UNITED STATES INTERNATIONAL UNIVERSITY

SCHOOL OF BUSINESS

Jimmy Macharia

Software Technologies Limited (STL)

"M/s Jyoti, this is Dipesh Kumar from Firestone East Africa Limited, it's Friday 16:45. Listen Jyoti – Bridgetone won't take this any further until we get a firm commitment from you and from STL. We've tolerated a lot of software errors so far, and this is a causing us loss in business revenue. What are you doing about it? Please call on me first thing Monday with an assurance that you will provide a lasting solution."

Jyoti Mukherejee, CEO of Software Technologies Limited (STL), listened to the message on her voicemail and wondered what course of action she should take. She was quite pleased with how STL had performed since 1991 when it was founded, and has for the last nine years been the CEO of the company. Forth quarter 1999 results indicated that the company was well on the way to achieving, for the first time in almost a decade, all three of its long-term financial goals of 20% EPS growth, return on equity, and an "A" Rated balance sheet. The company had not only withstood an aggressive sales drive and appointment of new vendors in Nairobi by its principal, Oracle International Corporation, but also launched its own e-Horizon suite of Software product to compete with others in the market like Oracle systems. To neutralize the effect of appointment of new vendors by Oracle, the STL board had in December 1998 made a key decision, that the eHorizon suite of products be developed to a full Enterprise Resource Planning (ERP) system. However, despite the use of their own software process improvement (SPI) model, the "STL Way" in the earlier developments of eHorizon, the error rate counter in their software development process as well as in other business processes including training, personnel and finance was at unacceptable level. Consequently the CEO and the board had decided to drop STL Way process improvement approach and implement a more proven model.

The call from Dipesh had kept Jyoti restless in thought over the weekend. On Monday, January 4, 1999 the executive board of STL was to meet and was expecting a recommendation from the CEO on the software process improvement model that STL would adopt to meet the challenges of developing eHorizon to a fully competitive ERP system as well as satisfy its customers. She wondered, "which approach among Capability Maturity Model - Integration (CMMI), ISO 9000, Six Sigma, and Total Quality Management (TQM), will I recommend to the board?"

Jimmy Macharia, Assistant Professor of Information Systems, prepared this case with the assistance of Dr. George K'Aol , Associate Professor of Entrepreneurship, and Charles Mayaka, Assistant Professor of Marketing both of the School of Business, United States International University (USIU) , as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation. USIU acknowledges the financial support of the International Finance Corporation (IFC) / Global Business School Network (GBSN) in the preparation of this case. Some names in the case have been changed.

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Background of Software Technologies Limited

Software Technologies Limited was founded in 1991 in East Africa, and was in 1999 one of the leading Information Technology (IT) Solution providers in the East African region. For almost 9 years, STL had provided flexible, innovative business solutions and services essential to running complex and dynamic multinational organizations. In 1995 they opened their branch in Uganda, while the branch opened in USA in 1998 was thereafter affected by low business due to the effect of 911 terrorist phenomena. By 1999, STL team grown to over 120 systems engineers and consultants spread over three continents. In Africa STL had branches in Nairobi-Kenya which was the STL headquarters, Kampala in Uganda, and Dar-es-salaam in Tanzania. In the United States of America (USA), branches were established in San Francisco in the state of California, while in the Asian continent STL branch was based at Mumbai (Bombay), India.

STL provided business IT solutions to a number of Kenya's major companies and industry leaders such as British Petroleum, British American Tobacco (BAT), DelMonte, Kenya Airways and Securicor. The STL IT solutions could be classified into six as follows:- (i) Oracle Database & Tools, (ii) custom and bespoke software development, (iii) eHorizon Suite of Solutions, (iv) Oracle E-Business Suite, (v)Training at the Institute of Software Technologies and (vi) 24 x 7 customer support.

