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**In this issue:**

## Six Sigma Encounter with Information Systems

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# Six Sigma Encounter with Information Systems

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## Abstract

This research examines the application of the Six Sigma methodology to a business problem that emerges with an information technology (IT) solution as the best alternative. A Time/Leave Reporting Process, which supports the payroll function, is investigated using Six Sigma methodology. That case application serves to demonstrate the Six Sigma approach to business process problem solving. Six Sigma is centered on a project team lead a business process owner, rather than an IT driven project team. The Six Sigma methodology is arranged as five phases with a variety of analytical tools deployed in each phase. The methodology focuses on a data analysis driven approach wherein data are collected and analyzed in identifying the root causes of the problem. That solution may or may not include IT. However, when IT is included in the solution, the Six Sigma project may take a detour as an IT project while the IT solution is prepared and implemented. The Six Sigma, process owner team loses much of the control of the project, when a speed bump is encountered. One advantage of an IT solution is that control is instantiated that makes it very difficult to deviate from the new solution. Six Sigma and traditional IT business problem solutions share many techniques that are compatible with one another. Their synergies should undergo further examination to determine how these two methodologies can better support future IT education.

**Keywords:** six sigma, systems development, systems implementation

## 1. INTRODUCTION

Ever since its conception at Motorola in the mid 1980's, Six Sigma programs have grown by leaps and bounds worldwide (Antony, 2007; Antony et al., 2005a,b). Some Six Sigma projects may lead to an IT solution; however, every Six Sigma project does not have that IT solution. This research reports a case application of Six Sigma that happens to result in an IT solution. The project was initiated without any pre-disposed predilection of an IT solution. Six Sigma methodology provides a very robust tool set for addressing business problems or opportunities in order to formulate a best solution. The purpose here is not to review all the possible tools of Six Sigma methodology, but rather to show how a selected set of these tools are applied in addressing a business problem that happens to culminates in an IT solution. Here, the Six Sigma process itself leads to an IT solution as the preferred alternative. Six Sigma focuses on the process owner (the customer) by listening to the needs of that owner and then making improvements to the process (Douglas and Erwin, 2000). A different project may apply other selected tools from among those used with Six Sigma projects, that is from the Six Sigma toolkit. And, it could lead to a change in manual business processes rather than an automated solution. Because IT projects may be initiated from a Six Sigma analysis, it is important for information professional to have an understanding of the Six Sigma approach. This understanding allows them to leverage the Six Sigma analysis, which has been completed, as they embark on the spin-off IT project.

Six Sigma projects take a problem approach to finding business solutions. That is, it is driven by the business problem first, rather than the availability of emerging IT. This is different from a more traditional IT approach that examines new and evolving technology and then searches for opportunities to deploy that technology. That is, the traditional IT approach is driven more by the availability of emerging technologies than business problems (Vitt, et al, 2002). This represents a "push" arrangement wherein the technology solution is pushed by IT as an opportunity to address a business issue. On the other hand, Six Sigma is a "pull" process with the methodology identifying a potential IT application opportunity, whereby the business problem is examined by a team organized around the process owner, who is usually a business manager not otherwise associated with IT.

The characteristics and features of the Six Sigma methodology applied to IT development are examined using a published case-based research approach methodology. A case-based research approach provides a means for investigating phenomenon in information systems in their original context and is particularly appropriate for exploratory studies (Yin, 1993). Applied to IT and Six Sigma, case-based research provides a schema for studying the characteristics of such applications. According to Voss, Tsikriktsis and Frohlich (2002) and Meredith (1998), case-based research is one of the most powerful methods in the development of generalizable conclusions about a field of study. The results of case-based research can have a very high impact that leads to new and creative insights into a field of study with a high validity with practitioners – the ultimate user of research.

This case research examines an application at an educational institution. These organizations typically divide processes into academic and administrative. The administrative processes support the day-to-day activities of managing the institution and are similar to those of other businesses, in general, whereas the academic processes support the activities of delivering educational programs. Administrative processes include those of procurement, accounts receivable, accounts payable, general ledger, and payroll. Opportunities exist for Six Sigma applications with academic processes (Holmes, Kumar, and Jenicke, 2005). For academic processes, the intangible nature of the educational process and product makes measurement vastly different from measuring the output of a manufacturing process where physical properties and well established measurement procedures exist (Does et al., 2002) Projects can be identified, goals established and measurements established for areas leading to incremental improvements. Initially, the best areas for applying Six Sigma in educational institutions may be in nonacademic support areas (Gross, 2001). This research focuses on that application with administrative processes.

The purpose of this research is to provide an example of how Six Sigma methodology can lead to an IT project and is used with such a project. Six Sigma methodologies provide a robust tool set for tackling business problems. Many times the solutions to these problems do not lead to an IT solution. However, an IT solution is always on the table as one potential solution for many business problems. This research portrays the use of one arrangement of Six Sigma tools with an IT solution. Other IT solutions may use other tools; however, the focus here is on this particular case study application and the tools supporting the analysis. The results are present as an overview of the Six Sigma process followed by the details of each phase of that process.

## 2. SIX SIGMA METHODOLOY

The core of Six Sigma is relentless problem solving. Typically (Dow, 2003), the Six Sigma methodology is arranged as the five phase: define, measure, analyze, improve, control (DMAIC). These are the process phases utilized in this project.

- **Define** – Identify the project opportunities, select and prioritize projects, and draft the project charter. The business opportunity is frequently identified by the local champion, who is a manager in the business unit where the opportunity has surfaced as an important business issue.
- **Measure** – Identify the key internal process that influences the critical to quality (CTQ) characteristics. Then, identify the key output variables so that the capability of the current process can be determined.

