterised by a structured approach to examining a problem and resolving it as discussed below. It is commonly combined with a Lean approach and this is called Lean Six Sigma (Krause, 2009). In transactional services organisations, characterised by human production rather than mechanical production, it is recognised that levels actually at six sigma are probably impossible to reach and the emphasis is on the improvement of processes rather than on the level of sigma attained (Kumi & Morrow, 2006).

The Lean Six Sigma approach to process improvement is a structured methodology encompassing the elements of **D**efining the problem, and then the elements of **M**easuring what is currently happening, **A**nalysing what processes need to be improved, designing **I**mprovements and then implementing and **C**ontrolling those improvements. This is known as the **DMAIC** approach to project execution (Hilton, Balla, & Sohal, 2008). The approach has much in common with other business improvement methods.

Lean Six Sigma is thus defined as a business management strategy which focuses on improving processes and collaboration to maximise gains (Krause, 2009). The Six Sigma methodology has been successfully implemented in many organisations leading to reports of tremendous quality improvements in products manufactured and services delivered (Jenicke, Kumar, & Holmes, 2008).

Originally the Six Sigma method was applied to manufacturing processes where considerable benefits were realised at Motorola and General Electric and many other corporations where the aim was to design or to improve a process so that it does not produce more than 3.4 defects per million opportunities (Box, 2006). More recently service related businesses have started to use the approach (Pestorius, 2007). Using the approach has allowed services, businesses and providers like hospitals to make impressive improvements in operational quality and service excellence with equally impressive returns on investment (Craven, Clark, Cramer, Corwin, & Cooper, 2006). Leading corporate users of this approach go so far as to mention it in their annual reports saying that Six Sigma strategies have led to enormous benefits in productivity, quality improvement and profitability (Caulcutt, 2001).

The core assertions of this Lean Six Sigma methodology are that:

- all work occurs in a system of processes
- variation exists in those processes
- variation leads to problematic outcomes, such as wastage and errors which require corrective solutions to reduce them

- structured analysis of this variation leads to robust, high leverage solutions
- solutions should be traceable back to problems via the methodological analysis used
- the "voice of the customer" (what the customer has to say about the problems encountered) should carry significant weight when identifying issues
- process participants, when exposed to Six Sigma analysis, know best how to develop workable solutions
- the role of the Six Sigma project manager is facilitation and not subject matter knowledge.

Despite the great successes in using the approach in the manufacturing sector and its huge impact on industry, where it is seen as a proven approach to competitive advantage and performance excellence (Ho, 2006), universities have been slow to acknowledge or to utilise this approach (Jiju, 2004). Commentators on Lean approaches to university management suggest that much could be gained from this approach in terms of reduced waste, improved efficiency, increased resource utilisation and enhanced sustainability (Comm et al., 2005; Comm & Mathaisel, 2008). Nevertheless, research studies of Six Sigma approaches to education are reported to be few in number, perhaps because of the complexity of educational processes compared to manufacturing processes (Ho, 2006).

However, one or two universities have looked at it to solve isolated and specific issues such as improving library processes or designing a new dormitory (Johnson, Gitlow, Widener, & Popovich, 2006; Kumi et al., 2006). Suggestions have been made that universities should be using the approach to help them streamline the increasing administrative load that academics and managers face (Bandyopadhyay & Lichtman, 2007). This is a stated aim of the Australian university involved, which is thus probably leading the world in looking at improving its processes using Lean Six Sigma methods.

Research Undertaken: How various techniques taken from the toolbox of Lean Six Sigma were used in this project.

The Lean Six Sigma toolbox is just the range of potential research and analysis tools that are commonly used in Lean Six Sigma projects (Bodie, 2007). Relative to academic research, research carried out in Lean Six Sigma is very solution oriented rather than methodologically oriented. The method and analysis of the research is secondary to the ability to find potential answers to the problem being investigated. A number of small research projects are therefore typically involved in any one Lean Six Sigma project. In this library project five research projects were involved in the overall research programme as discussed below.

1. **Project Definition (The "Define" step mentioned above in the DMAIC methodology).**
   Defining the scope of the project is one of the first steps in any Lean Six Sigma project. In this project that was done using in-depth interviews with the managers involved in running the library. This stage makes explicit what the problem is and where the limits of the project are. This identified the speed of return of books to shelves as one of a number of potential problems to investigate further.