Oracle Database & Tools was a product of Oracle Corporation, the world's largest enterprise software company .With annual revenues of more than $9.4 billion, the company offered its database, tools and application products, along with related consulting, education, and support services. Headquartered in Redwood Shores, California, Oracle was the first software company to develop and deploy 100 percent Internet-enabled enterprise software across its entire product line: database, server, enterprise business applications, and application development, and decision support tools. Oracle technology was found in nearly every industry around the world and in the offices of 98 of the Fortune 100 companies. Software Technologies Ltd. was one of the partners of Oracle in East Africa. They had almost 9 years relationship with Oracle in East Africa. STL offered Oracle's tools and databases including:- Oracle Database 10g, Oracle's Application Server 10g, Oracle Developer Suite 10g, Oracle E-Business Suite, Oracle Collaboration Suite, and Oracle Workflow.

In the third quarter of 1998 the Executive Management of STL had developed and published a three-year business strategic plan. Key to the success of the plan was the use of a process improvement model. STL therefore embarked on a project to develop a comprehensive process improvement model for the period 1999 — 2002 as a means of improving the software development activities within its software engineering department. To lead the process was M/s Jyoti Mukherejee –the CEO, Mr Prakash - Director Business Development, and Mr Vivek -Director Finance (See Exhibit 1).

STL Software Engineering

Custom and Bespoke Software Development

STL developed bespoke or custom software and applications that meet client needs, add value to their processes and dollars to their bottom line. Among STL's developed software was the industry-leading software product called the eHorizon Suite. The Executive Management of

STL had now agreed to extend the suite to a full ERP system to compete with other ERP products in the market.

eHorizon Suite of Solutions

The eHorizon Suite was a mid-range ERP solution designed and developed by STL that provided seamless total information solutions for a growing local and international market. It was developed using cutting-edge Oracle technology and had a line of over 25 customizable solutions encompassing all facets of a client's business; to help deliver cost savings and a tangible return on investment. Solutions were geared mainly towards assisting users to manage their information efficiently and effectively. The eHorizon solution suite included the following modules:

(a) *eHorizon Human Resources Software* and HR Management Solutions Suite comprised: eHorizon Personnel, eHorizon Payroll, eHorizon Loans, eHorizon Pension, and eHorizon Time & Attendance.

(b) *eHorizon Financials* was an integrated set of applications, which was designed to transform any business to a strategic force in the then fast-moving corporate arena. The suite included:-General Ledger, Fixed Assets, Receivables, and Payables .These Financial modules were often used in conjunction with the Manufacturing modules: Inventory, Purchasing, and Order Management.

(c) *eHorizon Customer Relationship Management (CRM)* was a high productivity sales tracking and Customer Relationship Management solution for companies looking to track, manage and analyze sales leads. CRM was a windows based graphical user interface (GUI) solution that exploited the benefits of the Oracle RDBMS and tools to deliver high response rates, easy to use data recording screens, powerful management inquiry screens and online context sensitive help. Major features included:- User defined sales cycle and status, Customer business profile, Daily diary generation, Prospect tracking, Correspondence generation, Follow-ups assignment and analysis, General task allocation and performance analysis, and Online product/resource information .

(d) *eHorizon Fleet* module was designed to be both a fully integrated or stand alone computerized fleet management system. It was the recognized market leader in both private and public sectors. This system provided a fast, easy and effective way to organize and run a company’s fleet from day to day. The system comprised of the following modules: Vehicle , Driver, Accident, Finance, Day-to-Day and System Management.

(e) *eHorizon Inventory* was a supply chain inventory management tool that was designed to increase operational efficiencies by streamlining material movement while providing tight material control.

(f) *eHorizon Time and Attendance* was an application that recorded the attendance of employees using biometric technology and the power of the Oracle database. It enabled an organization to eliminate "time-fraud" – where workers claim to have worked for longer hours than they actually have – and "buddy-punching" – where one worker punches or signs in for another. It was used to control access to highly sensitive locations and it substantially reduced the inaccuracies, and high management costs associated with such systems. Furthermore, the system makes the attendance module intelligent enough to compute accurate attendance including multiple levels of overtime.

STL Software Development Process

Over the years STL had used STL Way Methodology for process improvement. The methodology was developed in-house to describe a framework of eight stages of evolution or

steps of their software development process. The methodology describes an evolutionary progressive path from customer problem definition, to customer support. This method was applied to new software product development but not to the entire organization. There are eight stages in the STL way numbered 1 through 5. Each step corresponds to a generic set of activities and specific practices. The eight product development process were analysis, design, development, testing, integration, delivery, implementation, and after sales service.