- **Analyze** – Understand the root causes driving the defects. Brainstorming, prioritization, and statistical validation tools are used to identify key variables that cause the defects. The output of this phase is the identification of the variables that drive the process variation the most.

- **Improve** – Confirm the key variables and then quantify the effect these variables have on the CTQs, identify the maximum acceptable ranges of the key variables, make sure the measurement systems are capable of measuring variations in the key variables, and modify the process to stay within acceptable ranges.

- **Control** – Ensure that the modified process now enables key variables to stay within the maximum acceptable ranges, using such tools as statistical process control (SPC) or simple checklists.

The Six Sigma project team consists of seven project roles assigned, in this case application, to six team members. For this project, these are black belt (in-training), green belt, process owner (same as green belt), local champion, financial representative, and master black belt. Black belts and green belts are team members with Six Sigma methodology training and provide support for carrying out that methodology. Larger projects may use more green belts to support the additional work effort of the project. This project team interacts with other departmental users as needed to conduct the project and obtain their input to the solution.

## 3. DEFINE PHASE

The define phase is summarized by the project charter for the Time/Leave Reporting Process (Figure 1). The charter results from several meetings with the project team. The project black belt, process owner, and local champion are the key team members who formulate the project chart. These meetings provide the means for identifying the business problem and revising it until the final version of the project charter results.

## 4. MEASURE PHASE

The measure phase focuses on several activities (Dow, 2004a). The current process is defined using process mapping and flowcharting tools. The defect is defined for the specific improvement opportunity. A measurement system or approach is determined and evaluated that reflects the business process. A data collection methodology is proposed and assessed. The process capability and sigma value calculations are carried out to establish a baseline for improvement. This lays the foundation for conducting data collection that is analyzed in the next phase.

### Process Map

The process map develops an overview of the critical process (Figure 2). This assists in identifying inputs and outputs and in examining potential output measures. A "hidden factory" exists in many business processes. This is the result of process defects that must be corrected. When a defect occurs, first it must be found, and, second, action is required to remediate the defect. The correction activities are the hidden factory. That is, additional work is required without adding value to the product or service. For the Time/Leave Reporting Process, this is the defect opportunity presented in the next section.

### Deployment Flowchart

Details of the Time/Leave Reporting Process are analyzed using a deployment flowchart to portray the relationships among process steps or activities (Figure 3). The deployment flowchart shows people/activities and departments responsible and their assigned process steps. This is very similar to process flowchart charts used in developing IT solutions. Those charts have a long history in IT analysis and design (Semprevivo, 1976, p 127-134). They remain an important tool for understanding business processes within the Six Sigma methodology.

### Defect Opportunities

A defect is the amount of labor time required in completing the Time/Leave Reporting Process with the cycle time as the amount of labor time required per employee paid. In this process, a voided item is an incorrectly issued pay check. These errors increase the cycle time. The current relative quantity of these errors should not be increased and are a constraint of this project. A measure of this constraint is calculated as follows:

Voided item defect per opportunity (DPO)
=
Number of voided items from process errors / number of employees paid

This is a measure of the overall effectiveness of the process.

A defect is the process cycle time that is required to correct or rework a payroll entry in order to pay an employee. That is, a defect occurs with an error that must be corrected. Here correction involves both finding the error and then performing the rework action necessary to correct it. In payroll processing, this can be evaluated at either the individual field level or at the form level. The time to enter a value on a form is very short. Therefore, it is difficult to measure activity at this level. Because of this, defect opportunities are combined for analysis. The defect processing time measurements are taken without considering the number of items (fields) on different forms. The combination provides a better overall evaluation arrangement for this payroll process, while it also simplifies data collection.

## Measurement Plan

A good measurement system is needed to make correct decisions. While anything can be measured, it is important to concentrate on measurements that will lead to improving the business process. A good measurement system must be related to those activities which are critical to a process. They need to be reliable, easily understood, and have an identifiable variation. The measurement plan specifies what is to be measured, how it is to be measured and recorded, where it is measured and recorded, when it is to be measured and recorded, and who will do the measuring and recording. Table 1 present this project's measurement plan. In the table, EE designates employees within the payroll time and leave reporting systems under investigation.

## Root Cause Evaluation

Root cause evaluation looks at the apparent problems and their possible root cause. These possible root causes identify key variables for which data need to be collected. A subjective, weighted analysis is done to provide an indication of the ability to collect this data (Table 2). The method of measurement is proposed. The deliverable is the proposed method for conducting the data collection.

Table 2: Root Cause Evaluation Chart
(See Appendix)

## Sigma Value

Process capability is concerned with measuring the quality of the current process compared to some target. In a Six Sigma project, it is important to express the performance of the current process, which is being examined. The key question addressed is the determination of whether the current process is capable of meeting customer requirements. The sigma value, defects per million occurrences (DPMO), and capability value (Cpk) are measures of process capability. The sigma value is a quality level. This is related to the calculated standard deviation of the data; however, that standard deviation is only an input to a formula that is then used to calculate the long-term capability in the Improve phase. Six-sigma performance produces 1 defect per billion opportunities, over the short term.

Recall that the overall error rate, as measured in voided items, is not to increase as a result of any changes in the Time/Leave Reporting Process revision. The current number of voided items per million employee payments is 2,200. That is, the defects per million opportunities (DPMO) is 2,200. This translates to a σ-value of 4.35, which is less than the target level value of 6.00. This constraint is not to have any decrease as a result of process improvements.

However, a small number of voided items could still be very time consuming in making the needed corrections. As a result, the cycle time is judged to be a better measure of the defect. For cycle time the DPMO is 289,000, which translates to a σ-value of 2.06. That is, this is the number of items where the cycle time is greater than the theoretical limit. This provides a focus on the cycle time as a key process activity that is to be addressed through this Six Sigma project.

