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Kaizen Events at the University of St. Thomas: Experiential Learning for Students

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Abstract. This paper describes how the Operations and Supply Chain Management Department at the University of St. Thomas uses kaizen events as a vehicle to integrate undergraduate and professional programs with local area organizations. A unique business collaboration was created where the faculty members led an actual lean kaizen event at a local organization. Project team members included lead and support faculty, undergraduate students, professional certification students, and company representatives. In a one-week intensive experience, teams addressed real issues at a local organization and implemented changes that had positive impacts on the student learning experience and the bottom lines of the participating organizations. This paper discusses how to conduct a kaizen event student project as well as challenges and benefits related to this approach.



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Keywords: kaizen • lean production • experiential learning • student projects

1. Introduction

One of the most difficult challenges for students is relating the concepts and theories presented in the classroom to real-life experiences. Many institutions use student projects within their undergraduate and graduate courses to help students gain real-world experience. Semester-long field-based projects, however, require a significant amount of time for students, faculty, and client organizations. At the University of St. Thomas (UST) in St. Paul, Minnesota, we saw the need for our students to gain a better understanding of real-world business issues. Therefore, we created similar real-world projects for undergraduate students that were not connected to a course or a semester-long project. We instituted informal faculty-driven, student kaizen events outside the classroom that resulted in realized significant benefits for both students and companies involved with the process.

The contribution of this manuscript is in the new approach for conducting student projects not associated with a classroom grade or experience. This paper will provide a brief literature review, describe a framework for developing and conducting kaizen event student projects, and discuss the challenges and benefits associated with conducting kaizen events that are student projects. This will be followed by a section on analysis and results of specific projects from three points of view: the faculty, the students,

and the subject organizations. Finally, the paper will discuss some implications for replicating a similar program at other universities.

2. Literature Review

The paper provides insights into a unique form of student project that fills a gap not only in existing published literature but also in the students' experiences at UST. To develop this grounding, the manuscript will briefly examine the literature found regarding similar experiential student learning experiences, specifically as it relates to student projects and the application and use of lean and six sigma tools.

2.1. Project-Based Experiential Learning

Experiential learning theory (Kolb 1984) postulates that experiences provide a different means to learning. A hands-on active experience allows students to try core concepts in real time, reflect, and immediately learn from that experience. The purpose is to "integrate students' academic studies with work experiences in their chosen majors or career field" (p. 201). (McCarthy and McCarthy 2006). In addition, experiential learning has been shown to positively impact the accumulation of tacit knowledge, which is the type of knowledge that is difficult to obtain through observation (Armstrong and Mahmud 2008). And, when these projects are conducted with industrial

partners, students can gain practical problem-solving skills based on real-life business challenges (Konrad 2018), and universities benefit by establishing deeper connections to the business community (Gorman 2018).

In business programs, experiential learning can come from activities such as internships, project-based learning in courses, as well as service-learning projects. Faculty do not have control over traditional internship experiences since the company determines the project and tasks for the student. Service projects have been shown to benefit students in a number of ways. Service-based learning experiences are characterized as student experiences that are geared toward getting students in the community to work on a project that will address a community need (McLaughlin 2010) and as a type of civic engagement (Godfrey et al. 2005). Service-based learning projects are also shown to have a positive impact on students (Lester et al. 2005). However, these projects may or may not be tied to curriculum for a specific domain. Although students may learn through an experience, that service project may not specifically focus on OCSM content.

However, faculty can provide experience-based activities for students through some variation of a team project. Gorman (2018) conducted a review of field-based education projects that are tied to academic credit and identified a number of ways these types of projects contribute to student learning. The value and benefits of experience-based projects to students is apparent. Therefore, we sought to create an experience for students that was grounded in the OCSM discipline, short-term team based, but not tied to specific course credits to maintain flexibility. External kaizen projects support these objectives. Prior literature on student-based kaizen projects is discussed next.

2.2. Kaizen and Six Sigma Projects

Kaizen is the Japanese term for continuous improvement. A kaizen event is a project where the goal is to make rapid, significant improvements in a short amount of time (Manos 2007). As found in the literature, the benefits of lean, lean/six sigma, and kaizen events have been well-documented as they relate to the subject organizations (see also Manos 2007) even when they fail (see Farris et al. 2008). Critical success factors of lean (see also Farris et al. 2009 and Glover et al. 2011) frameworks for designing and managing kaizen events from the organization's perspective (see also Van Aken et al. 2010) and assessing success and sustainability (see also Bateman and David 2002 and Doolen et al. 2008) have also been thoroughly researched.

Very little literature exists related to the use of these concepts in academic institutions using student-based kaizen teams that addresses not only the needs of the

subject business but also the educational needs of today's business students. This is likely because very few institutions are attempting this unique pedagogical approach. We were able to find two streams of literature related to student-based kaizen teams. The first is related to traditional student experiences such as internships and short-term company-led projects and the second was related to student-based projects in classes.