Problems & Challenges at STL

Despite the use of their own software improvement methodology, the error rate counter was still high, and the CEO wondered where the processes were going wrong. STL had identified 350 key areas for optimization (continuous optimization). With the rising clients dissatisfaction with the error rate, the CEO and the board were looking for ways of reducing the error rate and consequently reducing the cost of maintenance and development. Many companies in Kenya at that time were small companies, and none had implemented software improvement model. Three years were needed to start certification, train, and institutionalize. STL had 5 projects that used 350 areas for process improvement, it was therefore critical that they get their error rate right. The situation was further made desperate by the fact that STL competitor were not focused on quality since they could secure numerous contacts through corrupt means.

In the experience of STL Way, optimization was not easy since it was a methodology only applicable to software projects. STL was therefore eyeing the benefits of adopting a process improvement process that would be applicable to the whole organization. In addition, they could imagine several advantages such as, boosting the motivation for staff, self evolving, and making their products more stable and reducing maintenance costs without depending on "Heroes" unlike in the STL way. However, the CEO and the manager Mr Patel Sing, feared that the implementation of a new process improvement model would be very taxing for the staff.

Competition in Kenya was from foreign companies, that largely dealt with hardware supply and hence lacked continuity of service. On the other had the government did not encourage local firms due to the fact that corruption was such a barrier to them and yet a door to foreign companies with huge capital. However, due to the quality of STL products, The Nairobi Stock Exchange has been using STL software since 19993, and the NATIONAL Social Security Fund (NSSF) to benefited from the use of STL software product from 1994. To meet the emerging challenges, the STL board of directors had unanimously agreed to drop STL Way and select among CMMI, ISO 9000, TQM, and Six sigma. M/s Jyoti the CEO had to advice the board which one was most appropriate for STL.

Software Process Improvement (SPI) Model Alternatives

Capability Maturity Model - Integration (CMMI)

Overview

CMMI stands for "Capability Maturity Model - Integration." It is used to help make business management decisions about how software is developed. The CMMI focuses on the managerial aspects in software development. Whereas a software development model is a way for programmers to code, test, deploy and build on their software. A software management model is a way for software projects to plan, organize and identify what needs to be done to run the project. It is a business management model used to gain insight and to control the development, so that you one can successfully predict and adjust project activities. Subsequent to the original release of the CMM, maturity models for other aspects of managing technical projects were created. In late 2001, the CMMI was released which integrated all the models. The CMMI also included changes to the basic structure of the CMMI which made the model more effective and widely applicable to companies that found the original models too rigid. Today, the CMM/CMMI are the de facto standard for software management throughout the US and is internationally recognized as a very powerful business tool and competitive differentiator. It is published and developed by the Software Engineering Institute in Pittsburgh, PA. Each capability level corresponds to a generic goal and a set of specific practices. It has been utilized by thousands of companies throughout the world to identify structure and implement their business improvement programmes, increasing their return on IT investment. See Exhibit 2.

Cost Benefit Analysis for CMMI

The STL board of directors mandated the CEO to table the cost benefit analysis of each potential model. The first to be tabled was that of CMMI, where process improvement dynamics of CMMI cost, benefit, and return on investment (ROI) analysis was done using Phillip's[1] equations for B/CR and ROI%. The implementation cost items were composed of CMMI Policies and Procedures were modeled for level 2 and 3 and CMMI Evidence of Use. These costs were $293,100 and $1,541,850 respectively. The assessment preparation costs were $240,000. This gave a total deployment costs for level 2 & 3 as $2,074,950. The benefits were to be realized by use of product lines and systematic reuse. These benefits included savings in maintenance and development, and an increase in productivity, which was consistent with CMMI experience. The total benefits of $12,164,200 in savings were to be released if they chose CMMI (see Exhibit 2b).

