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Extending the A3: A Study of Kaizen and Problem Solving

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Extending the A3: A Study of Kaizen and Problem Solving

Dr. Eric O. Olsen, Mr. Darren Kraker, and Ms. Jessie Wilkie

ABSTRACT

A case study of a continuous improvement, or *kaizen*, event is used to demonstrate how allowing "extended" responses to the respective sections of lean A3 problem solving format can enhance student, teacher, and researcher understanding of problem solving. Extended responses provide background and reasoning that are not readily provided by the frugal statements and graphics typically provided in A3s. This approach is an alternative to the iterative one-on-one mentoring most often recommended for learning A3 methodology and improves the efficiency in teaching. The case problem referenced involves a lecturer hiring process at a large state university.

INTRODUCTION

Modern universities are blessed (or cursed) with at least two imperatives: they must teach students and they must thrive as organizations. The paradigm of lean thinking (Womack and Jones, 1996, 2005) is uniquely applicable to both imperatives. The paradigm of lean thinking (hereafter referred to as simply "lean") fosters a learning organization through the application of the scientific method as embodied in the Plan-Do-Check-Act (PDCA) methodology (Spear and Bowman, 1999). This allows an organization to continuously adjust to changes in the environment and thrive. Lean organizations need associates (e.g. faculty, staff, and administrators) that can apply this methodology. The associates need to be taught. In a university, professors teach and students learn. The university as a large, complex organization serves as a laboratory where learning can be both facilitated and applied (Balzer, 2010). This paper describes just such a situation and analyzes the effectiveness of both the learning and the application using a *kaizen* event and an A3 problem solving methodology (Shook, 2008, 2009, Chakravorty, 2009). Because some readers may not be familiar with lean terminology, and how it is used specifically in this paper, a glossary of critical terms is included as Table 1.

TABLE 1: GLOSSARY OF CRITICAL TERMS

5-Whys	A lean technique used to drive the team or person working on the problem to the problem's root cause. Essentially continue to ask "why" until arriving at a cause which, if addressed, will provide an adequate countermeasure to the problem.
A3 Problem Solving	A seven-step problem solving procedure that is usually captured on a single side of an 11x17 inch sheet of paper.
Countermeasure	The preferred lean term for an interim solution to a problem. It recognizes that in an environment of continuous improvement, "solutions" are never as final as that term would suggest.
Extended A3	A proposed methodology where the logic and coaching behind the steps of an A3 problem solving sheet are provided.
Kaizen Event	A continuous improvement methodology that brings a cross functional team together for a limited duration to focus on solving a specific problem.
Lean (also lean thinking)	A management approach where value is maintained or increased while waste and inefficiency is reduced by engaging associates in problem solving.

Super Slack Resources	Organizational personnel resources that are available above those required to do the daily work. The modifier “super” indicates that these particular slack resources have more advanced lean training than the average associate.
Swimlane Flow Chart	A flow chart that is superimposed on horizontal bands that depict the various functional area and/or departments involved in the process.

BACKGROUND

In 2009, Cal Poly State University San Luis Obispo, California was hit by significant budget cuts that resulted in a ten percent furlough for all state associates. At the same time, the new interim provost observed, “The quality movement of the eighties and nineties somehow seemed to have bypassed San Luis Obispo.” Administrative processes were long, bureaucratic, and often “just silly.” The provost had had some exposure to the benefits of a continuous improvement approach at his previous university and reached out, finding a knowledgeable professor to help the university.

Because Cal Poly has a “learn by doing” philosophy, students applied their learning in local businesses and in simulated manufacturing environments, but rarely in university processes. After some discussion, the provost and the professor decided on a continuous improvement or “*kaizen event*” approach where select university processes were targeted for improvement.

The *kaizen* events were intentionally designed to be simultaneously purposeful and non-threatening. The primary selling point was that associates were already being asked to do more with less and lean was an approach to help them do their jobs. Only processes with strong sponsorship from willing organizations were selected.

A key feature of the *kaizen* event approach was to make it as user friendly as possible. Two mechanisms were employed. The first was to break the event into four separate sessions 14 hours in total. The sessions were held one to two weeks apart. This allowed for both a high level of focus when participating in the sessions and periodic relief from the stress of being away from work. It also allowed for data collection and reflection between sessions.

The second mechanism was to use MBA student teams as an integral subset of the larger *kaizen* team. The students had the role of “super slack resources.” They were “super” because they had additional knowledge about lean from participating in the lean class. They could help and assist other team members with tools and concepts. They were “slack resources” in the sense that teams need slack resources to continue their daily work while analyzing data and implementing improvements.

