A Lean Six Sigma Approach for Improving Utilization of Walk-In Tutors

Sandra Furterer, Ph.D, MBA
Email: sfurterer1@udayton.edu

Kellie Schneider, Ph.D
Email: kschneider2@udayton.edu

Michael Key, MA
Email: mkey@udayton.edu

Yusheng “Johnny” Zhang
Email: zhangy66@udayton.edu

Department of Engineering Management, Systems, and Technology, University of Dayton
Learning Initiatives Coordinator, Office of Learning Resources, University of Dayton

Abstract

Purpose: The purpose of this study is to improve the utilization of walk-in tutors at the University of Dayton.

Methodology/Approach: The Lean Six Sigma DMAIC method is used to identify factors that contribute to the utilization of walk-in tutors, identify opportunities for improvement, and ensure process improvements are maintained.

Findings: Understanding the factors that contribute to walk-in tutor utilization allows for more efficient and effective tutor staffing and assignment procedures.

Value: The methodology and processes outline in this case study may be implemented at other higher education institutions to improve the efficiency and cost effectiveness of their walk-in tutoring programs.

1. Introduction

Many higher education institutions (HEIs) struggle to stabilize the fluctuating operation costs and justifying idle time apparent in Walk-In Tutoring services. This case study is an example of adopting LSS within HEIs to improve tutoring center operations, specifically hiring, scheduling, managing, and collecting data within a Walk-in Tutoring model. Analysis of recommended improvement strategies showed successful modifications to a Walk-In Tutoring model to forecast utilization and decrease idle time.

1.1 Background

The University of Dayton hired Michael Key as the new Learning Initiatives Coordinator in August 2015 to coordinate Tutoring services for the Office of Learning Resources. Improvement goals were already set toward minimizing idle time in Walk-In Tutoring. The first action of the Learning Initiatives Coordinator was to move any course with infrequent or inconsistent use to appointment only, leaving Walk-in to support only critical courses. The Learning Initiatives Coordinator collaborated with Dr. Kellie Schneider, a faculty member in Engineering Management, Systems, and Technology department, to mentor Yusheng Zhang, a graduate student, in conducting a LSS analysis as his capstone project, sponsored by the Office of Learning Resources. The main roadblock for the project's success was hesitation by the administration to accept improvement recommendations from graduate research. Therefore, Dr. Sandra Furterer, another faculty member from the department, joined the team due to her professional experience applying LSS methodology to aspects of HEIs. The project is ongoing due to the recommended improvements and control factors identified by this case study.

2. Methodology

The research team chose to do a case study to apply LSS methodology to their campus' Tutoring center because of the many factors that exist to maintain quality and control; as opposed to a designed experiment and quantitative model. LSS allows action-researchers to collaborate objectively with stakeholders to improve processes. This case study is only one example of the vast applications of Lean Six Sigma for enhancing the knowledge and skills of program coordinators, directors, and administrators in higher education. Institutions of higher education are beginning to discover more applications of Lean Six Sigma, such as combining the principles of Six Sigma and quality management (Adina-Petruta and Roxana, 2014), improving online education (Bandyopadhyay, 2014), assessing student surveys (Al Kuwaiti and Subbarayalu, 2015), pedagogy and professional development (Tetteh, 2015), and a special issue on Lean Six Sigma in higher education was published in the *International Journal of Quality and Reliability Management* (Jiju, 2015). The author incorporated Lean Six Sigma experiential learning opportunities into a graduate Industrial Engineering and Management Systems course at the University of Central Florida (Furterer and Crumpton-Young, 2005). The author's students performed real-world Lean Six Sigma courses to improve the university's processes, including improving a WebCT course development and design process (Sharawi, et al, 2007), designing a process management model to achieve operational excellence using six sigma tools (Rodrigues, et al., 2006), improving web development and design processes within the university (Furterer, et al, 2006), improving the National Panhellenic Conference recruitment at the University of Central Florida (Jenness, et al, 2006), improving the faculty accreditation process (Furterer, et al, 2006), improving asset management at the university (Martinez, et al, 2006), developing a framework to incorporate six sigma problem solving to achieve operational excellence in the

university (Furterer, et al, 2005), using a Balanced Scorecard in a Six-Sigma academia improvement project (Akinrefon, et al, 2005), improving a graduate student management program (Nahmens, et al, 2005), improving education delivery system processes (Sharma, et al, 2005), improving the recruiting of university students through application of Six Sigma DMAIC methodology and tools (Furterer, et al, 2007), applying lean six sigma as an improvement tool in academia (Coowar and Furterer, 2006). This vast body of research exemplifies how lean six sigma was applied in higher education across a wide variety of processes.

