AC 2007-2037: DEVELOPMENT AND IMPLEMENTATION OF A
HEALTHCARE-BASED STANDARDIZED ECONOMIC IMPACT EVALUATION
METHODOLOGY

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Development and Implementation of a Healthcare Based
Standardized Economic Evaluation Methodology

Abstract:

Administrators and engineers use various methods to assess the economic impact of implementations as compared to the cost of intervention. These techniques, typically referred to as Return on Investment (ROI) models, vary with complexity and comprehensiveness depending on the application and strategic objectives of the analysis. Additionally, ROI techniques are typically tailored for use within different industries and organizations based on current business practices. Formulas can be as straightforward as a simple break-even analysis or more complex when accurately taking into account the time value of money. The variations of these methods are typically taught in most Engineering Technology curriculums under an Engineering Economics course.

The modern TQM methodologies, such as Lean and Six Sigma, require economic analyses to assess implementation impact. However, the inherent complexity and variability present within economic evaluation models often limit practical use for assessment of the economic impact of field implementations as well as within Total Quality Management (TQM) curriculums. In response to the limitations of traditional accounting and engineering economics methods, Engineering Technology faculty at IUPUI and other Purdue regional campuses have created an Excel-based spreadsheet model for evaluation of the economic impact of quality improvement projects throughout the implementation cycle. Although this tool was specifically developed for use within healthcare, we have found this methodology to be invaluable for supporting project initiation and assessment of field projects within our undergraduate and graduate quality curriculum.

This paper will present work conducted by Purdue faculty in collaboration with the Sisters of Saint Francis Healthcare Systems (SSFHS) at statewide hospitals and healthcare facilities to develop and implement the standardized economic model for use within healthcare implementations. This collaborative work focused on training and implementation of a healthcare-based economic assessment model within the framework of a Lean Six Sigma (LSS) program. As part of this effort, customized Excel-based ROI tools and supporting training documentation and hands-on exercises were developed to enable evaluation of project implementation throughout the Lean Six Sigma project cycle. The mechanism for applications of these tools and techniques within the healthcare industry will be presented as well as a discussion of application within Engineering Technology quality curriculum.
Introduction:
As Engineering Technology faculty, we often teach standard accounting methods for assessment of economic impact of implementation and return on investment (ROI). These methods, including Time Value of Money (TVM), breakeven analysis and minimum cost analysis, are typically taught within the framework of Engineering Economics curriculum. However, in application, these methods are often found to be overly complex and impractical when evaluating economic impact for field implementations or for use within quality curriculum.

This is exactly what Purdue faculty found when working with the Sisters of St. Francis Health Services (SSFHS) system. During the development and implementation of a statewide Healthcare Based Lean Six Sigma (LSS) Program, the IUPUI School of Engineering and Technology, in partnership with the Sisters of St. Francis Health Services (SSFHS) and statewide Purdue Campuses, began training and implementation of Lean Six Sigma based process improvement projects across the SSFHS hospital system. We understood from our previous work in manufacturing implementations that successful optimization and continuous improvement initiatives are dependent on management and administration support. Unfortunately, healthcare administrators often hesitated to recognize and support improvements until these efforts could be directly linked to financial improvements within their organizations.

Additionally, when we attempted to apply traditional accounting and economic analysis techniques to assess the impact of healthcare implementations, we found that level of complexity and systematic fragmentation within healthcare precluded development of consistent economic indicators linked with process performance. In the absence of appropriate indicators, it was virtually impossible to determine performance gaps, effectively drive performance improvements and accurately measure their impact.

A quick review of the healthcare literature revealed that our experience was not unique. There is extensive information detailing the obstacles preventing the linking of quality initiatives to financial results within healthcare\(^1,\)\(^2\). In fact the process of creating this link has been termed ‘building the business case’ for quality within healthcare. Additionally, investigations\(^3,\)\(^4\) into the obstacles preventing implementation of quality initiatives within healthcare have singled out the lack of this business case as the most significant factor.

Our statewide Purdue faculty responded to this experience by partnering with SSFHS to develop and implement a practical, accessible methodology for standardized evaluation of the financial impact of healthcare improvement projects. Our goal was to create a tool, accompanying training and hands-on exercises that would allow healthcare front line staff to confidently link their project implementation to direct and indirect economic impacts. The methodology developed includes an Excel based Return on Investment (ROI) tool and training exercises that are used to enable project leaders and team members to appropriately quantify potential project ROI prior to project implementation and validate ROI following implementation.
The objective of the ROI tool and exercise includes providing the healthcare professionals with an in-depth understanding of the importance of appropriate financial analysis in achieving management support of operational and patient care improvement efforts. This understanding is reinforced through a hands-on training exercise that provides practical application in identification and quantification of hard and soft financial impacts, productivity impacts as well as materials, equipment and purchased services cost savings for specific projects.