By spring of 2011, Cal Poly had gone through seven *kaizen* events. Although the results are mixed, the enthusiasm and frequency were growing. The university registrar even facilitated a *kaizen* event on Cal Poly’s course approval process. The outcomes show promise for using *kaizen* events to improve university operations.

METHOD

This paper uses the eighth *kaizen* event at Cal Poly to examine how both learning and application of lean is facilitated in a university setting. The process targeted for improvement was the lecturer and teaching assistant appointment (LTAA) process. The LTAA process was long and complex—it involved all seven colleges, the academic personnel department, and the payroll department. This length and complexity meant that no one partner in the process seemed to understand the entire process. The *kaizen* event was used to bring all the process associates together in one room, to combine their knowledge to gain a complete view of the process. The *kaizen* event was the first introduction to lean thinking for most of the university associates. These events developed into something that could be described as process improvement with an embedded lean education component.

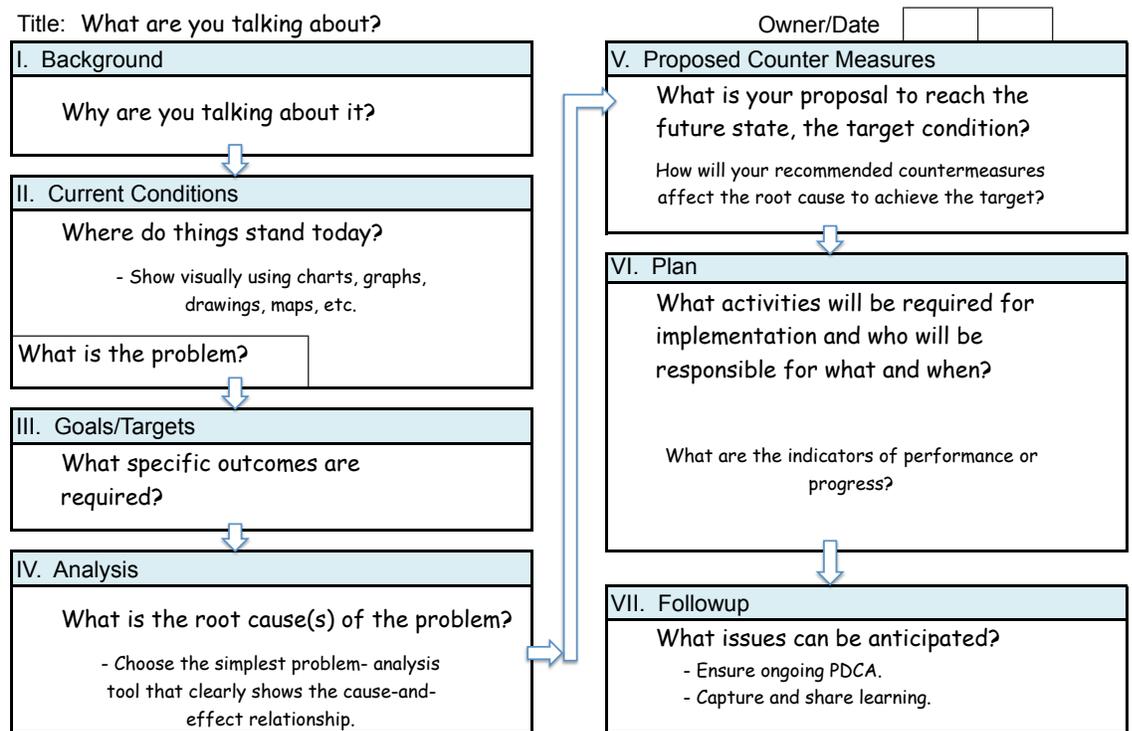
Specifically, the authors apply what they term as an “extended A3” approach. As part of the requirements for their MBA lean operations management class, a team of three students was required to participate in a kaizen event. This decision to use MBA students in the *kaizen* event embraced Cal Poly’s “learn by doing” philosophy in a way that promoted lean education across many areas of the university—from students to faculty and staff.

One of the class requirements was that each team creates an actual A3. The authors used John Shook’s *Managing to Learn* (2008) as a primary text for the course. In that text, Shook describes the process for creating an A3 from the perspective of an associate and a supervisor/mentor.

