Application of Six-Sigma in finance: a case study

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ABSTRACT

In recent years, companies have begun using Six Sigma Methodology to reduce errors, excessive cycle times, inefficient processes, and cost overruns related to financial reporting systems. This paper presents a case study to illustrate the application of Six Sigma Methodology within a finance department. Specifically, the case relates to the Continuing Account Reconciliation Enhancement project undertaken by the finance department of a major U.S. defense contractor. The goal of the project was to streamline and standardize the establishment and maintenance of costing and planning for all business activities within the current financial management process. The Six Sigma implementation resulted in a significant reduction in the average cycle time and cost, per unit of activity, needed to produce the required financial reports.

Key Words: Six Sigma, Process Management, Quality Management, Finance

INTRODUCTION

In 1987, Motorola developed and organized the Six Sigma process improvement Methodology to achieve "world-class" performance, quality, and total customer satisfaction. Since that time, at least 25% of the Fortune 200, including Motorola, General Electric, Ford, Boeing, Allied Signal, Toyota, Honeywell, Kodak, Raytheon, and Bank of America, to name a few, have implemented a Six Sigma program (Antony *et al.* 2008, Hammer, 2002). These companies claim that Six Sigma has significantly improved their profitability (Hammer, 2002). For example, in 1998 GE claimed benefits of $1.2 billion and costs of $450 million, for a net benefit of $750 million. The company's 1999 annual report further claimed a net benefit of more than $2 billion through the elimination of all non–value added activities in all business processes within the company (Lucas, 2002). Similarly, Allied Signal reported that Six Sigma was a major factor in the company's $1.5 billion in estimated savings (Lucas, 2002). Six Sigma has also enabled Honeywell to reduce the development time required to redesign Web sites by 84% for its specialty materials (Maddox, 2004b).

Six Sigma has been defined as a management strategy for improving product and process quality (Hahn *et al.* 2000, Harry and Schroeder, 2000, Sanders and Hild, 2000). It is also a statistical term used to measure process variations, i.e., how far a given process deviates from perfection, which causes defects. Six Sigma works to systematically manage variation and eliminate defects--or to get them as close to zero as possible (Harrison, 2006). Six Sigma initiatives have typically been implemented on shop floors of manufacturing firms to manage "process variations" (defects or errors), to improve quality and productivity (Revere and Black, 2003), and as a result, to increase the profitability of a company (Aggogeri and Gentili, 2008, Anand *et al.,* 2007, Lucas, 2002).

Functional support areas such as finance, accounting, marketing, human resources, procurement, and retail, however, have generally not kept pace with manufacturing in implementing Six Sigma programs. In part, this is due to the rigorous statistical requirements of applications that were considered too difficult to be applied within other functional areas or to predominantly service organizations (Harrison, 2006, Pyzdek, 2003, Watson, 2004). For example, in the areas of finance and accounting, Six Sigma has been used only to monitor and measure the financial impact of a program on the shop floor, in spite of the fact that, according to a 2005 Ernst & Young study (cited in Juras *et al.,* 2007), 14% of public companies have ineffective internal controls, which results in output errors, excessive cycle times, inefficient processes, and cost overruns.

This paper presents a case study of Six Sigma as practiced in the finance department within a major division (hereafter referred as IDS) of a leading defense contract manufacturer. Purposes of this paper were to describe the application of the Six Sigma Methodology in streamlining the financial reporting process within the finance division of IDS, to report preliminary findings, and to examine conditions which contributed to the successful implementation. The company's name and other attributes have been altered for reasons of confidentiality.

A detailed review of Six Sigma literature was not deemed necessary for the purpose of this case study since the literature is well known and pervasive, at least within manufacturing operations. First, this study will briefly summarize the five phases of the Six Sigma Methodology. Next, it will briefly describes the application of Six Sigma in various functional areas other than manufacturing operations. Third, the paper presents an overview of the Six

Sigma initiative at IDS, to provide a context for the case study. Finally, the actual implementation of Six Sigma Methodology in the Account Reconciliation process is discussed along with preliminary performance results.