## 5. ANALYSE PHASE

The purpose of the analyze phase (Dow, 2004b) is to establish a relationship between the defect and the variables that control it. Data are used to explore and statistically validate the relationship between the root cause and the defect. Cycle time reduction (CTR) tools support the analysis of the time and cost/investment of the process. CTR provides an understanding of the inefficiencies or waste identification and elimination. With CTR, value adding process steps are identified in evaluating process efficiency. The key question in CTR is "Does this step add value to the process?' A non-value added activity is one that is not essential for meeting requirements. Some team members felt that keying data written on a form was a value-adding step. A review of value-added activities was necessary to explain and clarify that merely keying data, which is already captured, is not a value-added activity. Value-added activities provide a focus for the root cause addressed by the Six Sigma project.

### AΔT

The AΔT (A delta T) technique is used for calculating the non-value adding time in a process. Then the root causes for non-value adding time undergo further examination for possible process improvement.

The AΔT measure is calculated as follow:

AΔT ratio = Actual (time) / Theoretical (time)
Where: Theoretical (time) = Value Added
Actual (time) = Theoretical (time) + Δ(time)

Δ(time) = Non-value Added (time) including Rework (time)

The AΔT for the payroll processing time is calculated as 3.84 (This is based on the data shown in the process steps of Figure 4). That is, the actual time is nearly four times the theoretical time. Or, nearly 75 percent of the actual time is consumed by non-value added processes. These non-value added processes are candidates for elimination in making changes to the revised system.

### Cost-Time Profile Analysis

Some Six Sigma projects focus on CTR. While reducing costs improves operating profit and reduces cash requirements, reducing cycle time improves customer service, quality, and cash flow. Gathering data for the cycle time portion of a cost-time profit analysis is often easier than obtaining the cost information. Cycle time then supports concentrating on those areas or process steps that add the most value to the project. Non-value added cycle time steps emerge as candidates for elimination.

The deployment flowchart (Figure 3) furnishes the framework for the process steps that are measured and analyzed (Figure 4). The amount of labor time to pay one employee is determined to be 5.3 minutes. Of this time, 3.9 minutes is non-value added time, so the value added time is 1.4 minutes. As indicated in Figure 4, both the non-value added employee time and the number of processing steps is 74 percent of these processes to pay one employee. So, the value added time and steps is 26 percent. This is a coincidental result, which is not likely to occur frequently in other similar project. The non-value added time per employee pay extrapolates to about 9,000 hours per year or roughly 4 full-time equivalent (FTE) employees. Elimination of these non-value added process activities represent an approximate labor savings of $30,000 per year in direct savings and $150,000 in soft or indirect saving.

Figure 4: Processing time per employee
(See Appendix)

## 6. IMPROVE PHASE

Six Sigma focuses on the inputs and processes that create outputs of interest to either internal or external customers (Dow, 2004c). The variation inherent in these outputs is determined by the variation in each of the independent variables of the processes and inputs. The purpose of the Improve phase is to determine a set of activities that enable the optimization of a process so that a required level of performance is delivered as defined by the customers of the process. In this phase, alternative solutions are identified, and the "best" or "optimal" solution is selected from among those alternatives. Brainstorming is used to generate a maximum number of ideas. The opportunity statement is the foundation for brainstorming. Idea generation goes beyond the immediate Six Sigma project team and involves many other participants in the process being examined. The ideas from brainstorming are organized and evaluated as the optimal solution is selected.

### Opportunity Statement

The opportunity statement sets the stage for brainstorming. This is the focus of all the ideas which are generated. For the Time/Leave Reporting Process this statement for an improved solution with reduced cycle time is:

> "How might we reduce the amount of personnel time used in performing the payroll Time/Leave Reporting Process for hourly and salary employees?"

### Brainstorming Morphological Box

Brainstorming generates many ideas which are organized by affinitization. Brainstorming employs a variety of tools (Dow, 2004b) to produce a large idea pool. These include pattern breaking tools, the idea mover, forcing associations, reversing assumptions, making comparisons, other points of view, and outrageous ideas. Once the pool is generated, then ideas are affinitized by organizing like ideas together in related categories. Those categories of ideas are subsequently grouped together to build an alternative solution. The categories and each of the alternative solutions are summarized in a morphological box (Figure 5). Two alternative solutions emerged. One is maximum automation. The second is to automate collection. Both of these are IT solutions, as opposed to changes or modifications in manual processes. No alternative solutions were found that provide a best solution by only changes to manual processes. Clearly, the proposed alternatives surfaced as a natural consequence of the Six Sigma methodology. They were a pull recommendation and not a push solution recommend from IT for deploying new, emerging technology. The maximum automation solution encompassed all nine solution categories, whereas the automate collection consists of only four categories or subheadings. The evaluation criteria are applied to each of these identified solutions using a nominal weighting scheme. These values are then summed to identify the best alternative. With a score of 36 this is the automate collection solution. The lower level elements of the categories, the brainstorm ideas, are shown in Figure 6. An optimal solution is available for further consideration.

### Risk/Benefit Analysis

Project objectives are threatened by many potential problems. Risk analysis identifies problems and proposes actions that will minimize or eliminate their impact on a project. Benefit analysis looks at the other side of the project at activities that will maximize the quality of the project, so these actions can be supported in conducting the projects. The activities of the risk/benefit analysis have costs and expected gains associated with them. The risk/benefit analysis (Figures 7 and 8) details these actions, and their expected monetary results for guiding the Six Sigma project's implementation.