An A3 is essentially a documentation of the Plan-Do-Check-Act (PDCA) process that the team went through to solve a problem and improve a business process. A key aspect of the A3 as a document is that it captures all the relevant information on a single side of an 11 by 17-inch paper. This forces the person creating the A3 to be frugal in the allocation of paper space to communicate the essential facts and logic supporting the countermeasures being proposed. However, as Shook demonstrates in *Managing to Learn*, much of the learning by the associate takes place through one-on-one coaching during the creation of the A3. In contrast, in a classroom, because a professor’s time is spread between multiple students, and the A3 is a team product, a surrogate for the individual coaching is needed. The extended A3 approach helps address this need.

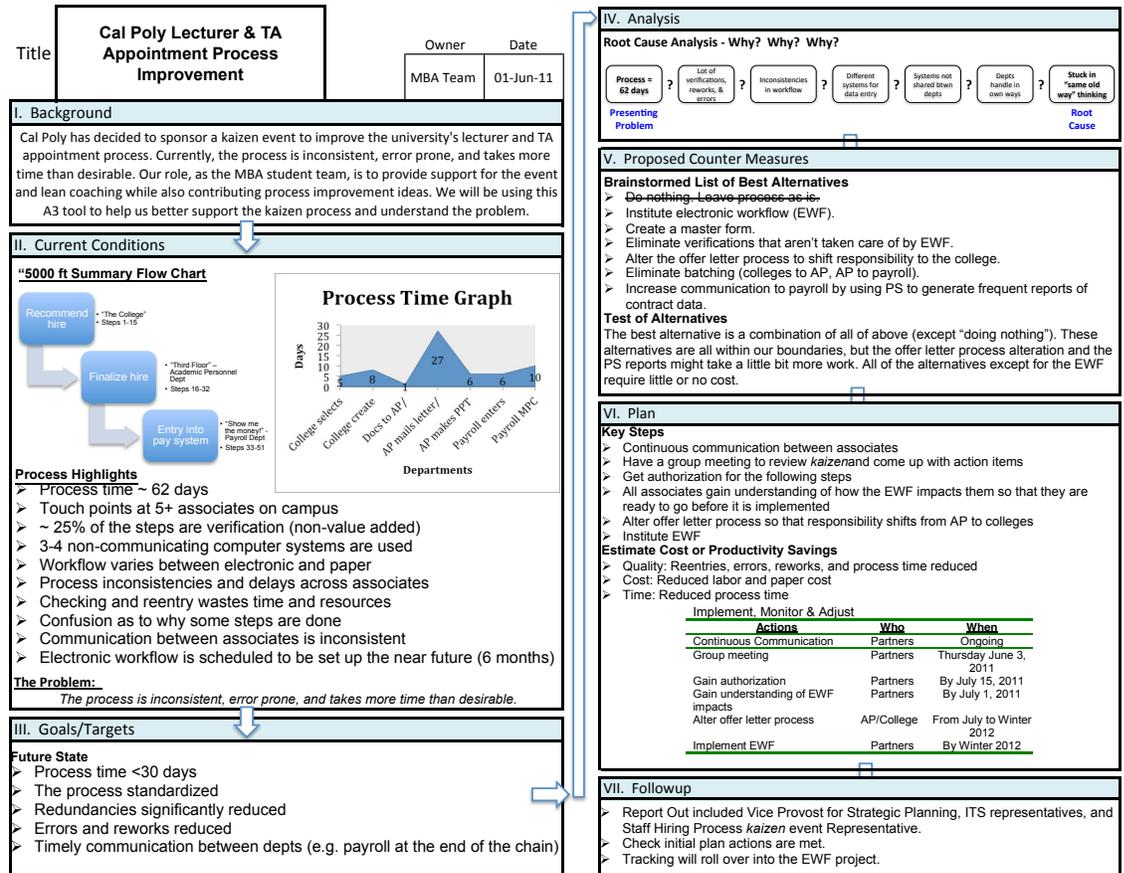
In the extended A3 approach, the student creates the A3 and supplies the background support and logic used to create each section. To demonstrate this approach we start with a completed A3 using the template provided by Shook (2008, p 8-9) as Figure 1. In each section of Shook’s template a question is proposed that acts as an initial guidance or prompt for the A3 creator. For example, the “background” section of the A3 has the prompt question, “Why are you talking about it?” Figure 2 shows the whole A3 completed by the student team.

FIGURE 1: A3 TEMPLATE



Note. From *Managing to learn: Using the A3 management process to solve problems, gain agreement, mentor, and lead* (p. 8-9), by J. Shook, 2008, Cambridge, MA: The Lean Enterprise Institute.