WHAT IS SIX SIGMA?

Over the past two decades Six Sigma has evolved from a focus on metric to the Methodology level and finally to the design and development of entire Management Systems. As a Metric, when a process is operating at Six Sigma level, it will produce nonconformance (i.e., defects or errors) at a rate of not more than 3.4 defects per one million opportunities. As a Methodology, Six Sigma leads to business process improvement by focusing on understanding and managing customer expectations and requirements (Brewer and Eighme, 2005; Rudisill and Clary, 2004). As a Management System, Six Sigma is used to ensure that critical improvement opportunity efforts developed through the Metrics and Methodology levels are aligned with the firm's business strategy. The focus of this paper, however, is on the application of Methodology for business process improvement within the financial reporting process.

The core of the Six Sigma Methodology level is DMAIC which stands for define, measure, analyze, improve, and control. These are explained in detail in the following sections. In the Define phase, the project team must work closely with stakeholders to clearly define the problem statement, project scope, budget, schedule, and constraints. Understanding customer (internal and external) requirements is the key to achieving the project's goal. The team has to define problems and goals of the project that are consistent with customer demands and with the firm's business strategy. Process mapping and "voice of the customer" (VOC) tools are iterative techniques recommended as a means of incorporating customer requirements.

During the Measure phase, the team creates a value stream mapping (VSM) of the process, capturing the flow of information—where and what information is needed. Then, based on the VSM, the team starts collecting data relevant to measuring the current process performance relative to the project's goals. The most important activities in this phase are the identification and validation of data accuracy. The most widely used tools are VSM, run charts, brainstorming, balanced scorecards, documentation tagging, data collection check sheets, and decision metrics.

During the Analyze phase, the team needs to collect and analyze the data to understand the key process input variables that affect the project's goal, such as whether time spent on current activities is value added or non–value added. A VMS may be used as part of the overall analysis to generate a list of potential root causes for why the process is not performing as desired. The tools that can be used are process flow chart, value stream mapping, cause-and-effect diagram, Pareto analysis, histograms, control charts, and root cause analysis.

During the Improve phase, the team needs to design and conduct experiments (DOE) on a small scale using a formal evaluation process to identify and evaluate optimal or desired alternatives against the established criteria. A list of all possible solutions should be developed, enabling the team to eliminate the root causes of problems. The recommended tools include brainstorming, cost-benefit analysis, priority metrics, failure mode and effect analysis, and process flow diagrams.

Finally, during the Control phase, the team should standardize and document the new process to support and sustain desired improvements. To sustain long-term improvements, *how* the improved process is expected to result in operational and financial improvements (Foster,

2007) should be transparent to all employees. Tools used include statistical process control charts, flow diagrams, and pareto charts.

APPLICATIONS OF SIX SIGMA

In recent years, a number of manufacturing and service companies have realized that Six Sigma Methodology is flexible enough to be applied throughout all business functions. Examples of Six Sigma applications in different functional areas other than manufacturing operations are discussed next.

Sales and Marketing

In recent years, several companies have considered using Six Sigma to improve marketing processes. For example, the marketing and sales organizations at GE and Dow have been using Six Sigma for new product development and customer support to reduce costs, improve performance, and increase profitability (Maddox, 2004a). Other companies use Six Sigma in marketing and sales as a road map to capture market data and competitive intelligence that will enable them to create products and services that meet customers' needs (Pestorius, 2007; Rylander and Provost, 2006). Rylander and Provost (2006) suggest that companies should combine Six Sigma Methodology and online market research for better customer service, and Pestorius (2007) noted that Six Sigma could improve sales and marketing processes.