2.3. Company-Led Student Experiences/Projects

The first article identified that addresses this area was by Alexander and Williams (2005), who documented a case study where the Boeing company provided training to Boeing employees, Wichita State University employees, and Wichita State University engineering students prior to executing a kaizen event (which they termed an "accelerated improvement workshop") within the Wichita State University Library. Next, Bradley and Willett (2004) describe two kaizen events, conducted by the Lord Corporation of Erie, Pennsylvania, where Master of Business Administration (MBA) students participated alongside the organization's personnel. Next, Allen et al. (2009) discussed the use of a team-based internship devoted to a kaizen event. In their example, the organization interviewed and hired the students, as a multidisciplinary team, for an internship with the organization focusing on a kaizen project. The authors found this approach successful, noting that the organization recorded positive financial outcomes and requested additional future teams.

2.4. Coursework-Related Student Experiences

Student-based kaizen events are an example of field-based student projects. Gorman (2010) described the value of field-based capstone projects in operations management at the University of Dayton, though those projects are semester-long in duration. Handfield et al. (2011) created a typology of field-based student project initiatives. In that article, the authors outlined the benefits of such student-based projects to various stakeholders, including the academic institution, students, alumni, and client organization. Other areas outside of business (law, for example) use field-based experiences such as externships as a fundamental part of their curriculum (Terry 2009).

These streams of literature highlight two separate approaches for students to learn and apply kaizen and lean techniques. The first approach is through traditional internship programs. In this experience, students learn firsthand how to deploy these techniques within an organization. However, there is no faculty guidance during an internship. The second approach is a faculty-directed student project within the structure of a university classroom experience.

Students through a course project learn how to deploy these techniques over the semester.

At UST, we merged these aspects to develop a short-term program that immerses students in a company much like an internship and provides faculty guidance, as in a classroom-led student project, without pressures of grades. Next, we describe our program and discuss specific benefits and challenges.

3. Background

This kaizen approach was initially driven by one of the lead faculty members who had extensive experience conducting kaizen projects as an industry professional. When vetted with other faculty and prospective companies, the idea evolved into the current form.

During the process, faculty discovered a need for a student experience that did not fit either of the two models listed earlier. There was limited space in the current curriculum to include a semester-long project course. In addition, even though many students had at least one internship, some students needed additional hands-on experience. We developed a program that provided positive impact to our students, faculty, and partner organizations.

Several factors can influence the success of student projects of this nature. Although the literature did not specifically address kaizen projects of this nature, several other manuscripts indicate key factors that drive the success of improvement programs and student experiences. Brun (2011) found that management support, communication, training, project and organizational infrastructure, and result-driven measures helped to create success in six sigma projects. Marzagão and Carvalho (2016) found that effective project management, effective methods and training, and leadership are critical factors that drive performance results in improvement projects.

From the student perspective, the literature supports similar drivers of project success. Rice (2018) found structure directly impacted students' perception of value from the project. D'Abate et al. (2009) also found that within the structure, defining the job characteristics had a positive impact on student satisfaction. In addition, they found supervisor support and learning opportunities also played a significant role in students' perception of successful internships.

When evaluating the success of student projects that involve working with outside subject organizations, several key factors can influence project success. Consistent with the literature, the project's potential impact and project infrastructure are key components for success. In this context, impact has several facets, including:

a. The impact on students, their knowledge and experiences, their learning of classroom materials and

their ability to apply them, and the impact on their confidence and skills to solve abstract problems

b. The impact on students' opportunity and ability to obtain internships and/or jobs

c. The impact on the subject organization, its potential financial and operational improvement, and the impact on its relationship to the hosting institution

d. The impact on the host academic institution

The second factor examined is the infrastructure to support the project. That structure, too, has several facets, including:

a. The structure of the project itself in terms of whether it is an existing catalogued course, embedded in a catalogued course, or is an independent, standalone activity, as well as whether students earn credits toward graduation for the project.

b. The time frame allocated for the project.

c. The composition of the project team.

To achieve the highest impact possible, the projects developed and completed through the Operations and Supply Chain Management (OSCM) department at UST had a unique structure.

First, the projects were independent of any course and students did not earn credits. Second, university teams included both undergraduate and professional students who had volunteered and been selected by faculty for the team, as well as the faculty from the OSCM department. Also, the project team included a cross-section of members from the host organization representing various levels, both horizontally and vertically, within that organization dependent on the area of the business under study. Finally, the time frame consisted of a single week, usually during the university's January term or spring break. Offering our project at this time does not conflict with regular semester courses and students are more available. Although not a normal collegiate time frame, this was consistent with a traditional lean production kaizen schedule. An outline of the kaizen program is described in the next section.

4. St. Thomas Kaizen Program Guidelines

UST is a private Catholic university with approximately 10,000 undergraduate and graduate students. Our campus is located in an urban setting and approximately half of the students live on campus. The OSCM department is in the Opus College of Business. Approximately 100 to 125 students concentrate in OSCM.

We have created guidelines related to before, after, and during the kaizen activities. A comprehensive checklist (see Figure 1) was developed to help facilitate these activities. This checklist can serve as a quick reference guide for those considering the development of this type of project. Each part will be discussed in more detail in the next section.