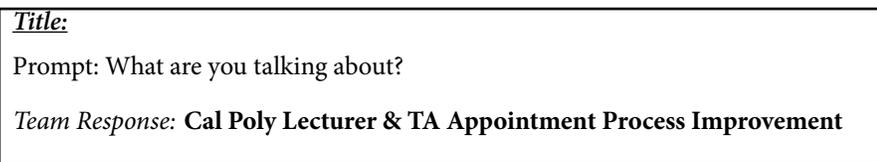
FIGURE 2: STUDENT TEAM A3



RESULTS

In the Results section of this paper we systematically present each section of the extended A3: the prompt question provided by Shook; the material that the MBA team provided as a response; the extended response that explains the logic behind the student response; and any coaching reflections or insights that would be provided by the instructor or reviewer.

FIGURE 3: TITLE, PROMPT, AND TEAM RESPONSE



Extended Response

In Shook's book, the owner of the A3 makes several attempts at getting the title right. The attempts by the main character range from "too vague" to "focused on the wrong issue." It is not until the A3 is near completion that the title reflects the proposed countermeasure(s) to the problem. In this case, the Title evolved very little over the initial improvement target identified when the kaizen event was chartered. The restriction to "lecturer & TA" held throughout the kaizen event, although the default transaction that the team traced through the process was a lecturer appointment. The appointment process starts from when the department chair makes a selection from the applicant pool to the point where the new hire receives their first paycheck from the state.

Coaching Notes

“Improvement” is rather generic to all *kaizen* events and does not provide the reviewer with a clear impression as to what form the improvement should take. Overall, the MBA team should be encouraged to change the title to something more reflective of the proposed countermeasures such as, “Make Lecturer Appointment Process Ready for Electronic Workflow.”

FIGURE 4.: COURSE COMPETENCIES AND KEY ACTIONS ASSESSED

I. Background

Prompt: What is the problem or issue?

Team Response: Cal Poly has decided to sponsor a *kaizen* event to improve the university’s lecturer and TA appointment process. Currently, the process is inconsistent, error prone, and takes more time than desirable. Our role, as the MBA student team, is to provide support for the event and lean coaching while also contributing process improvement ideas. We will be using this A3 tool to help us better support the *kaizen* process and understand the problem.

Extended Response

The Background section is the first section of the A3. It provides the foundation for the rest of the problem-solving logic. A good Background will explain why the problem is being discussed from the perspective of the organization. From the author’s perspective, if you understand why you are talking about a problem, then you will know where to begin your search for a solution. From the reviewer’s perspective, if you understand why this particular topic is being discussed, then you will maintain interest through to the solution.

In line with “learn by doing”, the MBA team conducted research to gain a deeper understanding of the LTAA process. Before the first *kaizen* event took place, the team familiarized themselves with the project charter.

The first *kaizen* event session was structured to support three main objectives:

1. Acquaint all the associates with one another;
2. Provide lean education through the introduction of basic lean tools and concepts;
3. Establish a commonly understood background on why this problem was being discussed.

The beginning of the first session was allocated to a round of introductions and sharing of each participant’s idea of what a “good outcome” for the *kaizen* event would be. During this discussion, the MBA team documented the conversation, which provided them with the information that would become the Background section of their A3.

Once everyone was acquainted, the focus turned to a short course in lean concepts and tools most applicable to the problem at hand. During this section, the university associates were given an overview of the concept of value from the customer’s perspective, waste identification, cycle time analysis, and process mapping.

A critical next step in the *kaizen* event process at Cal Poly is to have the associates apply their new knowledge of lean to someone else’s process. Associates new to lean are often feeling threatened when waste elimination is applied to their own process. First applying the concept to someone else’s process builds a unified understanding of value and waste. In this case, we looked at a simple travel reimbursement process that might be found in any company.

Next focus was turned to the target LTAA process. The participants confirmed the boundaries and scope of the process selected for improvement. This acted to confirm or modify the project charter.

The MBA team was talking about the LTAA process for two main reasons. The first was because the university had orchestrated a *kaizen* event to solve a problem that resulted in the MBA students being called in as “super slack resources.” The second reason was that they had a role to play within the *kaizen* event that went beyond process improvement into the realm of lean education. This A3 would allow them to meet their dual roles.