Advantages

The CMMI presents sets of recommended practices in a number of key process areas that have been shown to enhance software process capability. The CMMI is based on knowledge acquired from software process assessments and extensive feedback from both the industry and the government. The Capability Maturity Model provides software organizations with

[1] Phillips, J. J. (1997). Return on investment in training and performance improvement programs. Houston, TX: Gulf Publishing Company.

guidance on how to gain control of their processes for developing and maintaining software, and how to evolve toward a culture of software engineering and management excellence. The CMMI was designed to guide software organizations in selecting process improvement strategies by determining current process maturity and identifying the few issues that matter most. Many authors suggest that in recent years, a large number of software companies around the world have adapted the highly successful Capability Maturity Model- Integration for Software (CMMI) to guide software process improvement programs The CEO argued to the board the following advantages of CMMI to be: risk reduction, cost and schedule adherence, improved quality, improved communication and customer satisfaction. Among the advantages of CMMI, the CEO mentioned improved customer relationships, using metrics so as to stay informed and and enable planning, improvements in culture and attitudes of developers, and quality improvements as a by-product of all that. The marketing director reiterated that as an IT company, CMMI accreditation will facilitate STL entry to the global markets.

Disadvantages

The finance director wondered how STL would overcome CMMI deficiencies. He argued that the potential limitations of CMMI such as: the Effort and cost involved in implementation, its tendency to ignore the 'unique' aspect of projects, the validity of scale and maturity questionnaire, and it's application of assessment/evaluation method, were major concerns. One of the directors said that he was originally skeptical of CMMI but from his background reading, he found out that continuous improvement allows fine-tuning for the projects and helps eliminate non-value added work. The question of Microsoft disregarding CMMI altogether was inevitable. The CEO gave an answer characterizing Microsoft as, in fact, at least a level three company according to her observations of its process practices. The common conclusion was to have a predictable defect rate. It was a general view that a software development organization must be at the process maturity level equivalent to at least level four of CMMI and this applied not only to STL software producers or government contractors, but to all software vendors.

ISO 9000 Model Alternative

Overview

ISO 9000 is a series of standards recognized worldwide and developed by one of the technical committees of the International Organization for Standardization (ISO). The best known of the series are ISO 9001, ISO 9002 and ISO 9003. Each of these encompasses the elements of a quality management system, including key work processes through which an organization provides services or produces products. Recognizing that some flexibility is necessary to get a good fit between the standards and individual organizations, ISO created three standards with three different combinations of elements: ISO 9001, ISO 9002 and ISO 9003 (see Exhibit 3).

The Elements of ISO 9000

Although many people associate these quality standards with manufacturers, ISO 9000 standards are applicable to a wide variety of organizations seeking to improve client services.

STL therefore considered it one of the plausible alternatives. It had 20 key elements namely:- (i) Management Responsibility, (ii) Quality System, (iii) Contract Review, (iv) Design Control, (v) Document and Data Control, (vi) Purchasing, (vii) Control of Customer-supplied Product, (viii) Product Identification and Traceability (ix) Process Control, (x) Inspection and Testing, (xi) Control of Inspection, Measuring and Test Equipment, (xii) Inspection and Test Status`, (xiii) Control of Non-conforming Product, (xiv) Corrective and Preventive Action, (xv) Handling, Storage, Packaging, Preservation and Delivery, (vi) Control of Quality Records, (xii) Internal Quality Audits, (xiii) Training, (xix) Servicing and (xx) Statistical Techniques (see Exhibit 3).

Cost Benefit Analysis for ISO 9000

The CEO and her Committee for process improvement examined the dynamics of ISO 9001 cost, benefit, and ROI analysis using Phillip's[2] equations for B/CR and ROI%. Deployment Costs were modeled for ISO 9000 in a 20-person software organization using the El Emam's[3] cost model which resulted in $218,396. Assessment Costs were further estimated. These costs included assessment preparation and fees. Both totaled to $112,000. The benefits were estimated based on the Total Life Cycle. These benefits included 15% increase in maintenance savings, and a 13% increase in productivity, which was consistent with ISO 9000 experience. The total benefits of $2,772,600 in savings was to be released if they chose ISO 9000 (see Exhibit 4).