Figure 1. Kaizen Event Guidelines (Checklist)**Pre-Project Activities**

Company Activities

- ☐ Company Identification
- ☐ Lead Contact Identification
- ☐ Problem Identification and Proposed Benefit
- ☐ Project Selection and Structure
- ☐ Event Coordination
- ☐ Project Timing
- ☐ Facilities Requirements
- ☐ Identification of Resource Requirements
- ☐ Internal Company Team Representatives
 - Company Sponsor and Champion
 - Company Representatives
- ☐ Acquisition of Data (if necessary)
- ☐ Identification of key stakeholders of impacted process change

Faculty and Student

- ☐ Identification of Faculty
 - Lead Faculty
 - Mentoring Faculty
- ☐ Recruitment of Student Teams
 - Undergraduate Team Members
 - Professional Students
- ☐ Pre-Project Meetings
- ☐ Preparation of Materials for Event

Project Activities (4 to 5 days depending on the project)

- ☐ Kickoff meeting and team building
- ☐ Develop initial charter/A3
- ☐ Initial data collection – Day 1
 - Interviews
 - Observation
 - Initial Process Measures (if appropriate)
 - Spreadsheets and databases
 - Process Maps
- ☐ Data Analysis – Day 2
- ☐ Action Plan Development – Day 3
- ☐ Change something now – Day 3
- ☐ Post Process Measures (if appropriate) – Day 4
- ☐ Final Presentation and Handoff – Day 4
- ☐ Celebrate – Day 4

Post Project Activities

- ☐ Student Debrief of Lessons Learned
- ☐ Company Debrief on Lessons Learned
- ☐ Connect Students with the Company (if appropriate)
- ☐ Connect the company with Campus Recruiting (if appropriate)

4.1. Pre-Project Activities

In this section, we will discuss the components we determined necessary to conduct this type of kaizen event student project.

4.1.1. Company Identification. One of the program's unique components was the identification of companies for possible projects. In all cases, the sponsoring company employed a graduate of our undergraduate program or one of the university's certificate programs. The purpose of using graduates to find projects was to build goodwill between our programs and alumni. Finding a large number of projects would normally be a challenge using this methodology, so our approach was to conduct no more than two

projects per year and limit the number of students that could be involved.

This feature enhanced our working relationships between the business community and the university programs. Narrowing the company to one that employed a graduate of one of our programs accomplished several college mission-related goals. First, it linked faculty and students to local area companies who were asking for assistance in solving real-world problems. This gave our faculty and students the opportunity to demonstrate their abilities on a live industry-based project with a company that was familiar with our students and programs. Second, it created a tremendous amount of goodwill between the company and university. These companies realized the benefit of the university business programs and have since sent several company employees through the UST professional programs to obtain additional certification and training. In addition, the company sponsors often become a resource, visiting classrooms and club presentations to talk about the kaizen experience. Finally, it provided graduates a pseudo-return-on-investment for obtaining their degree from our programs. Several of these projects have been able to reduce operating costs in excess of \$200,000. This provided a great justification for the tuition charged for our programs.

4.1.2. Lead Company Contact. A final benefit of this approach was that it made the process of identifying a lead contact in the company easy. In all cases, the lead contact was the former student or a person to whom they reported to in the organizational structure. Having a strong internal champion was vital to project success. These contacts helped with planning, logistics, and any internal problems that arose during the process.

4.1.3. Project Selection and Structure. Several challenges occurred when setting up these events, including event coordination, project selection, and team roles and responsibilities. To ensure success, activities were coordinated several months prior to the actual event. The single most important activity to coordinate was the project scope. To create impact for both the students and the company, projects needed to be scoped such that impact could occur in a one-week time frame. We found that working on projects that were well defined and had limited impact to other elements of the business system helped to ensure positive results. Projects that impact multiple departments are much more difficult to coordinate or develop positive traction for change. When vetting the scope with the partner company, we found it beneficial to determine who were key stakeholders impacted by the change. Identifying these stakeholders

and getting them involved early in the process helped to ensure a successful event.

4.1.4. Event Coordination. Since these events were typically four or five full-day events, a block of time had to be chosen when both the students and company were available. As mentioned earlier, either spring break or January term were chosen as the time frame for the UST events. Prior planning was also required as several tasks needed to be addressed prior to the event, including collecting resumes, discussing roles and responsibilities, and emphasizing student expectations.

4.1.5. Team Composition and Roles. As described earlier, the project teams consisted of a mixture of the following:

Lead faculty: The lead faculty assumed the role of project coordinator and facilitator and coordinated all activities.

Mentoring faculty: The mentoring faculty worked intimately with the students throughout the project. They helped students understand, engage in, and tackle the tasks and jobs in the project and assisted with activity coordination.

Company sponsor and champion: The company sponsor was the primary stakeholder within the organization. This individual helped ensure that the project scope was appropriate and helped to remove obstacles (e.g., resources, personnel, scheduling) during the week-long event. The company sponsor also served as the primary steering committee member to ensure that the project was making progress and hitting targets for the organization.