Accounting and Finance

The Six Sigma Methodology has made its way into the accounting function and has contributed to reduced errors in invoice processing, reduction in cycle time, and optimized cash flow (Brewer and Bagranoff, 2004). The accounting department at a healthcare insurance provider, for instance, developed an applied Six Sigma Methodology to improve account withdrawal accuracy. Prior to Six Sigma implementation, rectifying an error in the billing process involved a number of reconciliation checkpoints and manual workflow, which resulted in 60% of customer accounts being charged less than the amount due and about 40% being overcharged. After Six Sigma implementation, the defect rate reached near zero and cycle times were reduced from two weeks to three days (Stober, 2006). The U.S. Coast Guard Finance Center used Six Sigma to create a new standardized process for accounts payable services, which improved customer satisfaction levels (Donnelly, 2007).

A number of companies have applied Six Sigma to the finance process to reduce variability in cycle times, error rates, costs, "days to pay" of accounts payable, and improve employees' productivity ratios (Brewer and Bagranoff, 2004; McInerney, 2006). Other companies have used Six Sigma to reduce the cycle time of the quarterly financial reporting process (Brewer and Eighme, 2005) and to reduce the time needed to close books, reduce variability in financial reporting, improve shareholder value, and increase the accuracy of the finance process (Gupta, 2004). Foster (2007) conducted a longitudinal study comparing the financial performance of companies who had implemented Six Sigma programs with those who did not have such a programs. He found significant effects for those firms using Six Sigma on free cash flow, earnings, and asset turnover. Six Sigma, however, did not appear to affect sales return on assets, return on investment, or firm growth. As a result, Foster (2007) suggested if

firms want to improve cash flow, earnings, or productivity in using assets, Six Sigma may of use. He also found that the companies with low cash flow and no Six Sigma programs did better than companies using Six Sigma. He suggested that for cash poor firms, Six Sigma may be a drain on resources in that these companies may not have the cash and time necessary to sustain effective Six Sigma results over time.

In another industry level analysis, York and Miree (2004) studied the link between quality improvement programs and financial performance. They studied the financial performance of "quality award winning" companies against SIC control groups both before and after winning the award. They found that quality award winning firms had better financial performance both before and after winning quality awards, suggesting that winning the award was a covariate for financial success.

Most studies have attempted to assess the impact of Six Sigma on financial performance have occurred at the aggregate industry level of analyses. Very few actual case studies have been reported of the impact of Six Sigma on the finance process itself. That is, how Six Sigma can change the way in which finance conducts its various work activities and the resulting impact has seldom been documented in the literature. This case study attempts to address this gap at the more micro level of within firm process analysis.

SIX SIGMA AT IDS

This case study is based on the information gathered from IDS's implementation of a companywide Six Sigma initiative. The Six Sigma initiative at IDS was developed by benchmarking the best practices of two other defense contractors, as well as Toyota's Lean Thinking model, to meet the stringent standard requirements of the Department of Defense. The initiative at IDS received the total commitment of senior executives, a consortium of external Six Sigma experts, and a group of highly trained individuals throughout the company's business divisions.

The Six Sigma team was comprised of a full-time master expert (Master Black Belt -- a common Six Sigma designation for the project leader) and a network of internal experts (Black Belts) working very closely with project managers. The primary goal of the team was to develop an overall Six Sigma strategy consistent with customers' requirements and the company's mission statement. The long-term goal of the team was to create special-level project opportunities for the division that could eventually lead to cultural change in the workplace. Forty projects were identified that encompassed the division's business profile. Using a formal standardized metric, the team prioritized a list of project opportunities in order of their anticipated contribution to the goals of the company.

In the next section, the implementation of DMAIC Methodology in one of these 40 projects i.e., the Continuing Account Reconciliation Enhancement (CARE) project is discussed in detail.

Define

Through collaborative efforts with other stakeholders in the project, the team visualized an opportunity to develop and document a standardized process for establishing and maintaining cost and financial planning for all business divisions within its current financial system. The primary stakeholders in this project were from the finance organization, which is responsible for

generating cost analyses and other financial reports for managements' consideration. The team had the commitment of the vice president of the division, who sponsored the CARE project. The process entailed identifying undesirable or non–value added activities within the current process, implementing improvements in control systems for achieving sustainability, and delivering measurable results that change the way people think and act.