Advantages

In one of the board meetings the chairman, Mr Prakash said "The existence of an organization without customers, or with dissatisfied customers, is in peril! To keep our customers — and to keep them satisfied, our software products and services needs to meet the our customers requirements. ISO 9000 provides a tried and tested framework for taking a systematic approach to managing our business processes, and our organization's activities so that they consistently turn out software products and services conforming to the customer's expectations. And that means consistently happy customers!"

Many authors suggest that ISO 9000 is arguably the most influential standard of its kind in the world. By the year 1999, over 343,640 companies from 150 different countries had sought certification with the ISO 9000 quality management standard. Its extensive diffusion and influence stand in stark contrast with the uncertainties over the standard's demerits such as cost. Further, a cross-industry analysis suggested that ISO 9000 improves the environmental performance of both certified and non-certified facilities. The CEO M/s Jyoti stated to the board that "Despite the fairly high cost, proceeding with formal ISO 9000 registration is money well spent. We as the STL board should look at it as a long-term investment in our company and for our customers. Over time, our improvements in operational efficiency should outstrip the initial costs."

[2] Phillips, J. J. (1997). Return on investment in training and performance improvement programs. Houston, TX: Gulf Publishing Company.

[3] El Emam, K., & Briand, L.C. (1997). Costs and benefits of software process improvement (IESE-Report 047.97/E). Kaiserslautern, Germany: University of Kaiserslautern, Fraunhofer-Institute for Experimental Software Engineering.

Disadvantages

The cost of ISO 9000 registration was significant in terms of both staff time and resources. Out of the 120 staff persons STL would likely require that ten people devote about half of their time to ISO 9000 implementation during an initial period of four to six months. In addition, the need to use external consultants to support the completion of the required tasks for ISO 9000 was a major overhead. Depending on various factors, such as how much consulting help STL would need, how many offices and branches would be included, STL would spend between $10 000 and $15 000 for support for ISO 9000 registration, particularly in the areas of training and manual preparation. They would also have to pay an additional $3500 to $7000 to cover the costs of an accredited ISO 9000 registrar. Among other concerns about the appropriateness of ISO 9000 to STL was the fact that by lumping everything under one heading "quality," the guideline blurred the lines between the software engineering, activities used to develop and maintain the software product (e.g., analysis, design, code, test, configuration control, reviews), and those engineering activities that fall under the heading of Quality Assurance (e.g., audits, inspections, metrics), which are used to assure the quality of the product and the development process.

Further, the guideline was criticized for it seemed to have skipped over one of the commonly accepted phases in software engineering, the detailed software requirements phase, as well as the guideline requirement for a quality plan. As stated in the guideline, the quality plan identifies a number of topics, many of which belong in the documents that define the engineering process or the specific plans for developing and testing a product and hence not necessary.

Six Sigma Model Alternative

Overview

The 1980s and 1990s mark the development of several quality tools. The tools ranged from total quality management (TQM), continuous quality improvement (CQI), to the new evolutionary tool appearing in the mid 1980s known as the Six Sigma. Many techniques, like TQM, CQI were the basic requirements for gaining a unique image and a competitive advantage. What was not central to these techniques, however, was the ability to measure quality issues and to detect the root cause of product defects faced by the organization at the production process. For the most part, quality issues such as defects were not detected until the product was out of the process or at the end of production, thus leading to exorbitant costs. The methodology’s lack of quantitative measurement and a database approach caused organizations to be ill advised with respect to product defects. Although the techniques such as TQM and CQI enabled companies to measure their operations with some degree of accuracy as to where the system had failed, they could not generate explicit data that could pinpoint at an early stage where in the processes the defects had occurred. The inherent limitations in these techniques prompted companies like Motorola to design a new technique known as “six sigma”. In the mid 1980s, in the form of a technical document to help minimize the defects that they were experiencing in their core competence. The development of this concept completely shifted Motorola’s view and approach to process evaluation.

Motorola developed Six Sigma in response to a growing number of complaints from its sales force about warranty claims for defective products and increasing pressure from competitors. Six Sigma not only improved Motorola’s products and processes, but it also saved the company more than US $15 billion in the 10 years after it began the program. This correlation between cost and quality, that highest quality results in lowest cost surprised many Motorola

executives. Since the late 1990s when Six Sigma started to move beyond the manufacturing industry and into the service sector, the adoption of Six Sigma among U.S. companies with revenues greater than $200 million had been around 28 percent.