Company representatives: The company representatives were team members working with the student interns and professional students. They provided detailed information about the problem and a cultural perspective as to why the problem existed. Company representatives also worked side by side with the students during the kaizen event.

Undergraduate student team members: The undergraduate team members were junior-level students majoring in OSCM. At the time of the project, these students generally would have taken a course in spreadsheet analysis, six sigma systems, process analysis, and lean in addition to the introduction to operations management courses. The majority had little to no experience working on a process improvement project. The students were recruited through class and the supply chain management club.

Professional students: The professional students were graduates of either the six sigma green belt certificate or black belt certificate program at the university. These students generally had significant

outside experience and were looking to gain additional knowledge and skills in process improvement. The mixture of team members varied from project to project based on the availability of students, project scope, and company requirements. There were no formal guidelines for determining the size of each project team; rather, the size was determined by the nature of the problem being addressed and how many students applied to participate. Some projects had as many as 10 students and others had as few as five.

4.1.6. Facilities and Resource Requirements. Conducting a kaizen event student project entails some critical facilities requirements. The team needs a place in which to convene—a daily war room—to conduct critical conversations and meetings. Additional requirements may include access to the computer systems, data, or permissions to use other systems related to the project. Within some organizations, this approval process can be lengthy.

4.2. Project Activities

Most of the events we conducted were designed to span four days. This usually allowed for a debriefing and a lessons learned session at the end of the event and a celebration of success event at the end of the project.

4.2.1. Kickoff Meeting and Team Building. Once the team and project scope were identified, a series of project meetings were held to establish the expectations of the event with the team. These meetings typically included discussion of the identified problem, the event structure, and the expectations for students. The kickoff meeting was critical to explain the parameters of the specific project. In our experience, a team-building exercise was often helpful in bringing the team together.

4.2.2. Initial Data Collection: Day 1. Day 1 of the kaizen event was structured around understanding the problem and beginning the initial data collection. After the initial kickoff meeting on the morning of the first day, the faculty led structured training sessions to introduce the team to the kaizen process. Most of the students and company representatives were familiar with kaizen but, generally, had not participated in an actual event.

The initial data collection process helped to build an understanding of the as-is condition related to the business problem. Since most of the students had little or no familiarity with the organization, we found that interviews and observations of process to be the most effective way to understand the problem. This activity normally took a large portion of day 1 in the kaizen event. The students and company

representatives often paired up to conduct observations and collect interview data.

Once the interviews and observation data were collected, the team usually assembled a process map related to the business problem. The development of an effective process map often provided insights on how the problem being studied was created.

Finally, there was often database or spreadsheet data surrounding the problem. This data were a good place for students to learn how to apply their analytical skills on real data. Since the data were live, or actual company data, it was often necessary for participants to sign a nondisclosure agreement with the organization.

4.2.3. Data Analysis: Day 2. Day 2 of the kaizen event activities focused on finishing the data collection and beginning the data analysis. Students and company members were often nervous about completing the event on day 2. Faculty members needed to be aware that the team often had to collect a large amount of data on the problem and then move the process forward into data analysis. Many company representatives felt uneasy about making any changes without sufficient supporting data.

The data analysis portion of the event was often challenging since most individuals involved in the event had never analyzed this type of data. The goal was to use observation data, interviews, process maps, and any supporting evidence from spreadsheets or databases to identify a specific improvement opportunity that could be addressed within the time frame of the kaizen event. Scope creep often became a real issue in data analysis because the project team wanted to solve every issue, not a just single one.

4.2.4. Action Plan Development and Immediate Impact: Day 3. Day 3 of the kaizen event focused on changing something right then and there. This day was usually the most exciting portion of the event as the team saw an immediate impact of their hard work over the previous two days.

In our experience, the challenge of day 3 was getting the teams to support their proposed changes with the data analysis from the previous day. In developing the action plan, several key activities usually occurred. A representative sample of action items that arose from the events, associated with action plan development, included:

- Voting on best ideas to implement
- Creating a mock-up of the new process/layout
- Consulting with impacted employees on proposed changes
- Outlining a time frame in which to make the changes

These steps were critical to getting buy-in for the proposed changes from members of the organization.

Implementation of the proposed solutions took place at the end of day 3 and into day 4. In some instances, as the new process or physical change was being implemented, the proposed solution was modified to improve on the results. The critical item stressed to the team was that before the end of the event, the change had to be in place and operational. In events that involved the physical movement of equipment, machinery, tools, or inventory, the team was often energized when they observed the actual physical change in the facility.

4.2.5. Final Presentation and Celebration: Day 4. Day 4 of the kaizen event activities focused on finishing the process changes and the final student presentation. Students were tasked to create a final presentation describing the results and their experience in the kaizen event. If the event involved a physical change to a process, the team measured the post-project impact of the change for the final report. Some form of celebration usually followed the final presentation and discussion.

4.3. Post-Project Activities

At the completion of the kaizen event, the team got together for a final debriefing session at the company site. The debrief gave the participating parties a chance to discuss the lessons learned during the project. It also gave students time to network with the company representatives and explore future job opportunities. All the companies that participated in our kaizen events have since recruited students through our campus recruiting office.