To date, this methodology has successfully been used within each of the 12 SSFHS hospitals to provide economic evaluation of patient care and operational improvement projects. Additionally, this analysis has been incorporated within the undergraduate and graduate level quality curriculum at IUPUI.

Applications of an Excel Based ROI Template within Healthcare:

To enable effective and consistent ROI analysis between the SSFHS project teams, an Excel based ROI tool was created. This tool includes a user interface section for entry of financial information as well as an automated summary sheet compiled from the data entry sections. Figures 1-4 show screen shots of the ROI template.

![Figure 1. Potential Project Impact Summary Worksheet](image-url)
Figure 2. Worksheets showing summaries of Hard and Soft Savings Impacts

Figure 3. Hard Savings Impact Worksheets
This ROI model is a dynamic tool that is continually updated throughout the LSS project cycle. All organizations that utilize a LSS methodology subscribe to a five step systematic process improvement cycle known as the DMAIC process; Define, Measure, Analyze, Improve, and Control. The ROI tool is initially created by an executive level team and then continually updated during each of these five phases of process improvement.

The tools utilizes healthcare specific financial terminology, including 1) Hard Savings, which is defined as direct cost savings associated with reduction in cost of materials, equipment, Purchased Services and productivity improvements leading to reduction in actual hours worked and 2) Soft Savings, which includes indirect costs savings, such as those resulting from improvements in productivity leading to increased direct patient care time. Estimated net additional margin contribution through increases in revenue generation is also considered. This metric is typically adjusted for average re-imbursement rate and/or payer mix.

**Preliminary ROI Model:** The Lean Six Sigma (LSS) project cycle begins with creation of a Champion team to identify an opportunity for improvement and complete a process improvement project charter document. This team typically meets during multiple sessions to evaluate the project alignment to organizational strategic objectives, define the project goals and determine expected project deliverables. This initial project charter includes a preliminary evaluation of anticipated project Return of Investment (ROI).

The Champion team, while developing the process improvement project charter document, is charged with identification and quantification of hard and soft financial impacts, productivity impacts as well as materials, equipment and purchased services cost savings.
Estimates of the anticipated investments to achieve improvements are also included in order to appropriately quantify ROI. Within the project ROI analysis life cycle, this step is referred to as the development of the “preliminary ROI model”. To provide confidence within the model, preliminary ROI models are validated by financial officers within the Champion team to insure that assumptions and estimates are clearly outlined.

The advantage of introducing the preliminary ROI model during the Champion phase is to quantify the anticipated ROI impact of a selected project prior to chartering the project team. Through the creation of even a rudimentary ROI analysis early in the project cycle, multiple projects can be directly assessed and compared against organizational financial goals prior to resourcing. Additionally, the preliminary ROI analysis is passed down to the project team within the project charter ensuring that expectations for project ROI are clearly outlined.

**Project ROI Model:** Once the project charter document has been completed the project team is created. Typically this team is composed of front line staff heavily involved in the process under investigation. The role of this team is to utilize the LSS methodology to optimize the process as outlined in the project charter. The ROI model is updated through each step of the DMAIC process as additional information about the process is collected by the project team.

The detailed ROI project model development begins with the creation of detailed flow diagrams or process maps. These process maps are developed as part of the Measure phase within the Lean Six Sigma DMAIC processes.

After the process maps are created, the project team identifies opportunities for increased revenue, cost reduction or cost avoidance within each step of the process as categorized by productivity impact, hard operational savings and additional revenue generation. Information from economic analyses available from evidence based clinical literature is used to link the cost impacts of improved patient outcomes. Financial managers provide information on specific hospitals costs, such as: net margin contribution, payer mix, patient demographics, costs of billings and collections, denial rates, grievance rates and costs to remedy, specific productivity rates per department, contract pricing, service costs, materials, equipment costs. Additionally, left without being seen (LWBS) rates, diversions, market share, days outstanding on accounts receivables are included within the spreadsheet.

Similar to the preliminary model, the ROI model presented during the Measure and Analyze Phases of the DMAIC process includes estimates of anticipated investments to achieve improvements. This provides an updated, but not yet complete, project ROI analysis.

The project ROI model is again updated during the Improve phase, prior to the implementation pilot. At this point in the project cycle, the implementation plan is used to determine resources and investments required to achieve process improvements. This more mature ROI model is presented to the Champion group for their approval during the pre-pilot tollgate review.
**Model Validation:** ROI model validation occurs following the project pilot. The actual project process improvements realized during the pilot are linked to financial indicators and compared against the required costs for the pilot implementation. This model is presented during the post-pilot tollgate for validation by the Champion group. As the project moves into full implementation, the ROI model is regularly updated using the Control phase dashboard measurements.

**Training Tools:**

We have created basic training tools and exercises that are used during the LSS training sessions to introduce the project team to financial concepts and financial model creation. These tools and exercises are outlined below.