Process Steps of Six Sigma

Key to the Six Sigma methodology of the 1990s is a five step process Define, Measure, Analyze, Improve, and Control (DMAIC). By systematically applying these steps (with the appropriate tools), practitioners of this approach had been able to save substantial dollars. Six Sigma organizations apply DMAIC or Design For Six Sigma (DFSS) structured knowledge-acquisition / problem-solving strategies that develop superior ideas leading to superior results in areas of strategic import, including financial results. DMAIC and DFSS are data-driven, fact-based approaches emphasizing discernment and implementation of the Voice of Customer (VOC). Six Sigma employs highly effective methods of VOC discernment in the "define" phase of both DMAIC and the DMADV (define-measure-analyze-design-verify) algorithm used in DFSS. Various tools and techniques are used throughout Six Sigma projects with those used in the Office of the Chief Technology Officer (OCTO) effort such as quality function deployment (QFD), the house of quality (HOQ), and failure modes and effects analysis (FMEA) (See Exhibit 5).

Cost Benefit Analysis of Six Sigma

In order to determine the suitability of the Six Sigma model, STL process improvement team examined the dynamics of Six Sigma cost, benefit, and ROI analysis using Phillips' equations for B/CR and ROI%. The deployment costs were modeled for implementing Six Sigma on a four-person project which resulted to $105,600 to train four people to perform Six Sigma. The cost of implementing Six Sigma by the four Six Sigma-trained engineers was $40,000. The total Life Cycle Benefits which included saved maintenance and development hours amounted to $4,664,600 (see Exhibit 6).

Advantages

"*The Six Sigma has the potential of being the biggest source of competitive advantage around, and hence, STL should consider its appropriateness for our business"* the chairman of the board said at one of the board meetings. *"The beauty of a Six Sigma approach to process improvement is the top-down commitment, buy-in, the focus on change based on voice of the customer, and using tools to gauge business effectiveness",* the CEO Jyoti stated *"As in any new model, six sigma has the same short-term advantages as any other change program: it produces quick-wins, can be implemented on the shop floor without having to change the entire structure and has the added benefit of providing a roadmap to progress well beyond gathering the initial "low-hanging fruits"*. However some board members wanted to where Six Sigma would manifest quick results. M/s Jyoti explained to them that `*"Some of the low hanging fruit were within the module development tasks and system analysis activities"*. The Six Sigma approach had become widely recognized as the most effective tool available to improve business performance and profitability. The evolution of the six sigma phenomenon and the ability that it enabled organizations to identify quality challenges, and has provided both tangible and intangible benefits. The tangible benefit would be the ability to reduce the number of defects from their production processes, for example 3.4 parts per million opportunities. The intangible benefits would often be referred to as business initiatives that could create competitive superiority, like GE's accomplishments.

Six sigma's would enable STL to maintain the focus on operational efficiency and magnify explicitly the impact when operation and process deviate away from the average number of defects. In the 1980's, terms like TQM and CQI were the buzzwords of everyday usage for business processes. These techniques' lack of measurement left a gap that organization had to fill ex-post. Six sigma established a completely new path to detect weaknesses in the process, and provided a mechanism to correct them. Although Six Sigma does not exactly provide huge cost benefits by its implementation, the glaring examples of many corporations having saved billions of dollars are true benefits. In addition the intangible results, such as having met the expectations of customers, and being able to improve employee relations are also paramount. Because some corporations have experienced its failure to meet stated goals, some critics often raise questions about the feasibility of implementing Six Sigma, while still others are dismissing it plainly. Obviously, in almost all cases, the reasons for Six Sigma failure had been external factors such as wrong or misguided selection of the tools, lack of application and lack of support from upper management. It was important to keep in mind that the successful implementation of Six Sigma required a top down approach and perseverance throughout. Also important to the process is proper and thorough Six Sigma training.