Figure 7: Risks/benefits analysis chart – Costs (See Appendix)

Figure 8: Risks/benefits analysis chart - Benefits (See Appendix)

Comparing benefits to costs, the one-time costs of the project are expected to be recovered in 2.4 years. This payback makes this a feasible project, which supports proceeding with its implementation.

### Implementation "Speed Bump"

A "speed bump" is a challenge that interrupts an implementation. A speed bump is similar to a "black hole" into which the Six Sigma project enters until the IT solution has been implemented. For this project, the speed bump results in shifting this from a Six Sigma project to an IT project for the procurement and installation of the selected software solution. Once remediation is determined to be a software solution, the Six Sigma project interfaces with an IT project. That is, the actual acquisition and installation of the software solution requires requesting IT resources for implementation.

Until this point in the project, control of the project is with the Six Sigma project team. When the software implementation shifts to the IT staff as one of their projects, then resources are allocated and tasked for that implementation. Project control shifts to the IT services organization. This is not the usual manner in which a typically Six Sigma project is expected to be conducted, wherein the Six Sigma team controls the resources, end-to-end, required for the entire process including implementation. However, a speed bump is a reality of a Six Sigma project, especially, where the best solution appears as computer automation. This was a lesson learned with this project, which was not set out as a Six Sigma project occurrence during the Six Sigma black belt training. In training, the entire project is under the control of the project team. Had the solution manifest itself as revisions to a manual process, which it could have, then this speed bump impediment would not occur in the Six Sigma project. Based on this application case, these speed bumps become part of project implementation whenever the control of implementation resources falls outside the direct management scope of the project team. Speed bumps are a reality of Six Sigma projects and must be anticipated by the process owner and other project team members.

## Selected IT Solution

TimeLink (2005) was the IT solution selected by the process owner and IT staff using IT's methods for the evaluation, selection, and contracting for this software. TimeLink is a web-based solution that interfaces with the SAP R/3 Enterprise software that handles the payroll processing within the human relations (HR) application module. This is the same HR module that does the entire payroll processing that produces employee paychecks for the educational institution.

TimeLink Enterprise 6 is a comprehensive family of workforce management solutions, providing a fully integrated set of industry leading applications to optimize the productivity of an organization's most valuable asset - its people. The solution set includes:

- Time and Attendance
- Workforce Scheduling
- Employee Self-Service
- Reporting and Analytics

As a pure internet application, TimeLink is developed in accordance with the J2EE specification, supporting multiple operating systems, database, application and web servers. It is designed to be flexible, extensible and fully scalable to meet the needs of complex organizations. An open architecture and a library of pre-built interfaces with leading ERP, HR and Payroll systems serves to leverage existing investment in technology systems and infrastructure.

An earlier release of the TimeLink software was previously installed by the education institution to handle some of their time clock data collection for payroll. However, TimeLink was not deployed to all hourly paid employees. The Six Sigma methodology guided the solution to IT's selection method that, in turn, placed TimeLink on the table as one of the possible IT solutions that were evaluated. Considering both the prior experience and the functional features of TimeLink, the IT department and the process owner evaluated it as the best software meeting their processing requirements. Without making this a Six Sigma project, this may have been a solution that would have eventually been explored for improving the payroll process. However, with the Six Sigma approach, the non-value added steps and their related data were clearly determined and analyzed in searching for an improved solution. This clearly differentiated this Six Sigma approach to the project from more traditional approaches to IT projects. And, it did provide for changes in the manual process, if that were determined the most appropriate course of action. However, a difficulty encountered with the implementation of TimeLink is that the solution depended on new functionality being added to the next release of that software. The new release presented a challenge in that this functionality encountered issues, which required a number of fixes before the necessary capability was provided with that software. The result was a longer than planned delay in the implementation of this IT solution. And, this bought about a considerable delay for the Six Sigma project for a typically expected duration.

## 7. CONTROL

The purpose of the control phase (Dow, 2004c) is to ensure the improved process performance is maintained over the long term, key learning is documented and shared, and the results are validated. Sustaining the gains means that changes/improvements are successfully implemented and stay implemented forever. Here, forever is defined as that time until there is a significant change in the business process. That is, business events or conditions make the change irrelevant. For example, a manufacturing plant is shut down or the impacted product is no longer sold. Sustainability does mean considering foreseeable future events that could threaten the improved process. This includes changes in volume, personnel and customer expectations.

When the implemented solution is an IT solution, the chance or risk of reverting back to the old manual processes are minimized. This is different from when changes are often made to manual processes. With manual process changes, increased diligence is required to insure that employees do not cross the line and return to the old ways. An IT solution removes the old way, like burning a bridge. It becomes very difficulty to return to the old manual processes. As an IT solution, the manual processes of the internal factory have been eliminated. Data are entered directly by the employee and flow through the IT solution into the payroll system. Hence the non-value added process steps no longer exist in the business process. Employees cannot use the old manual system with all of its non-value added step. In this manner, the IT solution brings a discipline to the Time/Leave Payroll Process that simply must be followed for an employee to receive a paycheck. The process owner has a solution, which insures sustainable gains.