This collaborative case study used the LSS DMAIC (Define-Measure-Analyze-Improve-Control) methodology to improve tutoring processes at the University of Dayton. In the Define phase, the team (i) developed the problem statement to gain an understanding of the gaps in the process, (ii) created the project charter to reach agreement on the project goals, and (iii) performed a stakeholder analysis to identify stakeholders impacted by the process and the project. The team used a SIPOC (Suppliers-Inputs-Process-Outputs-Customers) tool to understand the five to seven high-level activities to be improved. Finally, in the Define phase, the project manager developed a project plan, which guided the successful completion of the project.

The Measure phase relied on subject matter experts to observe operational processes and create process maps. The team created a data collection plan to identify the metrics and data necessary to understand the current processes. Understanding customer needs related to each process was essential in identifying the Critical to Satisfaction (CTS) characteristics. The research team used descriptive, graphical, and inferential statistics to understand the processes and factors that significantly affect them.

The Analyze phase identified factors and root causes contributing to the process problems using a Why-why analysis. The research team generated recommendations in the Improve phase to adapt processes, based on implementing and measuring them to assess the improvement to each process. Finally, in the control phase, control plans are developed and implemented to maintain process improvements.

Following is a description of the LSS DMAIC methodology applied to the higher education tutoring improvement process.

2.1 Define Phase

The team that embarked on the LSS tutoring project included an Engineering Management master's student, two faculty members from the Engineering Management, Systems and Technology department—one of whom is a Six Sigma Master Black Belt, and the Learning Initiatives Coordinator from the Office of Learning Resources. The developed project charter follows.

Overview: Walk-in Tutoring is the most popular operation model for tutoring centers. While this model is especially convenient for students, it can often result in low tutor utilization.

Problem Statement: Tutoring utilization for Walk-in Tutoring has historically been quite low. For Spring 2015 semester utilization was 37.7%, for Fall 2015, it was 44.5%, and

for Spring 2016, it was 17.4%. The Coordinator schedules tutors at 75% of the historical demand for the walk-in shifts, but this has resulted in low utilization. A new model is needed to improve tutoring utilization and reduce idle tutor salary costs.

Goals: The purpose is to improve the utilization of walk-in tutors at our university. Key project goals include (i) understanding the factors that contribute to tutor utilization; (ii) establishing appropriate tutor utilization goals; and (iii) improving the tutor scheduling process.

Scope: The processes included in this study are: 1) hiring tutors, 2) scheduling tutors, 3) managing walk-in tutoring appointments, and 4) collecting tutoring visit, work and customer satisfaction data. This project excludes student athletes, and students with disabilities, unless a tutor scheduled for Walk-in Tutoring tutors them during their scheduled shift. Baseline metrics are developed based on data from Spring 2015, Fall 2015, and Spring 2016. Data is collected and improvements are implemented to assess increases in tutor utilization in Fall 2016.

Critical to Satisfaction criteria for the tutoring processes are:

- 1) tutor utilization: total tutoring time divided by total tutor scheduled time and
- 2) student wait time: time students wait for their Walk-in Tutoring session to begin.

The stakeholder analysis, shown in Figure 1, identifies the project stakeholders, their role in the project, their potential impacts and concerns, and their initial and future receptivity to the project. Figure 2 shows the project risk analysis identifying risks that could negatively affect the success of the project.

Figure 1. Stakeholder Analysis

Stakeholder	Type	Primary Role	Potential Impacts/ Concerns	Initial Receptivity	Future Receptivity
Tutoring coordinator	Primary	Hire, staff, schedule, and manage walk-in visits	Tutor utilization, budget	Strongly Support	Strongly Support
Students to be tutored	Primary	Students that request tutoring as walk-in	Low wait time, learn subject	Neutral	Neutral
Tutors	Primary	Provide tutoring	Pay for tutoring, help students learn subject matter	Moderate Support	Strongly Support

Figure 2. Project Risk Analysis

Potential Risk to Successful Project	Occurrence of Risk	Impact of Risk	Risk Mitigation Strategy
Accurate tutoring visit and work data	Moderate	High	Perform measurement system analysis to assess data accuracy.