**Hospital Financial Basics:** The training exercise begins with instruction on “Hospital Financial Basics” which includes an overview of how hospitals operate, make and spend money. Next, the project team is introduced to the components of healthcare operating and capital budgets. These sections are critical to furthering the understanding of the team members on hospital finances and assist them linking the impact of process and patient care improvement to finances. There is also a discussion on the specific definitions approved by the financial department with respect to qualifications for hard and soft savings as well as revenue generation. Note that these definitions often vary by Healthcare organization.

This instruction continues with a review of the Cost of Poor Quality (COPQ) and the different types of Waste (Muda), including discussions and examples of how the Cost of Poor Quality and Waste are measured and allocated.

**Hands-on Exercise to Reinforce Principles:** Following the hospital basics instruction, the team moves to an exercise developed to provide experience in assessing a project during the DMAIC Measure phase and developing the initial Return on Investment Analysis (ROI) Project Model. Figure 5 shows a team ‘in action’ during the hands-on exercise.
The project team is broken up into a minimum of two groups to promote learning from each other. Each group receives the following:

- Written Project Charter
- Process Map of Environmental Services process for removing white bag trash from Unit floors
- Time trials data per Environmental Services employee for process of removing white bag removal from Unit floors
- Poster Paper Size Return on Investment Analysis calculation template
- Markers and Calculators

The case study used during this exercise is an Environmental Services white bag removal project. Each group reads the project charter to understand with the project scope, reviews the process map and the project time trial data. This information allows the group to determine the cycle time it takes for the Environmental Services staff to complete the process of removing the white bag trash from the hospital units’ floors.

The teams are given 10 minutes to discuss the information and data they have received. Teams are then given another 20 minutes to financially quantify the Cost of Poor Quality and Waste within the current process.
After the groups have created their ROI models for the case study, they are asked to present out to the other groups. This point is critical in the learning cycle as the team members begin to recognize the variation that can occur in quantifying financial impact. This also serves as a learning experience with respect to many different ways financial impact can be quantified.

After the completion of the group exercise using the Environmental Services White Bag case study, the team is then asked to repeat the same processes with their current projects.

A review of the ROI analysis is then conducted at the end of each phase of the project. The team is asked to present it to the class as well as meet with their respective Project Financial Champions to get their approval on the approach prior to all Tollgate reviews.

**Lessons Learned:**

Often, the team members are not familiar with the financial aspects of the hospital. The instructions of the “Hospital Financial Basics” are critical to the learning process. Additionally, introducing the ROI model can present challenges with the amount of information known and unknown on a project following the DMAIC Measure phase. For this reason, the ROI model created in the measure phase is deemed a “Work in Progress”. As the project progresses the ROI model becomes more realistic, with the final and most accurate model created following the pilot implementation.

It is often difficult to find a team member or members to ‘own’ the ROI model. It is very important to identify individuals within the project team to work with the Financial Champion to regularly validate the model.

Difficulty sometimes arises in the Financial Champion buy-in of the approach to creation and validation of the ROI model. It is imperative that the team understand how the Financial Champion defines soft and hard savings, as well as revenue generation.

**Applications of the Excel Based ROI Template within Quality Curriculum**

Typical quality curriculum within Engineering Technology programs includes Total Quality Management (TQM) courses at the graduate and undergraduate level. Within the IUPUI MET and IET programs, TQM courses require direct application of principles to a field project, typically with an outside company. These projects typically result in a report returned to the company with recommendations of operational or process improvements as a result of the student project team analyses. An estimate of economic impacts in the form of an ROI analysis is a required component of this report.

Initially, the economic assessment of the impact of implementation recommendations was assessed using traditional accounting or engineering economy methodologies. As previously stated, these methodologies were cumbersome to both the student and the partnering company. However, since the healthcare ROI model was developed under the partnership with SSFHS in January 2006, it has been customized for use and applied within TQM projects for non-healthcare (service and manufacturing) applications within the Engineering Technology quality curriculum.
This customization includes adjustment of financial terms to meet those most often used within service and manufacturing industries. Additionally, the case study for the hands-on exercise has been changed to reflect environmental services waste removal from a service facility.

Feedback from the students and partnering companies has been very positive. Similar to our work in healthcare, we have found that the inclusion of front line staff in developing the ROI model increases overall awareness of the financial implications of the project.

Conclusions:

We have created a methodology for standardized economic evaluation of process improvement projects within healthcare. This methodology includes an Excel based ROI Tool and instructional materials and exercises used to introduce project team members to financial concepts and financial model development. Although initially developed for use within healthcare, this methodology has been successfully applied within the framework of undergraduate and graduate level quality curriculum.

The next steps in development of this methodology are to more formally link the Excel based tool with financial information from evidence based clinical economic research models for patient outcomes.