The Six Sigma team began by working with internal customers to define the objectives of the project, including the deliverable, opportunity statement, scope, schedule, budget, and constraints. The team defined the current problem as "the process cannot produce all Financial Planning and Analysis (FP&A) requirements in the most efficient and effective manner." The primary objective of the project, therefore, was to streamline and document all cost elements in the planning process for the current financial system.

To achieve the objective, the Six Sigma team recognized two primary issues. First, there was a need to clarify and simplify the current financial reporting process for internal customers by identifying all non–value added and confusing steps to reduce reporting cycle time and cost. Second, the team envisioned an improved process for both internal (called Firm contracts) and external customers (called Non-Firm) companies who outsourced their financial reporting to IDS. The improved processes were expected to result in more timely, complete, and accurate data for planning.

Measure

At this stage, the team conducted value stream mapping analysis to measure the performance of the current reporting process in terms of average hours required to complete the FP&A reports and the subsequent cost of preparing all the reports using activity based costing (ABC) methods. The existing cost and financial planning process was not clearly documented or consistently followed, which often resulted in rework and dual update loops, as shown in Figure 1 (Appendix).

These loops inevitably create opportunities for non–value added activities such as errors, excess movement, additional IT training and maintenance costs, inconsistent data, and waiting time to creep into the process. For example, in step 1 on Figure 1, when an internal (Firm) contract was received it was entered into SAP; whereas Non-Firm business was not entered into business planning and simulation (BPS) software until it was required by the five-year plan, resulting in delays and substantial variations in the process. In step 2, when a project is not defined, it costs more and delays the process because the finance department has to request more information (step 3). Only when a project definition was sufficiently established for a Firm for a contract, will a transaction be opened in SAP in step 4.

Another problem with the existing process, step 5, was that the financial reporting for project definition was produced with data from the Business Information Warehouse (BIW), which is a combination of databases, and database management tools that are used to support management decision making. The BIW is used in SAP and as well as other applications to support management decision making. In step 6, the project cost plans were not necessarily developed by the finance team for the program (i.e., the Cost Experts), and preparers consequently used a myriad of different financial tools (e.g., Microsoft Excel, BPS, etc.). Next, in step 7, cost element breakouts were defined using input from the various reporting tools. The Non-Firm data was added in BPS as requested by external clients, and Firm data was entered into SAP for the five-year plan FP&A requirements. In step 8, the analysis was prepared along

with reports and presentations. Finally, in step 9 the FP&A's were revised to incorporate management change requests and both SAP and BPS data bases were updated as needed.

The team found that they were spending, on average 150 hours to produce 10 internal Firm financial statements and 50 hours on 10 outside Non-Firm reports. In summary, the finance department spent a total of 200 hours to generate 20 reports (including the ongoing costs of preparing 12 monthly reports) for an overall cost of $360,000. Using activity based-costing principles the cost of an activity is equal to: Volume x Time x Labor Cost. In this case, this would be equal to 32 reports times 200 hours times a fully burden labor costs for a total of $360,000.

Analysis

The team began this stage by creating a cause-and-effect diagram, as shown in Figure 2 (Appendix). This tool is used to identify possible root causes of why "the process cannot produce all cost and FP&A requirements in the most efficient and effective manner." The team identified three major causes and grouped them into the following categories:

1. Lack of complete Firm cost and financial plans
2. Multiple sources of data and databases
3. Lack of complete Non-Firm cost and financial plans

Next, the team used these categories as the basis for further detailed analysis to identify the contributing factors for each major cause, as shown in Figure 2. For example, one of the major causes related to the "Lack of Firm complete cost and financial plan" (activity 1) was attributable to: a) incomplete costs being entered into BPS and SAP for all businesses within the division, b) the current project cost plans were defined in various, inconsistent formats at the discretion of the finance managers, c) the cost element plan was not required for contracts to be established in SAP. Furthermore, planning was done using multiple tools and was not copied into or maintained in a common centralized database. Additionally, planning was not consistently performed at the cost-element level because it was not previously considered necessary for FP&A requirements. Hence, the analysis concluded that planning was not required for contracts to be established in SAP, nor was it necessary for FP&A requirements.