## 8. DISCUSSION

Several leading information systems analysis and design textbooks were analyzed to determine whether or not they include Six Sigma tools and methods. The following Six Sigma characteristics, which were useful in developing the solution for the Time/Leave Reporting Process, were not presented in these current textbooks:

- Hidden factory
- Value added/non-value added
- Project charter
- Defect and defect per opportunity
- Measurement plan
- Root cause
- Sigma value
- Cycle time reduction
- A delta T
- Cost-Time Profit Analysis
- Opportunity statement
- Brainstorming
- Morphological box
- Risk/benefit analysis

These tools and methods supported development of the IT solution described here. Clearly, the Six Sigma methodology may be deployed in addressing a business problem or opportunity that results in an IT solution. The Six Sigma methodology is becoming more widespread among many business organizations. As a result, future IT education should consider the inclusion of some Six Sigma methodology. For some IT concepts, this may mean incorporating Six Sigma terminology were it may readily align with current IT concepts included in these courses. For some courses, this may mean adding Six Sigma methodology to IT concepts where there this a good match between the business problem solving approach of Six Sigma and the current methods of IT systems development. This seems to be both a challenge and opportunity for the future of IT education

## 9. CONCLUSION

This research effort examined the use of the Six Sigma methodology in providing an IT solution to a business problem. The Time/Leave Reporting Process was observed in applying this methodology to that business problem. Six Sigma is a pull process that is driven by a project team organized around a process owner and conducted with the assistance of a Six Sigma black belt. Following the data-driven, five-phased approach of Six Sigma, an IT solution emerged as the best method for mitigating the business problem with an improved process. An IT solution instantiates a robust control arrangement, because it removes old ways of carrying out these business processes. This elimination, or "burning bridges," insures the continuation of the new process until there is a change in how business is conducted.

The Six Sigma methodology shares a number of problem solving techniques and methods with prior approaches to IT problem solving. However, Six Sigma is more business problem centric with the process driven by a business area team, rather than an IT project team. Six Sigma and traditional IT project methods appear to be compatible. Both Six Sigma project teams and IT project teams can learn from each other as their methodologies continue to evolve. That is, these methods are complimentary and not mutually exclusive. Future research should examine additional Six Sigma projects that result in IT solutions to illuminate the synergy among the techniques of these business problem solving approaches. Future IT education should consider the tools and methodology of Six Sigma, especially in those areas where many similarities already occur.

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## APPENDIX

| Project Charter |
|---|
| **Project Impact/Strategic Alignment:** Support the educational institution's academic mission by improving the time/leave reporting process. |
| **Opportunity Statement:** Current process is fragmented. Paper timesheets/time rosters require processing and handling by the initiating department and Payroll Services. Considerable time is used in finding and correcting error conditions that would result in a voided item (the issuance of an incorrect pay check). |
| **Project Scope & Boundaries:** The paper-based time/leave reporting systems for all employee groups that encompasses the main campus and all satellite campuses. |
| **Goal/Objectives:** Developed an improved time/leave reporting process that is more efficient, reduces voided items, and meets the institution's reporting requirements. |
| **Timeline:** Completion of Control Phase by March 1. |
| **Deliverables:** Revised process to improve efficiency and reduce labor effort in reporting process. This should provide a soft dollar saving, which is still being determined. Documentation and training will be provided for a revised system. Other changes will be assessed at the end of the analyze phase. |