Coaching Notes

It would have been interesting to introduce the A3 tool to the university associates as well as the MBA team. This would have allowed for an intriguing juxtaposition of A3s from two different perspectives on the same process. It could have potentially provided a powerful example of the lean education uptake of the university associates—what was the extent of their grasp on lean methodology? There might have been, however, complications in introducing the A3 to the university associates. It might have confused them when coupled with everything else that was occurring in the *kaizen* events. This is a point for further exploration in future Cal Poly *kaizen* events.

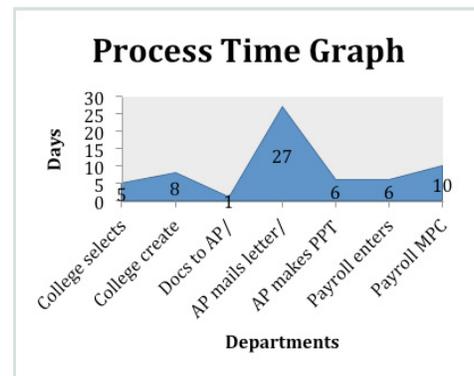
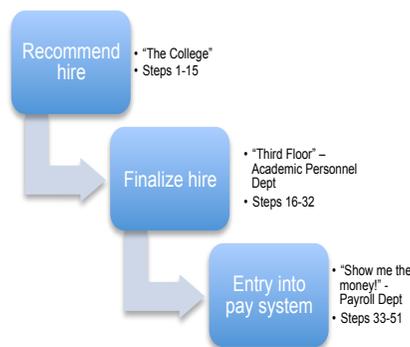
FIGURE 5: CURRENT CONDITIONS, PROMPT AND TEAM RESPONSE

II. Current Conditions

Prompt: Where do things stand today? Show visually using charts, graphs, maps, etc.

Team Response:

“5000 ft Summary Flow Chart



Process Highlights

- Process time ~ 62 days
- Touch points at 5+ associates on campus
- ~ 25% of the steps are verification (non-value added)
- 3-4 non-communicating computer systems are used
- Workflow varies between electronic and paper
- Process inconsistencies and delays across associates
- Checking and re-entry wastes time and resources
- Confusion as to why some steps are done
- Communication between associates is inconsistent
- Electronic workflow is scheduled to be set up the near future (6 months)

Extended Response

The Current Conditions are designed to show where the process stands today. Once there is an understanding of the current process state, then a problem statement can be proposed. The use of visuals, in addition to words, can help the author convey the current situation and the problem statement in a way that respects the limited space of the A3.

The MBA team developed their current conditions section after participating in the second *kaizen* session. The second session focused on having the university associates map the current state of the process. A “swimlane” flowcharting approach was used to highlight the handoffs between departments. The *kaizen* event allowed for comprehensive process mapping because it involved all the associates and departments that touched the process.

Coaching Notes

The purpose of this section was to provide a clear overview of the current state using words and visuals. The MBA team used a bullet point format to organize the information in ten clear, concise statements. Their goal was to give the reviewer an overview of the current process that included metrics such as: time, touch points, inconsistencies, workflow type (electronic vs. paper), step types, and communication. One focus of the A3 approach is to guide the team to “gather fact-based information” in the front end of the process as a way to offset the tendency of the team to jump to countermeasures (Marksberry, Bustle, and Clever, 2011).

FIGURE 6: PROBLEM STATEMENT, PROMPT AND TEAM RESPONSE

Prompt: What is the problem?

Team Response:

The Problem: The process is inconsistent, error prone, and takes more time than desirable.

Extended Response

After the first two *kaizen* event sessions, a clear view of the process presented itself. This was an essential step in defining the problem because without a complete view of the process, only isolated, non-system level problems and solutions are identified. The process mapping also allowed the time for understanding and buy-in to occur. The overall problem was defined as: ***the process is inconsistent, error prone, and takes more time than desirable.*** Not only had the problem been defined, but also the process associates had gained an understanding of lean tools, techniques, and methodology necessary to address the problem. “A problem well-stated is a problem half-solved.” This often-used statement is attributed to Charles “Boss” Kettering (1876-1958), founder of General Motors Research Laboratories. The Problem Statement focuses the reviewer on the problem to be addressed and is the logical foundation for building the solution and the rest of the A3. An organization with well-established standards can look at problems as the difference between standard and actual results. In less advanced organizations, such as Cal Poly, the place to start is with the “presenting problem” or pain points for the organization. The MBA team’s problem statement identifies the major categories of “pain” for the organization as variation in how the process is executed; susceptibility to making mistakes; and taking too much time.