5. Project Applications and Results

This section introduces four companies who took part in the kaizen events during 2013–2016: GMI Companies, Smyth Printing, Sensata, and SGK Inc. Each of the projects were conducted during the January term with exception of the GMI Companies project, which was conducted during spring break.

5.1. Kaizen Projects

5.1.1. GMI Companies. GMI was a company that manufactured refurbished centrifuges for the medical industry. The primary issue facing GMI was insufficient capacity to store products to deliver them to customers on time. Activities included using the 5S process to reorganize the entire shop floor, analyzing inventory to determine the frequency of use, and standardizing the setup of production stations. The team was composed of 11 students, one professional student, two company representatives, one lead faculty, and one other supporting faculty.

Over four days, the team was able to free up 50% of the floor space on the main production floor. In

addition, all work areas on the main production floor were standardized in terms of layout. In the warehouse, the team created a more organized system for storing inventory. High-volume inventory items were located closer to the production floor and less frequently used inventory was marked for an obsolescence study. Fifty-three large trash bags were removed as pure waste and garbage from throughout the facility.

During this project, we had a substantive issue to resolve with a student. The student did not believe that participating in the company's 5S program was good use of his education. We informed the student that the 5S event would yield 50% new floor space and a new production line for the organization. Despite the impact on the company, the student left the team. The project moved forward seamlessly, however, because of the dedication of other students and company representatives.

5.1.2. Smyth Printing. Smyth Printing is a family-run printing organization that produces materials for a variety of large organizations such as General Mills and Conagra. Smyth was facing unexpected risks in order fulfillment that were resulting in large cost outlays. This was a five-day event. The team was comprised of six students, five company representatives, one senior company champion, one lead faculty, and one other supporting faculty.

Over the course of the five-day event, the team focused on a nontraditional form of kaizen event. The team examined the preproduction process for scheduling and sequencing jobs to the production floor. The primary issue facing the production scheduling were "bombs" that were placed into the production system that disrupted the organization's entire master schedule. A bomb was defined as a job that was delivered to the production floor with incomplete work orders. Because of these bombs, issues would arise midproduction that jeopardized the entire work schedule.

The kaizen team created a work standard (and form) for scheduling jobs that included more complete inputs from the entire work team. Although the results were not as immediate as traditional kaizen events, each production bomb could cost up to a \$100,000 so avoiding a single occurrence was a significant event. The final product was a preproduction checklist that included all the necessary components to feed production. The company later reported that the new process avoided several potentially large cost events and issues with lead time.

5.1.3. Sensata Companies. Sensata is a large producer of sensors primarily for the automotive industry. This

division of Sensata produces power inverters for military and commercial applications. The primary issue at Sensata was inventory related to outdated bill of materials. This was a four-day event. The team was comprised of five students, two professional students, two company representatives, the general manager, and one faculty member.

This was an inventory obsolescence and removal project. Sensata already ran a lean production floor but struggled with the engineering change order (ECO) process in keeping the bill of materials (BOM) accurate and current. Prior to the kaizen event, company personnel estimated that many of the BOMs were up to 50% inaccurate because of the ECO process. Since all of the inventory in the system was ordered through blanket purchase order agreements using Kanbans (visual signals that indicate when to replenish inventory), the inaccuracies were never noticed, and the production flow was not disrupted. However, the obsolete items were taking up valuable shelf space leading to excess money tied up in inventory.

The team did an extensive analysis of all BOMs using spreadsheets. The team was able to determine which inventory items on the shelves were obsolete and how much money was invested in inventory on the shop floor. Once the team determined which items were obsolete, the student portion of the team spent an entire day locating the items on the shop floor, removing them from the storage area, and quarantining the items for write-offs by the corporate controller. Approximately 25% of the existing shelf space was freed up over the course of the project and approximately \$200,000 in expired inventory was found.

5.1.4. SGK Inc. SGK is a service-based organization that does brand management and development for large corporate clients. The primary issue at SGK was the number of times graphic art files went through revisions (change orders) with clients. Each revision was both costly and time consuming, leading to lower profitability for SGK.

The five-day event at SGK focused on the reduction of revisions related to graphic art files with SGK's largest customer. The team was comprised of nine students, one professional student, two company representatives, one facilitator, one lead faculty and one other supporting faculty. The team focused on mapping the entire process and learned that both software and file updates were causing a significant issue in the process. By the end of the event, students were able to build some automation into the SGK software to handle some of the file issues. In addition, a standard process was developed to run the production process.

6. Evidence of Effectiveness

To better understand the effectiveness of our kaizen events, we obtained feedback from at least one company representative involved in each of the four kaizen events. We asked the representatives about their perceptions of our students, the benefits of the program, and realized savings at the company. We also asked a few additional questions to provide insight on the effectiveness of the kaizen events. Table 1 summarizes this feedback. Next, we list some of the representatives' important points.

6.1. Perceptions of Students

Sponsors were impressed that students volunteered for these projects during break and were committed to the projects even though it was not tied to a course grade. All respondents said that, if given an opportunity, they would participate in another UST kaizen event and would recommend our kaizen field-based project program a colleague or business partner.