The team used VSM analysis to recommend the following actions for overall process performance improvement:

1. Identify all business divisions that require a baseline in the current financial database.
2. Establish baseline data by resource, cost element, and time phasing for each project.
3. Identify and eliminate all non–value added activities to improve the response time at all levels of management for a variety of cost analysis and FP&A requirements, including five-year plans, bookings forecasts, sales forecasts, and annual operating plans.

Improve

In this stage, the team provided two solutions for implementation by the finance department. First, implement all the actions identified through VSM analysis. Second, redesign the process by following the flow chart shown in Figure 3 (Appendix) which essentially simplified the process by eliminating non-value added steps in the current process.

In addition, the Six Sigma team recommended that all business divisions be required to implement the following actions to enhance financial reporting capabilities:

1. Develop initial cost-element plans by project for both internal and external contracts.

2. Regularly copy cost plans to various FP&A versions for five-year planning, sales forecasting, and bookings forecasting.

3. Update and maintain cost-element plans as new businesses are identified and funding is received.

4. Update and maintain financial plans.

5. Copy updated financial plans to various FP&A versions accordingly.

After implementing the recommended process changes and actions, the following results were achieved:

- Cost-element and financial planning activities for all business divisions were standardized, consistently created and maintained in a centralized database;

- Processes were streamlined, documented, and consistently followed throughout the reporting process;

- Significant reduction in cycle time was achieved for producing the FP&A reports; specifically, the revised process resulted in 100 hours reduction in cycle time, resulting in cost savings of $130,000 per year or roughly a 64 percent reduction.

A cost savings of $130,000 may not appear to be much considering the cost of Six Sigma implementation, but recall this is only one of forty projects within the finance function. In reality, the reported cost *savings* of $130,000 a year is actually cost *avoidance*. That is, in order to increase profitability one must lower cost by, for example, reducing headcount through attrition or by absorbing future increases in the volume of work but with the same labor costs.

Control

The goal of the project was to pull cost elements and financial plans from their various sources, organize them, and combine the information into one comprehensive report for analysis and monthly program presentations. To sustain results, the team standardized, documented, and distributed the new process for the finance department to follow. Additionally, ongoing performance was monitored and became part of the formal performance evaluation process.

SUMMARY AND CONCLUSIONS

In an effort to remain competitive, process improvement has become a strategic imperative for companies. The Six Sigma primarily used on the shop floor has improved firms' manufacturing processes. In recent years, however, Six Sigma Methodology has proven to be successful in other functional areas, including sales and marketing, supply chain management,

accounting, and finance. Current financial reporting procedures of most companies contain numerous errors, excessive cycle times, duplicated data entry, and additional costs due to inefficient processes. Specifically, Six Sigma is one tool that could enable finance departments to streamline their financial reporting process, as described in this case study.

The purpose of this paper was to explain how Six Sigma Methodology was applied and implemented within the finance function of a major division within a defense contractor. The Six Sigma DMAIC Methodology was used to streamline the 'Continuing Account Reconciliation Enhancement' process. The team followed the five phases of DMAIC in this project and the result was a significant reduction in errors, cycle times, and costs associated with preparing financial reports. The potential impact of cycle time reduction on both internal and external customer satisfaction was not measured in this study but could be incorporated into future research.

Lessons learned from this case study are as follows:

1. Lack of standardize, clearly documented, and agreed upon processes inevitability leads to variability which results in confusion and adds labor cost.
2. Maintaining a single centralized database (verse multiple databases) can reduce systems maintenance costs, data duplication, and overall processing cycle times.
3. Six Sigma Methodology can be successfully applied in business functions and services other than manufacturing operations.

More in depth case studies are needed in the future to specify the contingent conditions under which Six Sigma may or may not be optimally deployed.

The success of Six Sigma Methodology implementation ultimately depends on executives' continuing commitment to the program. To sustain improvement in the future, the processes and their associated metrics must be simple, transparent, understood, and accepted by all parties involved. Otherwise, none of it will be of any use, as people will not follow them, trust them, or use them.