Figure 1: Finalized Project Charter

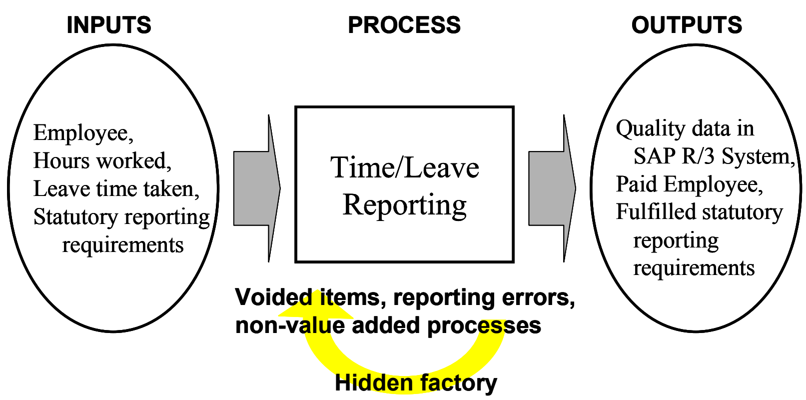



Figure 2: Process map

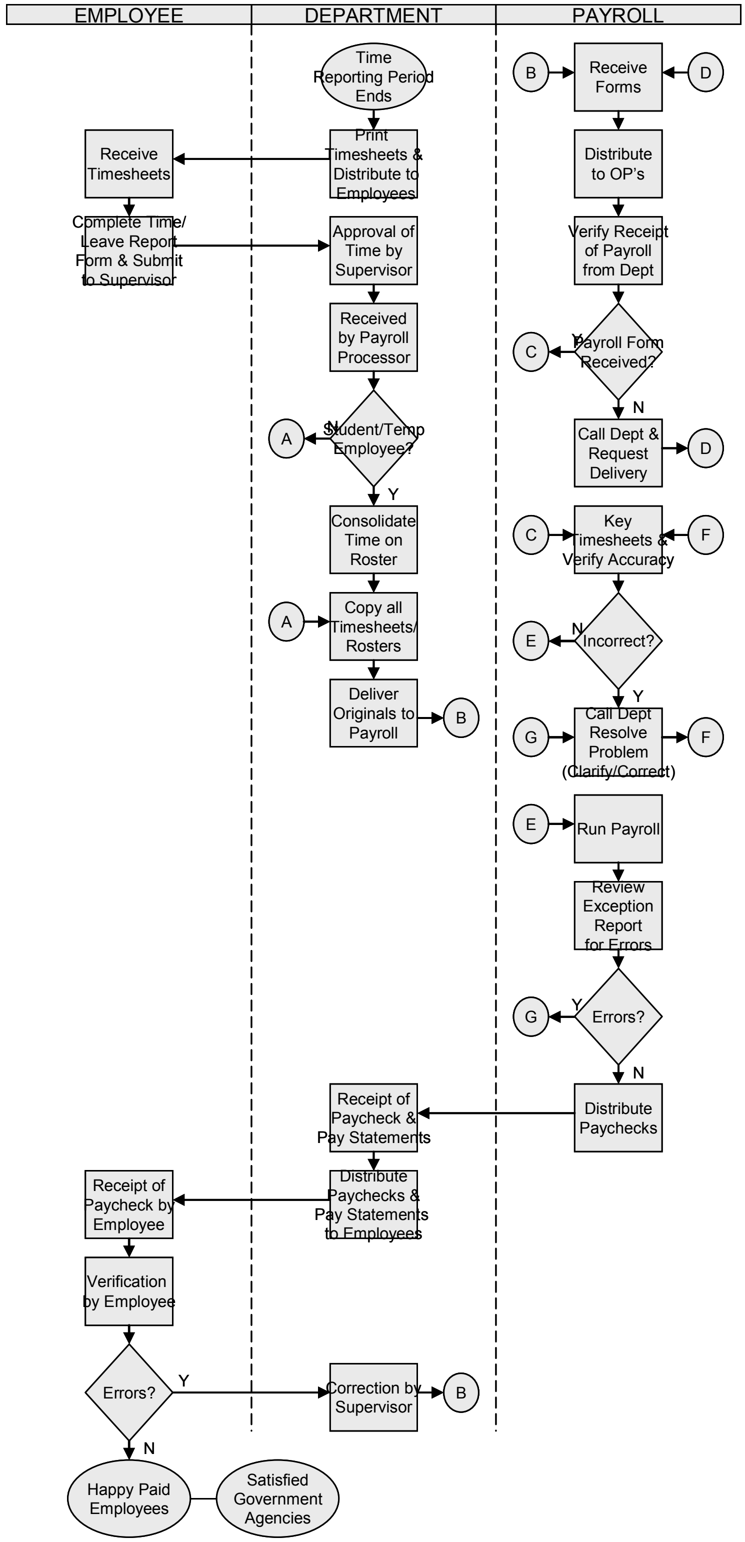



Figure 3: Time reporting process

Table 1: Measurement Plan

Project title: Improve Efficiencies in Payroll Time & Leave Reporting

| Performance Measure | Operational Definition | Data Source & Location | Sample Size | Who will collect the data | When will data be collected | How data will be collected | Other data that should be collected at the same time |
|---|---|---|---|---|---|---|---|
| Total Cks & Advices | Count of Items | Stats/Job Log File | 18 months | Central Payroll | 6/14-7/8 | Manually | |
| Total Voids | Count of Items | Payroll Ck Log book | 18 months | Central Payroll | 6/14-7/8 | Manually | |
| **DEPT DATA COLLECT:** | | | | | | | |
| Corr Process Time Std T/S | EE Counts & Times | Data collection sheets | 3 pay cycles | Lib, OIT, Prof Ed | 6/28-8/1 | Manually | Exper. of Collector |
| Delta Time Std T/S | EE Counts & Times | Data collection sheets | 3 pay cycles | Lib, OIT, Prof Ed | 6/28-8/1 | Manually | Exper. of Collector |
| Corr Process Time BW T/S | EE Counts & Times | Data collection sheets | 3 pay cycles | Lib, OIT, Prof Ed | 6/28-8/1 | Manually | Exper. of Collector |
| Delta time BW T/S | EE Counts & Times | Data collection sheets | 3 pay cycles | Lib, OIT, Prof Ed | 6/28-8/1 | Manually | Exper. of Collector |
| Corr Process Time SM T/S | EE Counts & Times | Data collection sheets | 3 pay cycles | Lib, OIT, Prof Ed | 6/28-8/1 | Manually | Exper. of Collector |
| Delta time SM T/S | EE Counts & Times | Data collection sheets | 3 pay cycles | Lib, OIT, Prof Ed | 6/28-8/1 | Manually | Exper. of Collector |
| **PAYROLL DATA COLLECT:** | | | | | | | |
| Corr Process Time Std T/S | EE Counts & Times | Data collection sheets | 3 pay cycles | Central Payroll | 6/28-8/1 | Manually | Exper. of Collector |
| Delta Time Std T/S | EE Counts & Times | Data collection sheets | 3 pay cycles | Central Payroll | 6/28-8/1 | Manually | Exper. of Collector |
| Corr Process Time BW T/S | EE Counts & Times | Data collection sheets | 3 pay cycles | Central Payroll | 6/28-8/1 | Manually | Exper. of Collector |
| Delta time BW T/S | EE Counts & Times | Data collection sheets | 3 pay cycles | Central Payroll | 6/28-8/1 | Manually | Exper. of Collector |
| Corr Process Time SM T/S | EE Counts & Times | Data collection sheets | 3 pay cycles | Central Payroll | 6/28-8/1 | Manually | Exper. of Collector |
| Delta time SM T/S | EE Counts & Times | Data collection sheets | 3 pay cycles | Central Payroll | 6/28-8/1 | Manually | Exper. of Collector |

**Definitions:**

| | |
|---|---|
| Performance Measure | name of variable in process map |
| Operational Definition | describes exactly what is to be measured including formula, etc. |
| Data Source & Location | system where data comes from, e.g., SAP, GPI, log-book |
| Sample Size | how many samples will be collected at one time, e.g., n=1 or n >1 |
| Who will collect the data | responsible person for data collection |
| When will data be collected | at what time will the data be logged (frequency) and over what time period (duration) |
| How data will be collected | log-sheet, automated, manual |