The companies consistently highlighted that they most appreciated the interaction with students coupled with the faculty team's facilitation and guidance of the project. When asked specifically about our students, respondents commented:

The students participating were of a very high caliber—very comfortable in this setting and actively played a participating role. Based on this one experience—we have a great perception of UST as a quality learning institution with high performing students.

Unbelievable. To think a group of kids could come into a business, without understanding of the product and processes, manipulate data with confidence, and provide recommendations, conflicts with most beliefs.

6.2. Financial Benefits

Handfield et al. (2011) discuss an important factor in the success of field-based projects—the real savings for the organization. For our kaizen events, half of the projects have resulted in real dollar savings for the organization. The savings came from direct reduction in cost or identification of and reduction in inventory. Students were also able to make the connection between inventory, capital, and lead time. One sponsor noted:

We located over \$90,000 of inventory we didn't know we had. Additionally, we were able to cut lead time from 38 days to five days and hold that average. This allowed us to order the right inventory and increased sales in one year by 35% or four million dollars.

6.3. Job Placement

Another measure of effectiveness for kaizen events is the number of students that are hired for internships or full-time positions with the companies

involved in the projects (Handfield et al. 2011). Across the four projects, a total of five students were hired as a direct result of their work conducted on these projects. In addition, two professional students were hired as contractors.

6.4. Student Feedback

Student internships have long provided value to students, companies, and universities. Students learn how to apply concepts taught in class; companies get an opportunity to see students' capabilities firsthand and to hire those students; and universities create a stronger connection with the business community (Divine et al. 2007). In addition to the benefits listed, our projects included a highly condensed time frame with focused projects. This allowed students to make a more meaningful impact on the partner organizations. The following are a few quotes from students.

Most importantly of all, completing a project before graduating makes interviewing 100x easier. When you're right out of college, most people have an internship or two, with some sort of fluff to put on their resume but it is never really that impressive. Running a project that actually saves money and makes people more efficient is what our major is all about.

The benefits of a Kaizen are being ability to take strategic "pie in the sky" type concepts and be able to apply them. Lean and Kaizen principles are easy to understand in a book or academic setting but where businesses have a direct impact to their bottom-line is application and implementation of lean six sigma principles.

After the first few days on my project, I felt confident that I'd identified the proper solution and tried to work backwards with the data to make it fit my proposal. I quickly realized that our solution was not going to have the intended impact. This mistake taught a critical lesson I'd been taught about how to effectively solve problems: observe and quantify and let the data guide you to the solution.

6.5. Faculty Feedback

Faculty noted that there is a significant amount of work in setting up the projects as well as a significant time commitment (an entire week for a project that is not part of their course). However, the benefits of participation exceeded these concerns. Faculty who were involved with the projects found it refreshing to engage with students about operations concepts outside of the classroom and rewarding to witness students applying the concepts taught in class. Faculty also found it beneficial to see the concepts in practice, as it provided additional examples that they could incorporate in the classroom. Faculty also noted that it was an opportunity to help shape students' professionalism in real time with a real client and in assisting students in defining their role on a team and that role's importance to the

Table 1. Feedback from Project Representatives

Provide a short summary of the kaizen project with UST operations students.	What was your role during the project?	Did the project result in any tangible dollar savings?	Approximately how much dollar savings resulted from the kaizen project?	Discuss any additional benefits realized after the project.	After experiencing a kaizen event with UST operations students, what are your perceptions of the students?	How many UST students did you hire for internships and full-time positions after the kaizen events?	If possible, would you participate in a kaizen event with UST operations students and faculty?	Would you recommend a colleague or business associate to participate in a kaizen event with UST?
The St. Thomas operations group did a week-long kaizen event at our company, GMI, in Ramsey, Minnesota. The project focused both on inventory control and production flow where we implemented the 5S's.	Corporate lead and project champion	Yes	We located over \$90,000 of inventory we didn't know we had. Additionally, we were able to cut lead time from 38 days to five days and hold that average. This allowed us to order the right inventory and increased sales in one year by 35% or four million dollars.	We were able to identify those that were team focused and those that wanted to do things their way. This project also benefited our company culture, and it created an atmosphere where we all worked toward a common goal. It increased my value as a leader, which led to a promotion.	Great valuable work. Great value and line of site for interns. I think this program helped the instructor better understand who to recommend for future positions seeing them work in a real setting.	2	Yes	Yes
The scope of the project was optimizing our planning process for new work. This included creating standard work for defining when a meeting is required, number of resources needed, what information is needed, and communication of the information coming out of the meeting to the necessary downstream departments and shop floor.	I was an active participant on this project.	No	The planning process for new projects/items is critical to our production workflow. This event helped streamline the use of our front-end technical resources. It helped further clarify when a planning meeting is required and what information is required to bring to the meeting and take away from the meeting. Ultimately,	The students participating were of a very high caliber—very comfortable in this setting and actively played a participating role. Based on this one experience, we have a great perception of UST as a quality learning institution with high-performing students.		2	Yes	Yes

Table 1. (Continued)