Coaching Notes

Tacking “than desirable” on the end of the problem statement indicates that there are no exact standards and that a definition of “desirable” is something that should be addressed in the A3. Another aspect of the MBA team’s problem statement is that it confirms the presenting problem in the Background section. It might be suggested at this point, that the Background section be modified if for no other reason than to eliminate redundancy and provide more information in the limited space of the A3.

FIGURE 7: GOALS/TARGETS, PROMPT AND TEAM RESPONSE

III. *Goals/Targets*

Prompt: What specific outcomes are required?

Team Response:

Future State

- Process time <30 days
- The process standardized
- Redundancies significantly reduced
- Errors and reworks reduced
- Timely communication between departments (e.g. payroll at the end of the chain)

Extended Response

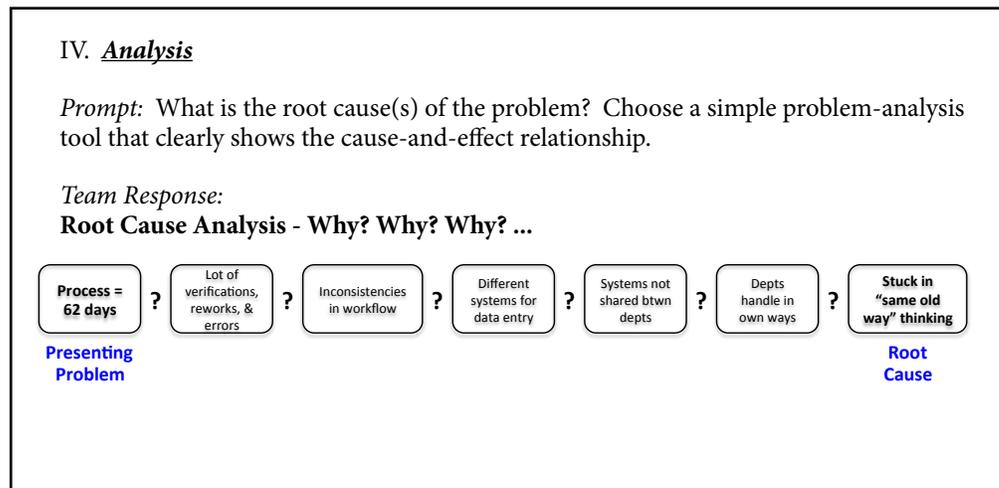
The Goals and Targets identify the desired outcomes. A good bit of the third *kaizen* session explored what the future state should be for the LTAA process. This exploration involved an extensive group brainstorming. The associates split into three groups, which were divided based on subsets of the process flow: “the college,” “the third floor” (academic personnel department) and payroll. Each group held its own mini-brainstorming session to determine improvements for its specific process piece. The results were compared and the MBA team then aggregated the results that became the basis for the Goals/Targets section of the A3.

Coaching Notes

The MBA team chose to present their Goals/Targets as a “future state.” Two factors contributed to using this approach. The first was the maturity level of the associates participating. Being new to lean concepts, it would have been demoralizing to have them sign up for goals and targets that they viewed as unattainable. Teams need to feel the goals and targets represent a significant accomplishment that is attainable for buy-in.

The second factor was the lack of hard data at this point in the *kaizen* event. Many teams just starting, find that they do not have the data they need to identify, quantify, and target a future condition. The main source of data was the swim lane flow chart created in the *kaizen* event itself. The data on the number of process steps, their content, and relationship to other steps was adequate. The time estimates were checked against sample process documents that the student team could review. The data on “errors and rework” and “process variability” was largely anecdotal. This also resulted in targets that are more qualitative.

FIGURE 8: ANALYSIS, PROMPT AND TEAM RESPONSE



Extended Response

The Analysis section is designed to identify the root cause of the problem statement. It allows the author to utilize various simple problem-analysis tools that can show a cause-and-effect relationship.

During the second *kaizen* event, the 5-Whys problem-analysis tool was introduced (Liker, 2004, pp. 252-254). A simple, yet elegant, tool, it allows users to understand their problem hierarchically down to the root cause. A powerful feature of the 5-Whys approach is that it recognizes that a problem is not a simple statement, but rather a complex series of cause-and-effect relationships.

Coaching Notes

The team limited themselves by beginning the 5-Whys with a narrow question that only focused on one aspect of the problem statement—the time component. They might have benefited by posing a broader question, such as: “Why is the Cal Poly’s LTAA appointment process in need of improvement?” Alternatively, they could have applied a separate 5-Whys analysis to each element of the problem statement. A potential

outcome of this approach might have been to recognize common root causes. This in turn may have better focused the team on a more limited set of countermeasures with the greatest impact.