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APPENDIX

Figure 1: Current Work Flow Process

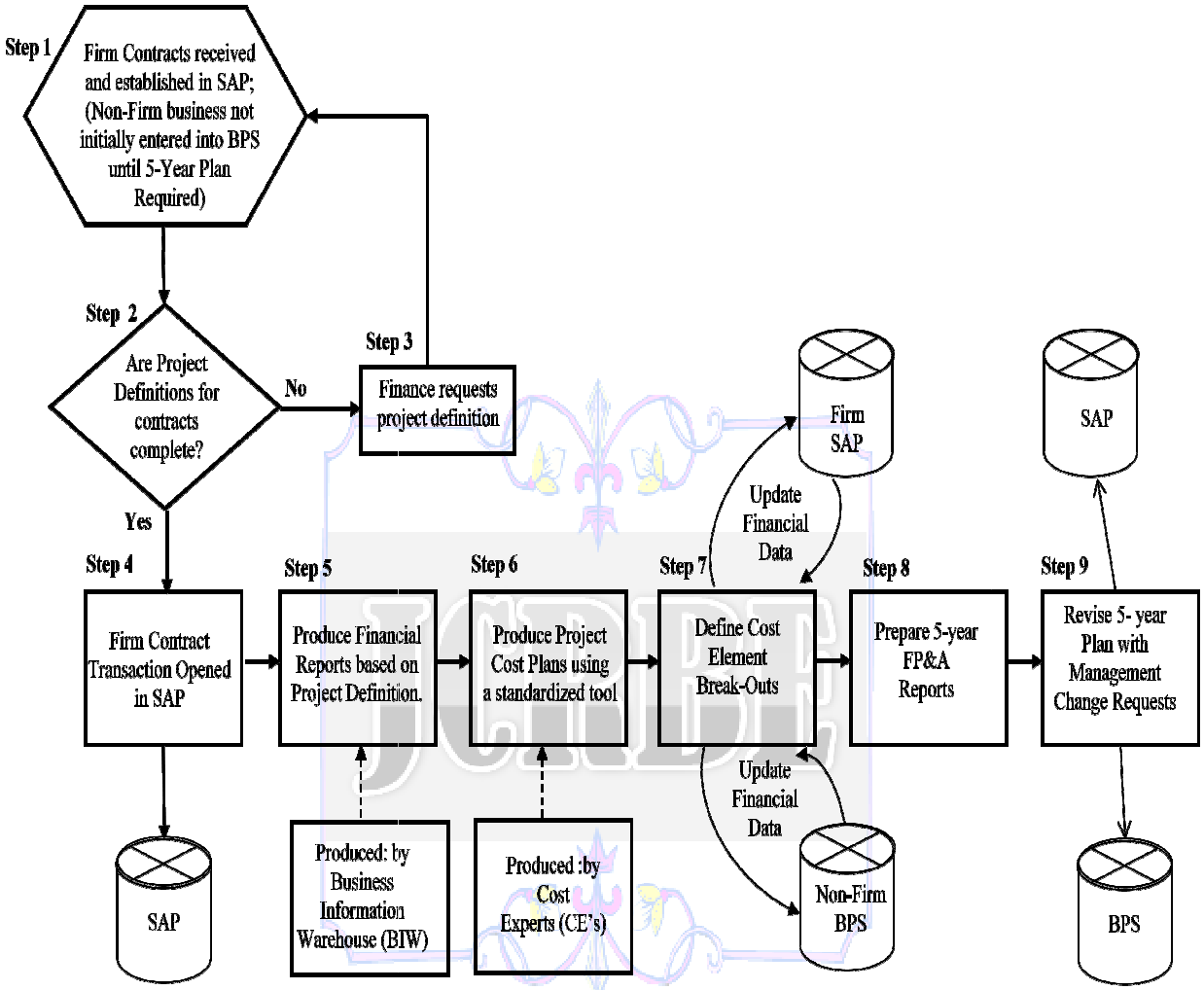