2. **In-depth interviews**
   Five in-depth interviews were conducted with senior library managers in order to explore the range of the perceived problems with current library practices and processes. The aim of this was to gain an initial and basic understanding of the problem and how the Lean Six Sigma approach could potentially help resolve those

problems. This piece of research confirmed that the speed of return of books to shelves was an issue with library services.

3. A Customer Survey

Customers were defined as users of the library services. A small survey of 32 users was carried out to determine what they reported as the main barriers to book availability and to determine other measures of customer satisfaction in their usage of the library. This piece of research confirmed that from a customer point of view, the speed of return of books to shelves was also an issue with library services. At this stage this issue was identified as the main service area to try and improve at the library.

4. Problem Measurement: Process Mapping (As-is process map)

A map of the current process was developed to show each of the steps in the current process. This is called an "as-is" process map because it displays the process as it is currently found, prior to any improvements being made.

This was achieved by walking through the process with a library staff member for a day as that person carried out their re-shelving duties. This was compared to a review of the same process at another university library and at a state run library which were undertaken to act as process benchmarks. This process mapping highlighted a number of redundant and unnecessary steps in the journey of the book back to its shelf.

Figure 1 shows where books were in the library system after 24 hours of being returned, before any process improvements were implemented, according to a sample survey carried out by one Six Sigma team member working alongside a library staff member for a day. Other surveys of similar data were collected by library staff themselves. Averaging results across the different surveys carried out found book return rates of 56%, on average, within 24 hours and 82% returned within 48 hours.

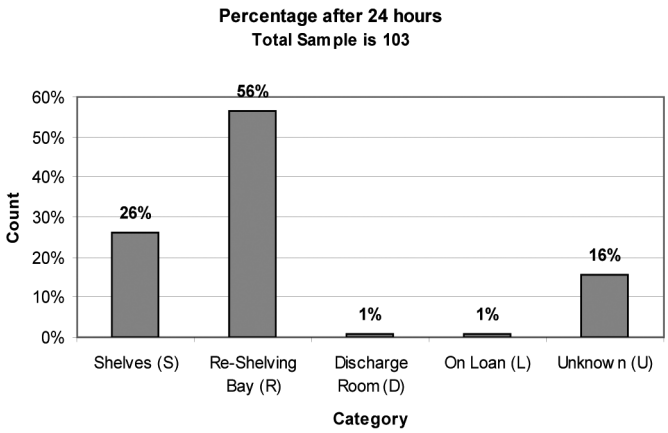

Figure 1: Where returned books were after 24 hours
(According to a sample survey carried out by one Six Sigma team member working alongside a library staff member for a day).

Table 1 shows the number of steps involved in the book return process before any process improvements were implemented. Touch points are simply the number of times that books are handled by library staff in the book's journey back to the shelves.

Pick ups and put downs are simply the number of times books were picked up and put down again in the existing re-shelving process. Sorting involves moving books into different piles by discipline, type or area of the library where the books were shelved. Moving involves physically moving the books. Scanning was the scanning of book bar-codes back into the library system after they had been returned. Waiting was the physical act of waiting for another event to end before resuming further work in re-shelving the book.

Table 1: Existing Process Steps before Process Improvement

Process Step	**Touch Points**
Pickup/Put Down Books	13
Sorting	4
Moving	5
Scanning	1
Waiting	6
TOTAL	29

5. **Analysis Phase: Jury of Expert Opinion**
Issues identified were taken to a jury of expert opinion for further clarification and analysis. A jury of expert opinion is a small group of people who are very knowledgeable about a particular issue or subject. In this case a group of library staff were recruited into a focus group discussion aimed at defining the problems associated with library services delivery and to brainstorm possible solutions. They firstly generated a wide range of possible causes of the problems the library faced and then refined these down to a narrower list of probable root causes of each problem. This jury was re-convened once as the discussion evolved and developed and individual interviews were also carried out as the project developed in order to clarify issues in an iterative fashion.

This stage of the research identified a number of ways in which the re-shelving of books could be streamlined, for example by eliminating some of the steps in the process such as sorting the books onto different tables before re-sorting them onto holding shelves and then taking them from the holding shelves onto trolleys for distribution throughout the library. Holding shelves were completely removed from the process.