Table 2: Root Cause Evaluation Chart

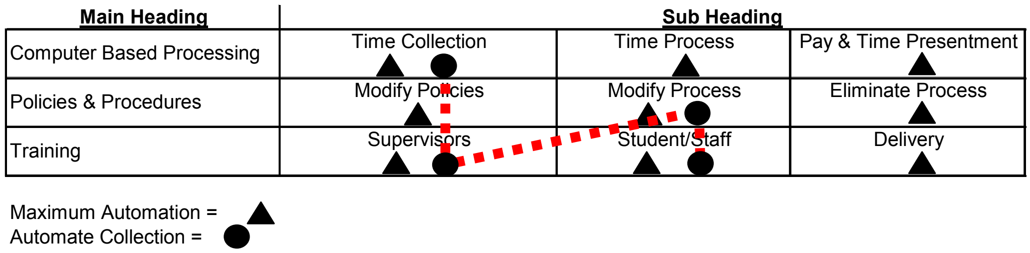
| Problem: Errors in Payroll & Time Reporting Process | | | | | |
|---|---|---|---|---|---|
| **Problem/Error Type** | **Possible Root Cause** | **Probability** | **Actionable** | **Total** | **Measurable?** |
| Missing Data | Employee forgot to fill out timesheet | 3 | 3 | 6 | Yes, by count of missing timesheets |
| | Supervisor's don't collect the time reports (aren't very responsible) | 1 | 1 | 2 | Yes, by having the departments count missing timesheets |
| | Supervisor is on vacation or out sick and responsibility of collecting reports has not been delegated | 1 | 1 | 2 | Yes, by having the departments count. |
| | Payroll processor is on vacation or out sick and responsibility of collecting reports has not been delegated | 1 | 1 | 2 | Yes, by having the departments count. |
| Errors in Data Collected | Employees, supervisors or payroll processors do not know employee contracts or policies | 3 | 9 | 12 | Yes, by counting each time we have to explain the contract |
| | There is limited training for employees and supervisors on how to fill out the time report | 9 | 9 | 18 | No, not sure how we would, unless new EE's |
| | There are human errors when transferring data from one time report to another | 3 | 9 | 12 | Yes, by counting post payroll errors |
| | The hiring data for the employee has not been entered into the SAP system & therefore does not display on the time report | | 1 | 1 | Yes, by counting calls we make to employment offices |
| | Paperwork has not been processed for changes to pay or cost centers through HR resulting in incorrect data on time report | 1 | 1 | 2 | Yes, but difficult, would take a lot of inquiry |
| | Financial aid package changes after time report is printed, therefore incorrect data displays on time report | 3 | 1 | 4 | Yes, but difficult, would take a lot of inquiry |
| | Employees try to circumvent the system and intentionally enter incorrect data because they disagree with policy or are dishonest | 1 | 1 | 2 | No |
| Keying Errors | There are human errors when keying or interpreting data from time reports | 1 | 9 | 10 | Yes, by counting post payroll errors of this category |
| Probability of occurrence (frequency) & Actionable Ratings: | | | | | |
| High = 9, Medium = 3, Low = 1 | | | | | |

| Actual Process Step | Time (per employee) (minutes) | Time (per Payroll) (minutes) | VA (Y or N) | | Number Employees (avg payroll) |
|---|---|---|---|---|---|
| Receive Timesheets | 0.0333 | 176.0 | Y | | 5286 |
| Complete Time/Leave Report Form & Submit to Supervisor | 1.0000 | 5286.0 | Y | | 5286 |
| Print Timesheets & Distribute to Employees | 0.0536 | 283.5 | N | | 5286 |
| Approval of Time by Supervisor | 0.2500 | 1321.5 | Y | | 5286 |
| Received by Payroll Processor | 0.0333 | 176.0 | N | | 5286 |
| Consolidate Time on Roster | 1.9084 | 10087.9 | N | | 5286 |
| Correction during Consolidate | 0.6566 | 3470.7 | N | | 5286 |
| Copy all Timesheets/Rosters | 0.0119 | 63.0 | N | | 5286 |
| Deliver Originals to Payroll | 0.4291 | 2268.0 | N | | 5286 |
| Receive Forms (in Payroll) | 0.0333 | 176.0 | N | | 5286 |
| Distribute to OP's | 0.0800 | 422.9 | N | | 5286 |
| Verify Receipt of Payroll from Dept | 0.0333 | 176.0 | N | | 5286 |
| Call Department & Request Delivery | 0.0238 | 126.0 | N | | 5286 |
| Key Timesheets & Verify Accuracy | 0.4107 | 2171.0 | N | | 5286 |
| Call Dept Resolve Problems (Clarify/Correct) | 0.0366 | 193.5 | N | | 5286 |
| Run Payroll (Total pay 3-5 hrs., off cycle indiv. Pay 1.5 min.) | 0.0341 | 180.3 | Y | | 5286 |
| Review Exception Report for Errors | 0.0168 | 88.8 | N | | 5286 |
| Distribute Paychecks (to Dept) (Entire campus by Delivery dept.) | 0.0397 | 240.0 | N | | 5286 |
| Receipt of Paycheck & Pay Statements (in Dept) | 0.0333 | 176.0 | N | | 5286 |
| Distribute Paychecks & Pay Statements to Employees | 0.0333 | 176.0 | Y | | 5286 |
| Receipt of Paycheck by Employee | 0.0333 | 176.0 | Y | | 5286 |
| Verification by Employee | 0.0333 | 176.0 | N | | 5286 |
| Correction by Supervisor (if Error) | 0.0978 | 517.0 | N | | 5286 |
| | | | | | |
| | | | | | |
| Total | 5.3156 | 28128.2 | | | |
| Value Added processes | 1.3840 | 7315.8 | 6 | 26.01% | 26.09% |
| Non-value Added processes | 3.9316 | 20812.3 | 17 | 73.99% | 73.91% |