The SIPOC diagram, shown in Figure 3, identifies needed improvements to the major activities of the processes, along with the suppliers and their inputs to the activities, the outputs of the process activities, and the customers of the inputs. It provides a check and balance to the

stakeholder analysis, shown in Figure 1, to identify all appropriate stakeholders and validate the scope of the processes to be improved. The team identified the key milestones and activities, shown in Figure 4, to close out the Define phase.

Figure 3. SIPOC Diagram

Suppliers	Inputs	Process	Outputs	Customers
Students to be tutored, Students to be hired for tutoring, Tutoring staff	Student qualifications; student applications; need for tutoring; historical tutoring utilization and work data	Hire tutors	Hired tutors	Tutoring staff; Tutors
Tutoring staff; tutors	Need for tutoring; historical tutoring utilization and work data	Schedule tutors	Tutoring work schedule	Tutoring staff; Tutors
Students, tutors, tutoring staff	Students with need for tutoring by class	Manage walk-in tutoring	Tutored students	Tutoring staff; Tutors
Students, tutors, tutoring staff	Tutored student data, tutor work data,	Collect tutoring data	Tutor work data; customer satisfaction survey, tutor visit data	Tutoring staff

Figure 4. Key Milestones and Activities

2.2 Measure Phase

The data collection plan, shown in Figure 5, identifies and defines the metrics for measuring the Critical to Satisfaction characteristics that are important to the customers and processes.

Figure 5. Data Collection Plan

Critical to Satisfaction (CTS)	Metric (short title)	Operational Definition (metric description)	Data Collection Source	Analysis Mechanism	Sampling Plan (size, frequency)
Tutor utilization	Tutor utilization %	Total tutoring time divided by total tutoring scheduled time	Tutoring database	Statistics	All walk-in tutoring visits data for Spring 2015, Fall 2015, Spring 2016
Student wait time	Average wait time	Average wait time for students from time sign in to when tutoring session begins	Tutoring database	Statistics	All walk-in tutoring visits data for Spring 2015, Fall 2015, Spring 2016

The team developed process maps, shown in Figures 6, 7, and 8, for each of the customer-facing activities in the SIPOC tool.

Figure 6. Process Map for Hiring Tutors

Figure 7. Process Map for Scheduling Tutors

Figure 8. Process Map for Walk-In Tutoring

The Master Black Belt performed the statistical analysis on the tutoring data collected from the TutorTrac data management system. Each visit included tutee demographics and tutor visit data including:

Gender, ethnicity, nationality, college, major, GPA, athlete type, tutoring type, subject, tutor time in and out, tutor total time, number of visits this semester for each student. Additionally, the Learning Initiatives Coordinator included each tutor's scheduled hours. The baseline for tutor utilization, shown in Figure 9, was calculated as:

$$\frac{\text{total tutoring time}}{\text{total scheduled time}}$$

Tutor utilization decreased in Spring 2016 due to replacing graduating tutors.

Figure 9. Baseline Tutor Utilization

Semester	Tutoring Hours	Scheduled Hours	Utilization Percentage
Spring 2015	1363.9	3616.29	37.7%
Fall 2015	1178.7	2648.59	44.5%
Spring 2016	598.5	3434.10	17.4%

2.3 Analyze Phase

The team investigated the impact of *Class* on the *Mean Time of Visit* as well as *Number of Visits*, which are shown in Figures 10 and 11. Freshmen have a higher mean time of the tutoring visit and a higher number of visits for Walk-in Tutoring. Sophomores also have a high number of walk-in tutoring visits. These trends were expected since most of the courses supported are freshmen and sophomore courses.

Figure 10. Mean Time of Visits by Class for Fall 2016

Figure 11. Number of Visits by Class for Fall 2016

The team performed a Why-why analysis, shown in Figure 12, on the question, “Why is tutor utilization low?” and identified the following root causes: changes in university class schedule, not considering best practices, and no incentive for reducing budget. During the Measurement phase, it became apparent to collect detailed utilization, work, and wait time data.