After completing the five stages of research, a brainstorming session was then undertaken to identify possible solutions to the problems identified in the research. Brainstorming is a small-group method of generating multiple ideas for later refinement and analysis (Boddy, 2008). Further research in the form of focus groups (Boddy, 2005) was then used to refine and sort those ideas according to their perceived practicality and usefulness. In the case of this current research project, ideas generated from the earlier juries of expert opinion were subject to critical analysis and discussion after a brainstorming session in order to determine

which ideas were the most promising for implementation. These ideas were prioritised for implementation according to their perceived promise, ease of implementation and potential benefits to the library.

Analysis of Main Findings

The as-is process map together with the jury of expert opinion (the project team) found that there was a bottleneck of work for library staff every Monday which was probably caused by the practice of dispersing all brand new books throughout the library every Monday. Brainstorming suggested that this could be solved by changing the days for new book discharges. This change to the current process was implemented.

Another cause of the Monday backlog was the lack of any rostered re-shelving shifts on the weekend. These shifts had been dropped a few years previously due to budget constraints. Dedicated re-shelving shifts on Saturday and Sundays were restored and the rostered weekend re-shelving staff collected internally displaced items, re-shelved and also sorted and moved trolleys of discharged items. This meant that by the time of the first re-shelving shifts on Monday mornings there were library trolleys already loaded ready for re-shelving, i.e. it removed the Monday morning backlog of work, allowing a smoother flow of work throughout the rest of the week.

The flexibility and availability of casual staff was also identified as crucial to avoiding re-shelving backlogs. Casual shelf fillers were all university students who had reduced work availability during re-shelving peak periods such as the examination weeks. As new casual re-shelving staff were required a mix of non-university students with increased availability were recruited. This has provided greater flexibility to increase re-shelving hours at times of peak need and avoid backlogs at any stage over the year.

The library was using four chutes for book returns and returned books were then centralised on holding shelves prior to dispersal back to the library shelves. This involved several physical pick ups and put downs of the books which although only taking a few minutes for each book, involved a lot of unnecessary steps in the book return process and involved a great deal of time when multiplied by the very large number of books handled by the library on a daily basis.

The number of return chutes was cut back to one main chute with the addition of a single streamlined table to collect books from the chute receiver. Books are now sorted straight into trolleys for return to the library shelves and the holding shelves in the sorting area have been completely removed to dispense with this unnecessary step in the sorting process. This change now requires that one person attends the return chute at all times so that a backlog of books does not build up.

Another change made was that the re-shelving roster was amended to introduce more structured rostering with shifts spread throughout the day. Monitoring of workloads was increased to check for potential backlogs twice daily and direct staff to areas with the highest workload.

Implementation Outcomes

It is generally recognised in the Six Sigma literature that a potential barrier to successful process improvements is the staff involved in the existing process (Llorans-Montes & Molina, 2006). This is because their reluctance to adopt the new processes can jeopardise the

implementation of such processes. In this project the processes of returning books to library shelves, like many other processes at the university, had grown and developed over the more than one hundred and thirty-four years of the library's existence (its doors first opened in 1875). Previous re-shelving practices were not unique to the library but reflected common practice in many similar large university libraries. The age of universities as institutions is recognised in the literature as a factor in their reluctance to change their well established habits and work practices (Comm et al., 2005).

Understandably, the personnel in the library were very established in their ways and it was a leap of faith for them to accept that although they felt that the current system was too demanding and onerous, this was not their fault at all but rather merely a by-product of the library's historically implemented processes. Processes that worked well in the past but were no longer efficient.

It was also initially difficult for some staff to understand that they did not need increased staffing, which they quite naturally perceived as being the best solution to the problems of overwork that they faced. Rather, it was the process of working, which they had inherited, that needed fixing in terms of making it smoother, quicker and more efficient. The ways of fixing this process were generated from accessing the collective wisdom and creativity of the library staff themselves, through research and brainstorming sessions facilitated by the process excellence team.

With the improvement in the process there has been a change in the percentage of books correctly back on their shelves from 56% after 24 hours to 93% after 24 hours, this is shown in Figure 2. Improvement over 48 hours was from 82% to 100% returned. The primary aims of the project have thus been achieved. Teaching and learning resources are more available in less time than before.