percent of time

percent of process steps

Figure 4: Processing time per employee




**Evaluation Criteria**

| | Overall Commitment | Benefits (Outcome) | Time frame | Policy/ Legal | Costs | Controlled Process | Total |
|---|---|---|---|---|---|---|---|
| Maximum Auotmation = ▲ | 9 | 9 | 1 | 3 | 1 | 9 | 32 |
| Automate Collection = ● | 9 | 9 | 3 | 9 | 3 | 3 | 36 |

| Key Evaluation | |
|---|---|
| Overall Commitment | High = 9, Medium = 3, Low = 1 |
| Benefits | High = 9, Medium = 3, Low = 1 |
| Time Frame | Short = 9, Medium =3, Long = 1 |
| Policy/Legal | High = 9, Medium = 3, Low = 1 |
| Costs | Low = 9, Medium = 3, High = 1 |
| Controlled Process | High = 9, Medium = 3, Low = 1 |

Note: In general, Good/most desirable = 9, Medium = 3, Least desirable = 1

Figure 5 Brainstorming Morphological Box

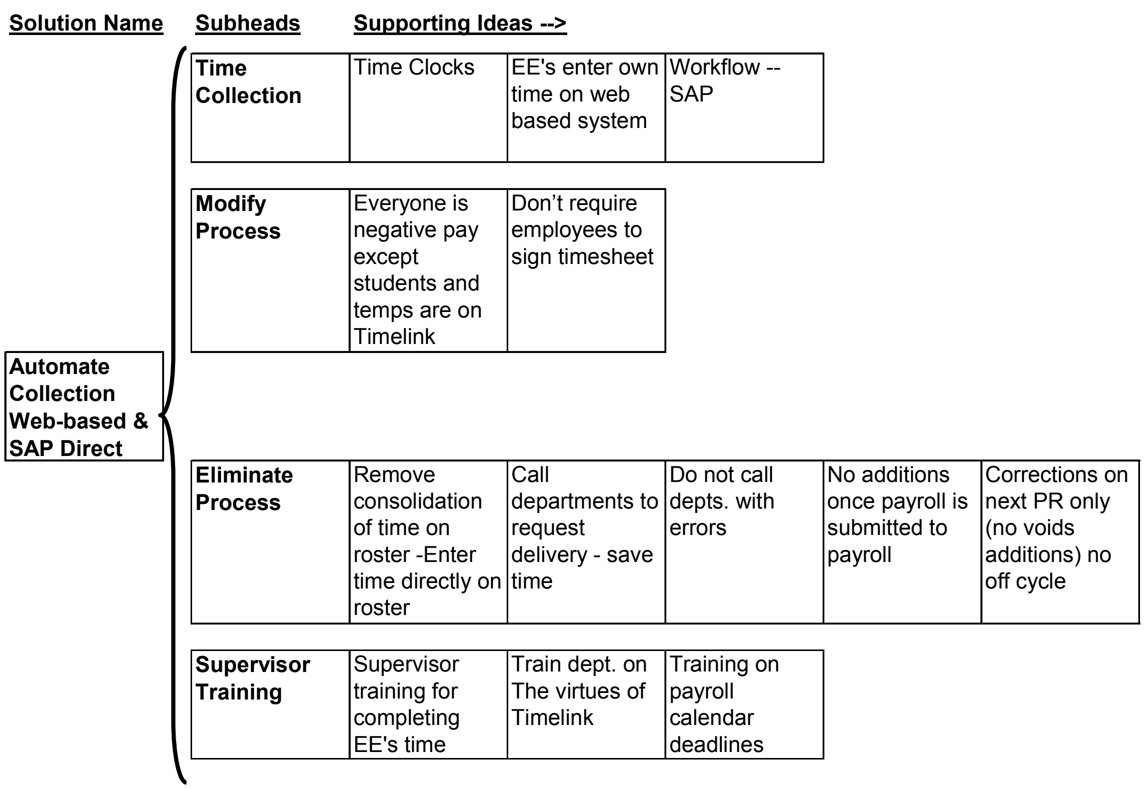



Figure 6 Selected Optimal Solution

| Risks | Actions to Minimize | Costs One-Time | Costs Ongoing (annual) |
|---|---|---|---|
| Upgrade to Timelink version 6, one time software costs of approx. $90k + server $10k | Utilize a good vendor contract negotiator | $100,000 | |
| Resources necessary for upgrading or implementation of Timelink (1-2 technical people) One month of work overall | Be somewhat flexible with the timing of the implementation. Need good management commitment. CM could put drag on resources. | $17,232 | |
| Additional timeclocks necessary to equip all buildings for students to | | $15,750 | |
| Exempt employees may abuse this system because they aren't required to record time centrally | This type of abuse is going on now but could be reduced by educating supervisors as to expectations from top management. | | |
| $ Impact: | | $132,982 | $25,900 |

Figure 7: Risks/benefits analysis chart – Costs

| Benefits | Actions to Maximize | Benefits One-Time | Benefits On-Going |
|---|---|---|---|
| Would eliminate 99% of duplicate data entry if employees enter time directly vs. employee entering on T/S and then payroll entering into SAP. [This is a portion of the soft savings sited below] | | | $12,323 |
| Eliminates duplication of data entry by departments for student employees - no longer will need to transfer detailed data to timesheet roster. [This is a portion of the soft savings sited below] | Improve training for employees and departments | | $39,607 |
| Eliminate duplication of data entry in centralized payroll offices, this should eliminate approximately 1/2 an FTE | | | $28,280 |
| $ Impact: | | $0 | $80,493 |

Figure 8: Risks/benefits analysis chart - Benefits