FIGURE 9: PROPOSED COUNTERMEASURES, PROMPT AND TEAM RESPONSE

V. *Proposed Countermeasures*

Prompt: What is your proposal to reach the future state, the target condition? How will your recommended countermeasures affect the root cause to achieve the target?

Team Response:

Brainstormed List of Best Alternatives

~~x Do nothing. Leave process as is.~~

- ✓ Institute electronic workflow (EWF).
- ✓ Create a master form.
- ✓ Eliminate verifications that aren't taken care of by EWF.
- ✓ Alter the offer letter process to shift responsibility to the college.
- ✓ Eliminate batching (colleges to AP, AP to payroll).
- ✓ Increase communication to payroll by using PS to generate frequent reports of contract data.

Test of Alternatives

The best alternative is a combination of all of above (except “doing nothing”). These alternatives are all within our boundaries, but the offer letter process alteration and the PS reports might take a little bit more work. All of the alternatives except for the EWF require little or no cost.

Extended Response

The Proposed Countermeasures section is a space for the A3's author to succinctly communicate the “leanest” options for process improvement. The term “leanest” is used here to refer to countermeasures that are no cost or low cost. These countermeasures are developed after the Goals/Targets have been identified. They are designed to provide a means to achieve the desired goals.

Time was allocated in the third *kaizen* session directly after the ideal situation and target brainstorming to identify potential countermeasures. With their goals fresh in their minds, the associates took advantage of their combined experience to brainstorm a list of potential countermeasures that would help them address the problem statement. Three groups individually examined the three stages of the LTAA process. This division allowed for the efficient use of time. A comparison of common countermeasures identified by all three groups allowed additional narrowing of the efforts during the planning section of the A3.

FIGURE 10: PLAN, PROMPT AND TEAM RESPONSE

VI. **Plan**

Prompt: What activities will be required for implementation and who will be responsible for what and when? What are the indicators of performance progress?

- Incorporate a Gantt chart or similar diagram that shows actions/outcomes, timeline, and responsibilities.

Team Response:

Key Steps

- Continuous communication between associates
- Have a group meeting to review *kaizen* and come up with action items
- Get authorization for the following steps
- All associates gain understanding of how the EWF impacts them so that they are ready to go before it is implemented
- Alter offer letter process so that responsibility shifts from AP to colleges
- Institute EWF

Estimate Cost or Productivity Savings

- Quality: Reentries, errors, reworks, and process time reduced
- Cost: Reduced labor and paper cost
- Time: Reduced process time

Implement, Monitor & Adjust

<u>Actions</u>	<u>Who</u>	<u>When</u>
Continuous Communication	Partners	Ongoing
Group meeting	Partners	Thursday June 3, 2011
Gain authorization	Partners	By July 15, 2011
Gain understanding of EWF impacts	Partners	By July 1, 2011
Alter offer letter process	AP/College	From July to Winter 2012
Implement EWF	Partners	By Winter 2012

Extended Response

The plan section is an important piece of the completed A3. It lets the reviewer know exactly what actions need to be taken to achieve the goals and targets that were set. Then it goes further and lets the reader know who is taking ownership of those tasks and specifies the time frame. This allows for task tracking and accountability, which are key aspects of any process improvement project.

Coaching Notes

The students attempted to outline the steps that would be needed to achieve the desired changes that they identified in the preceding sections of their A3 document. These steps were outlined in the Key Steps subsection. The students followed the Key Steps with a section providing concise approximations of expected savings associated with time, quality, and cost. These estimations are important metrics for ensuring tangible results from changes that will be implemented because of the *kaizen* event.

FIGURE 11: FOLLOWUP, PROMPT AND TEAM RESPONSE

VII. *Followup*

Prompt: What issues can be anticipated?

- Ensure ongoing PDCA.
- Capture and share learning.

Team Response:

- Report Out included Vice Provost for Strategic Planning, ITS representatives, and Staff Hiring Process *Kaizen* Event Representative.
- Check initial plan actions are met.
- Tracking will roll over into the EWF project.

Extended Response

The Follow-up section of the A3 allows for a lean concept called *hansei*, which is a process of intense reflection (Liker, 2004, p. 257). It provides an opportunity to ensure that learning that resulted from the *kaizen* is communicated to appropriate people in the organization. In addition, the Follow-up provides a “heads-up” to the reviewer on future or peripheral issues that could stand in the way of successful implementation.