Figure 12. Why-Why Diagram

2.4 Improve Phase

The team brainstormed improvement ideas and performed a Quality Function Deployment (QFD) House of Quality, shown in Figures 13 and 14. The QFD House of Quality ensured that the improvement recommendations prioritized and aligned with the CTS criteria.

One way to increase tutor utilization is to allow scheduled appointments during Walk-in Tutoring hours. With this hybrid model, tutors would meet with tutees at Walk-in Tutoring when they are not meeting with students that had previously scheduled an appointment. Allowing appointments during Walk-in times may also assist in appropriately forecasting demand and adjusting staffing needs.

The team plans to investigate strategies for assigning tutors to students during Walk-in. The current assignment policy prioritizes scheduling Tutors with the smallest course profile over Tutors with the largest course profile. This means Tutors with larger course profiles are likely underutilized compared with Tutors who support only a few courses. In a related project, we are investigating different strategies for the assignment process to identify opportunities for further improvement.

To improve scheduling efficiency, it may be helpful to create desired course portfolios to assist in the hiring process. For example, it may be desirable for students that are able to tutor the Calculus sequences to be able to provide tutoring for Chemistry and Physics courses.

Currently, Walk-in Tutoring takes place in a location that does not become available until 6:30pm. Based on historical data, students prefer earlier tutoring times. Therefore, it may be beneficial to identify other spaces on campus that would allow Walk-in Tutoring to begin earlier in the afternoon.

Figure 13. Improvement Ideas

Improvement Ideas	Root Causes	CTS	Category	Priority
Revise scheduling approach: Incorporate hybrid model using tutors for walk-ins and appointments	No incentive to reduce budget	Tutor utilization	Scheduling	1
Investigate strategies for assigning tutors to clients	No incentive to reduce budget	Tutor utilization	Managing Tutoring	1
Monitor daily or weekly utilization of individual tutors	Not collecting detailed tutoring and work data	Tutor utilization	Monitoring	5
Identify course portfolios preferences for tutor hiring.	Not understanding factors that contribute to need for tutoring	Tutor utilization	Hiring	1
Identify tutoring location that will allow for expanded hours	Reduce time available for tutoring	Tutor utilization	Managing Tutoring	4

Figure 14. Quality Function Deployment

Quality Functional Deployment (QFD) or House of Quality **2.5 Control Phase**

In the Control phase, the team developed a control plan, shown in Figure 15, to maintain new process improvements.

Figure 15. Control Plan

Process Steps	Control Mechanism	Measure/Metric	Criticality (H M L)	Action Taken if Problems Occur	Owner
Hire tutors	Hire based upon critical tutor visit factors	Tutor utilization	H	Re-analyze tutoring data	Director
Schedule tutors	Statistical process control	Tutor utilization by tutor	H	Identify assignable causes	Director
Manage walk-in tutoring	Statistical process control	Wait time	M	Identify assignable causes	Director
Collect tutor data	Ensure tutoring visit and work data is collected weekly.	Tutor utilization; Wait time	L	Identify assignable causes	Director

The following improvements were implemented in the Fall 2016 semester:

- 1) Scheduling approach:
 - a. Reduced the number of classes for walk-in tutoring to focus on high volume courses.
 - b. Incorporated a hybrid scheduling approach, using the tutors for walk-ins and appointments during the same time period.

The Fall 2016 utilization was 62%, a significant improvement from the prior semesters, as shown in Figure 16. This resulted in an 18% to 45% improvement over previous semesters.

Figure 16. Tutor Utilization Percentage

3. Conclusions

The Lean Six Sigma project was successful in improving tutor utilization for the Office of Learning Resources Tutoring Center. The department plans to incorporate continuous process improvement in the future. This case study can be used as a guide for other higher education institutions that would like to improve their processes, enhance quality and efficiency, and reduce costs of providing services in higher education.

4. Future Work

The team will investigate and implement the following improvements in the future:

- 1) Investigate strategies for assigning tutors to clients
- 2) Monitor daily or weekly utilization of individual tutors via statistical process control
- 3) Identify course portfolios preferences for tutor hiring
- 4) Identify tutoring location that will allow for expanded hours.

The department also plans to share the success of this project with other departments, to help “sell” the value of Lean Six Sigma methods and tools in higher education.

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