Figure 2: Cause-and-Effect Diagram

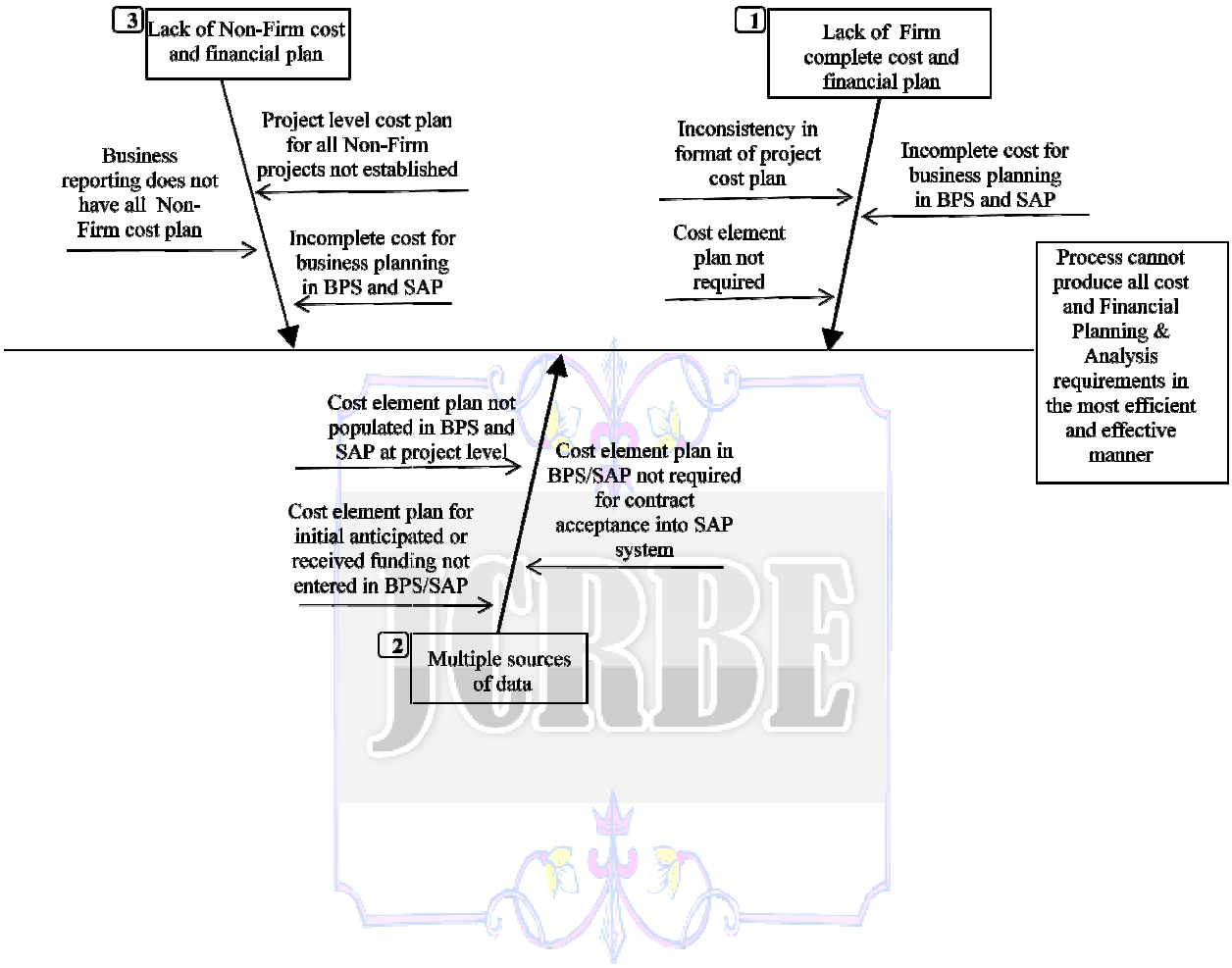

Figure 3: Proposed Work Flow Process