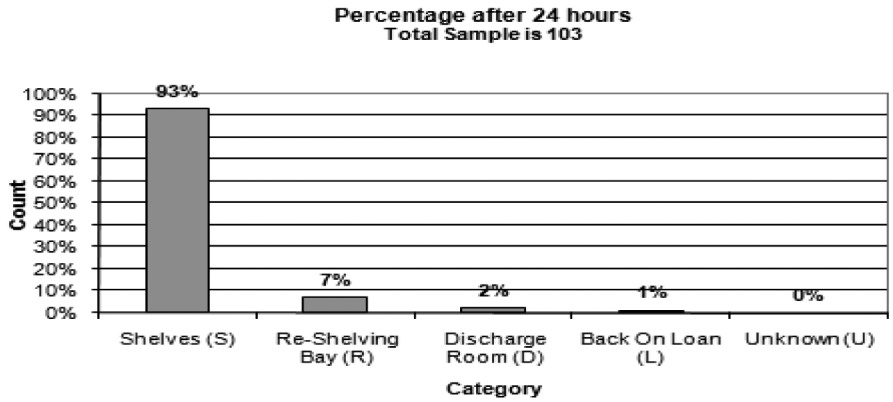

Figure 2: Where the returned books are now after 24 hours of been returned.

The process of replacing library books and journals back onto shelves once they have been returned has now been re-engineered in a much leaner manner, so that the process involves 14 discrete steps rather than the 29 discrete steps it previously involved. This is shown in Table 2.

Table 2: Process Step Reductions in the New Process

Process Step	Old Process	New Process	% Reduction
Pick up/put down	13	5	61.5
Sort	4	3	25
Move book	5	2	60
Scan	1	1	0
Wait	6	3	50
Totals	29	14	52

Other Benefits Realised

That library books and journals are now returned to shelves on average, nearly a day earlier than they previously were, equates to an eight percent improvement in the availability of these teaching and learning resources. An equivalent increase in resources would involve buying 160,000 more books and journals.

Besides the speed of book returns the project has resulted in a reduction in the floor space needed for re-shelving of 28 square metres. This has been released for re-use as seating and desk areas in the library, allowing further utilisation of resources. The project allowed an immediate transfer of $50,000 in casual salary costs from re-shelving to digital service strategy developments.

The project has established the main library of the major Australian research university as a 'best practice' model for this process. Other libraries in the University and beyond the University are requesting information to help them implement similar initiatives. A final benefit is that of transfer of skills to library staff, who enhanced their evidence based management decision abilities with tools gained from the Lean Six Sigma methodology. They have subsequently established some key measuring and monitoring processes to ensure the current process remains stable.

Control Measures Implemented

In Lean Six Sigma, control measures are the final element built into a new system to ensure that it continues to function in the revised and desired manner and does not suffer from systemic recidivism or entropy. In this case systems were put in place to ensure that a regular monthly measurement of key book return time indicators is conducted to make sure targets are being met. Key performance indicators have also been put in place to establish a minimum requirement or expectation in a 3-hour shift, for how quickly books are being returned to the shelves and for the accuracy of books being placed on the shelves in the correct order.

Conclusions

Commentators on the Six Sigma approach to process re-engineering have wondered whether it is applicable to the complex educational sector, concluding that it could be a viable and effective strategy to improve the pace of quality improvements in such settings (Ho, 2006). The success of this first completed Lean Six Sigma project at the library of major Australian research university shows that Lean Six Sigma approaches to process improvement can work in a university setting, leading to lasting and permanent improvements in efficiency. The re-shelving of library books and journals is now much quicker and more efficient at the

University's library, meaning that scholars can have access to learning and teaching resources in a much timelier and consistently reliable manner. Books and journals are now back on shelves, on average, nearly one day earlier than they were before, and this is the equivalent of an eight percent increase in resources.

The Six Sigma approach to process re-engineering could be directly applied to other administrative and academic areas of university activities. For example, the handling of higher degree by research students could be streamlined so as to avoid the wastage of having people drop out before they even start because they can't find a suitable supervisor, or drop out because the process takes so many years to complete, or drop out because their supervisor moves on. As another example, the time it takes academics to get fully equipped and briefed when they start a new job could be reduced from the two weeks it commonly takes at the moment down to a single day. This could be done by combining the fourteen or so forms typically involved in the start of a new academic job, to a single on-line form which activates all services (telephone, access cards, computer provision, parking space etc.) simultaneously. These projects have already been started at the Australian university concerned.

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