Provide a short summary of the kaizen project with UST operations students.	What was your role during the project?	Did the project result in any tangible dollar savings?	Approximately how much dollar savings resulted from the kaizen project?	Discuss any additional benefits realized after the project.	After experiencing a kaizen event with UST operations students, what are your perceptions of the students?	How many UST students did you hire for internships and full-time positions after the kaizen events?	If possible, would you participate in a kaizen event with UST operations students and faculty?	Would you recommend a colleague or business associate to participate in a kaizen event with UST?
				communicating the plan to the floor (additional information outside of our standard specifications) is critical to successful execution. This event helped frame up how to gather this information and relay it to production.				
E&O analysis	Mentor	Yes	\$200,000	It was nice to have a third party discover the findings and not always management that is closer to the process.	Smart, educated, communication skills, before coming to our site. They get a background of the education, then use it in a live setting. I think it shows in each of them.	2	Yes	Yes
Without the use of BOM, identified, segregated, obsolete material	I was a resource and provided a safe working environment.	No		The event defined four tiers of potential obsolescence. The fourth quadrant identified 250K non-moving parts ranging in high stock keeping unit (SKU) count throughout the entire facility. The material was	Unbelievable. . . . To think a group of kids could come into a business, without understanding of the product and processes, manipulate data with confidence, and provide recommendations,	1	Yes	Yes

Table 1. (Continued)

Provide a short summary of the kaizen project with UST operations students.	What was your role during the project?	Did the project result in any tangible dollar savings?	Approximately how much dollar savings resulted from the kaizen project?	Discuss any additional benefits realized after the project.	After experiencing a kaizen event with UST operations students, what are your perceptions of the students?	How many UST students did you hire for internships and full-time positions after the kaizen events?	If possible, would you participate in a kaizen event with UST operations students and faculty?	Would you recommend a colleague or business associate to participate in a kaizen event with UST?
Evaluation of our packaging graphic production operations for specific clients, 3M and Merck	Sponsor	No		segregated, freeing up critical space for high used materials. Data points regarding input quality from our clients to begin the artwork production project. These served up fact-based conversations with our clients about current state struggles.	conflicts with most beliefs. Very high. We hired one of the students from the kaizen event and have hired another UST operations student since then.	3	Yes	Yes
Identify obsolete and excessive inventory	As inventory control manager, I helped with categorizing inventory into their respective buckets.	Yes	Do not know					
The current process to gather and communicate information that is pertinent to a job to all areas of production was not effective. This led to unnecessary downtime in production and at times nonconforming materials to be produced . . . In addition, we did not have a formal	Co-leader	No		Develop an efficient and effective structure for preproduction planning meetings to ensure that all elements of a project are adequately reviewed. . . . Development of a low-level information systems solution (no programming resources		2	Yes	Yes

Table 1. (Continued)

Provide a short summary of the kaizen project with UST operations students.	What was your role during the project?	Did the project result in any tangible dollar savings?	Approximately how much dollar savings resulted from the kaizen project?	Discuss any additional benefits realized after the project.	After experiencing a kaizen event with UST operations students, what are your perceptions of the students?	How many UST students did you hire for internships and full-time positions after the kaizen events?	If possible, would you participate in a kaizen event with UST operations students and faculty?	Would you recommend a colleague or business associate to participate in a kaizen event with UST?
process in place that allows us to capture information from what is learned in production to use in future estimating and job planning, which can lead to repeat situations.				required) for storing information that would be accessible to all departments and can be updated with downstream information.				

team. Future considerations for this program are renumeration for work either in terms of course releases or a stipend to conduct future research.

7. Unique Contribution and Future Considerations

Our model for field-based projects brings a unique aspect to the literature on this topic. We were able to achieve many of the benefits discussed in prior literature, but in an abridged manner. Many factors can be used to classify field-based project initiatives in academic literature. Table 2 introduces several factors used to examine how our approach to field-based projects is distinctive. As highlighted by Handfield et. al (2011), field-based projects in OSCM have traditionally consisted of a formal organizational structure where staff is funded by the participating company, or a less formal structure in which a faculty member organizes the project within a course. Unlike our project, most of the field-based student projects highlighted in previous studies were course embedded with a classroom component. Lastly, most prior research projects did not discuss whether they materialized into real dollar savings and student placement hires.

7.1. Benefits

The real strength of our project was that the event was held at the company, addressed a real issue, and was co-led by faculty and company representatives. This gave students a real-life project to learn from in a controlled setting while still giving them the opportunity to make a real difference to the company.

The projects were voluntary for our students and took place between fall and spring semesters or during spring break. The projects tackled a current issue and had the potential to create real savings, which they did. And, like Handfield et al. (2011), our projects often resulted in student hires.