By highlighting “Report Out” attendance, the student team documented upper level management and other organization support for the successful outcome of the project. The vice provost is a champion of the *kaizen* event process at Cal Poly. The Information Technology Services (ITS) representatives would play a key role in the follow-on Electronic Work Flow (EWF) project. Their buy-in was important to the success of the EWF project, as a major countermeasure. Their attendance also exposed a group to the *kaizen* event process that was being used for other process automation work at Cal Poly.

With respect to the “Staff Hiring Process *Kaizen* Event Representative,” there are two separate, but similar hiring processes at Cal Poly: one for academic personnel and one for administrative staff. The staff hiring process *kaizen* event had just completed three weeks earlier and was in the process of implementing its own plan. The opportunity to share the results of a related process improved and reinforced the learning for both events.

Coaching Notes

The one critical thing that the team’s A3 does not do is to provide an adequate handoff for the follow-up responsibility. The team was a “temporary” slack resource. The team was not able to provide follow-up as well as someone in the Cal Poly organization. The ownership for “check initial plan actions are met” could have been highlighted as an issue in and of itself. This is particularly import to the University’s *kaizen* event process, which is just starting to establish a follow-up infrastructure and a track record of success. Another insight that might have been covered in the Follow-up section is direction on how the A3 process could be more directly integrated into Cal Poly’s *kaizen* event process.

RESULTS UPDATE

Approximately 18 months after completing the A3, the authors can report the actual results of implementing the EWF countermeasure. Having participated in the *kaizen* event from the beginning, the individuals from ITS were able to guide the process improvements toward a technically viable solution. During the implementation phase of the EWF it was important to have the process well defined and not cluttered with non-value added steps. This made implementation much simpler. *Kaizen* events have now become standard practice when implementing any electronic workflows across the university. The primary goal was to create an electronic form with data source directly from the campus Enterprise Resource Management System (ERMS) and allow the approval to be routed automatically and signed electronically. This reduces touch time, data entry/copy errors, and allows for transparency of the overall process. When implementing an

automated solution, the technology enforces a consistent, repeatable, standard work solution. In the end, the automated solution took longer than expected to implement, but resulted in major reductions in the time to complete the hiring process. The overall average time to complete a new hire has been reduced from 62 days to 15 days, with 90% of all hires completed within two days. Additional improvements that were achieved include:

- Pulling data from source ERMS ensures accuracy, saves time and prevents errors, reducing the return rate from 30-40% down to 1-2%
- Data validation occurs before the process even begins
- Data changes in ERMS result in users being notified during routing
- Appointments can be tracked both while in process and after completion

CONCLUSION

The results of this study show promise for the use of modified lean methodology within public university operations. The appropriate application of lean thinking—*kaizen* events, A3 problem solving, and process mapping—can lead to sustained improvement of processes through greater communication, understanding, and systematic problem solving. To gain insight and to learn from the experience, an “extended A3” approach was introduced. Teams learning to apply the A3 process write up both their responses to the A3 prompts and their rational (i.e. extended response) for the responses. This allows the reviewer, or professor, to better understand and evaluate the critical thinking of the authors and provide feedback.

The extended A3 approach highlighted both positive contributions of the student team’s A3 and opportunities for improvement. In future implementations of the extended A3 approach, student teams will be required to use extended A3 write-ups in earlier drafts of their A3s. This will allow for more cycles of learning and improvement.

The A3, as a tool in industry, is well known. This paper presents an interesting application and extension of the A3 in an academic setting where its role in teaching problem solving to teams of students is emphasized. As an A3 approach, it is limited by the context and scope of the problem. Students still need a variety of opportunities and mentor feedback to become proficient A3 practitioners. There is also a limiting difference with respect to industry where practitioners get to see the results of their A3 efforts. In this case, handoff issues were critical and the student team never saw the results of their efforts that took over a year to implement. More than a single case study is required to explore the effectiveness of the extended A3 approach in teaching students and aiding practitioners.

Finally, the extended A3 approach offers interesting possibilities for research into the process of learning to create A3s. The extended A3 approach provides better visibility to the logic that goes into creating an A3 than can be ascertained from just looking at iterations or the final product. It also provides a way to generate multiple examples in a relatively standardized archival form for qualitative research. For example, the extended A3 provides a vehicle for comparing perspectives between students and University associates with respect to A3 problem solving and therefore, potential insights for both students and practitioners.

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