The infrastructure of these projects yielded several positive effects. The multifaceted, multilevel composition created numerous opportunities for all members of the team. The interaction between undergraduate and professional students provided both groups with insights and experiences not available on single-level teams. For all, it provided a distinctive experience because it was a nonstudent-focused project. An equal partnership existed between different levels of students, faculty, and organizational members. The interaction between students and organizational members gave students the opportunity to display their talents and abilities, providing prospects for structured internships and employment following graduation. For the subject organization, this introduction to short-term rapid process improvement projects provided financial and operational improvements, as well as a blueprint for

Table 2. Literature Review Factor Comparison

Author/articles focusing on student kaizen teams	UG/ G/ Other		Department	Course embedded	Team content	Students hired	Duration	Team size	Other comments
	Institution	Other							
Alexander and Williams (2005)	Wichita State University	UG	Industrial Engineering	No	UG students, faculty, outside industry consultants	n/a	3 days	>6	Internal university project
Allen et.al. (2009)	Truman State University	UG	School of Business	No	Interdisciplinary student team	n/a	Semester	n/a	Done as internship, team selected by industry partner
Bradley and Willett (2004)	Cornell University	G	School of Engineering, School of Industrial and Labor Relations, School of Business	Yes	Students, industry	n/a	Semester with three-day projects	Twelve teams of five students plus industry partner members	Focus on manufacturing, no intro training on lean tools
Gorman (2010)	University of Dayton	UG	Operations Management	Yes	Student	n/a	Semester	3	Operated as consultancy
Handfield et.al. (2011)	North Carolina State University	UG and G	Business	Yes/practicum	Student (supply chain management [SCM] focused)	Yes	Semester	3–5	SCM focused
This research	University of St. Thomas, St. Paul	UG	OCSM	No	Student, faculty, industry	Yes	1 week	6–10 students, 1–3 faculty	

Note: UG = undergraduate; G = graduate.

future kaizen projects. As importantly, it forged a strong bond between the organization and the university that could be relied upon in the future. As alluded to earlier, this structure allowed students to make the leap from concept to practice. It filled the gap in their knowledge-experience base, building confidence in their ability to see, analyze, and solve unstructured or abstract business problems, all within a relatively short time frame. Finally, this structure provided an effective solution to achieving this kind of impact for a smaller, resource-constrained university.

7.2. Considerations for Replication

Although the current kaizen model works well, we foresee potential challenges and have suggestions for next steps as this type of learning activity becomes more institutionalized. For future faculty replicating this approach, we have identified three key areas that should be addressed prior to launching this approach: faculty compensation and remuneration, company recruitment and involvement, and student recruitment. In our approach, the kaizen event projects are recorded as faculty service, which accounts for a fairly small portion of our annual review process. To increase the sustainability of the model, faculty compensation or remuneration should be considered for this type of project. Either providing additional pay or course load reduction may encourage more faculty to participate and provide additional capacity to handle more projects. Since this is a fairly significant time commitment for faculty, a better approach to compensate faculty will make it more sustainable.

An additional challenge in maintaining the program's sustainability is recruiting companies to participate in the process. There are advantages to collaborating on projects with organizations in which our graduates work. The difficulty with this approach is scalability. This approach has helped us build strong relationships with several of our past graduates. However, if we want to scale the program to include every student in our concentration, it would be challenging to identify the number of projects needed every year to support the effort. To scale this program to include every student in a program, a university would need infrastructure built at the department and college level to identify potential clients as well as staff dedicated to vet companies. We suggest only recruiting highly motivated students and companies and limiting the number of projects every year, thus keeping the process manageable for the faculty or department.

Another challenge is recruiting students to participate in the projects. Our students are not paid as part of this process and need to allocate a week of time in the January term or spring break to participate in

the events. To ensure high-quality students in our projects, faculty informed students of the opportunity in their classes and the supply chain club marketed the process to students. A better process to demonstrate the value of the student learning experience should be considered to interest more students from a broader perspective in the program. Once interested students were identified, the company and faculty reviewed students' resumes and experience to select the most appropriate students for the projects.

Last, there are some logistical challenges related to conducting these types of student projects during January term. Our January term is a good time for this type of project because students need to be immersed in the project for full-time hours for an entire week. However, it is difficult for students to participate if they also want to take another course during January term. This could impact the quantity or type of student that participates. Faculty members are also giving up time during the January term to be on-site for the projects without compensation or course load reduction. Lastly, we are capacity constrained and can sufficiently complete one project per January term.

8. Conclusion

We achieved multiple learning objectives with the kaizen events. This approach provides students with a concentrated, focused, and implementable framework through which they can practice the tools that have been presented in the classroom setting in a real-time organizational environment. At the same time, the projects introduce them to industry practices and allows them to make contacts and build relationships with those industries. Our corporate partners saved money, reduced inventory, and learned about our students. Our department benefited from learning more about the work of local organizations that we were able to bring back into our classrooms. These projects also enhanced our reputation in the business community. All in all, the contacts and relationships established through these projects benefited the students, the subject organization, and the sponsoring college or university.

The value of kaizen events for practice is well established. Kaizen events can result in decreased costs and improved operational performance. In addition, field-based projects give students an opportunity to bridge theory and practice. Our approach to combining kaizen events and field-based projects yielded mutual benefit for companies, students, and faculty. The projects were short-term, non-course-embedded projects for undergraduate students that resulted in real dollar savings for the clients and led to job and internship opportunities for students.

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