Disadvantages

Although the growth of Six Sigma had been significant, it had not been as effective as it could. Not many companies had adopted Six Sigma and for the two main reasons: it was a demanding and difficult task., and the training is expensive with only the largest companies in a position to afford Black Belts. Collecting and tracking huge amounts of data across multiple departments/business units has been difficult for Six Sigma due to a lack of standardized process monitoring technology. As a result, improvement projects tended to be department or function specific with poor integration between processes across the enterprise. Finally, although the Six Sigma methodology for solving problems is one of the best because of its discipline and rigor, it falls short in the "control" phase. Six Sigma's control phase tends to use manual methods for managing and sustaining improvements over time. It took a lot of time to figure out what data was needed, to develop a reliable data collection process and to analyze the results. A word of caution however the fact that when you target a specific process impact up and down stream in a transactional process, this would be detrimental. There is need to have a view of the whole process .

"From a realistic standpoint, I'm sure there are disadvantages too. But those disadvantages as in any process improvement program are not built into the methodology. Disadvantages, probably are more closely related to a lack of commitment in adopting the process; poorly defined problem statements resulting in poorly implemented solutions, lack of training on tools and measurements; and other things that many change agents face regardless of the methodology" The CEO M/s Jyoti explained to the board.

Total Quality Management (TQM)

Overview

Total Quality Management (TQM) was a management approach that originated in the 1950's and had steadily become more popular since the early 1980's. All companies tried to be the best and applied some strategies to reach their objectives of quality. Developing TQM was considered a competitive advantage and made the company more efficient, more valuable and more creative. The main goal of TQM strategy was to develop a program to achieve customer satisfaction and value. This program required to be developed internally and externally to achieve the perspective until the final customer. It could be applied in two levels ,Internal

departments and external partners. The TQM implementation would come from a real well determined program. That meant companies had to implement TQM by addressing identified constraints. Managers in companies where TQM was implemented developed their strategies depending on all these points. Some of the companies who had implemented TQM include Ford Motor Company, Phillips Semiconductor, SGL Carbon, Motorola and Toyota Motor Company.

Key Elements of TQM

TQM is a management philosophy that seeks to integrate all organizational functions such as marketing, finance, design, engineering, and production, customer service among others. It aims to focus on meeting customer needs and organizational objectives. TQM is the foundation for activities, which includes commitment by senior management and all employees, meeting customer requirements, reducing development cycle times, just in time/demand flow manufacturing, improvement teams, reducing product and service costs, systems to facilitate improvement, line management ownership, employee involvement and empowerment, recognition and celebration, challenging quantified goals and benchmarking, focus on processes / improvement plans, specific incorporation in strategic planning. This shows that TQM must be practiced in all activities, by all personnel, in manufacturing, marketing, engineering, research and development, sales, purchasing, and human resources (see Exhibit 7).

Cost Benefits Analysis of TQM

The CEO and her team examined the dynamics of TQM cost, benefit, and ROI analysis using Phillips' equations for B/CR and ROI%. Deployment Costs were modeled the PSP training and training costs for implementing TQM on a four-person project. This came to a budget-busting $148,400 to train four people to use TQM. The implementation costs by their four TQM-trained engineers came to $163,400 for their four TQM-trained engineers to produce 10,000 source lines of code (SLOC) using TQM. The Total Life Cycle Benefits were estimated for saved maintenance and development hours which. was estimated a savings of an impressive $4,525,400.

Advantages

The advantages of TQM are enormous because it motivates workers and generates substantial Potential in the organization. Although short-term gains are minor, cumulative long-term gains can be significant. TQM advantages spring from the principles on which it is founded, which includes among others empower workers, reduce variability in quality standard, reduce waste,, and management by facts

Disadvantages

The disadvantages of TQM highlight potential problems in real world applications would be: (i) TQM does require a change in organizational culture that may take years to accomplish; (ii) Some firms become disillusioned with TQM when they do not see any impact on their profit lines in the short run. As a result, they dismantle the TQM program before it is complete; (iii) Focuses on internal processes rather than on external result; (iv) Focus on minimum standard; (v) Develops its own ponderous bureaucracy; (vi) In addition, total

quality philosophy involves a comprehensive transformation (vii) Delegates quality to quality Czars rather than to real people; (viii) Does not require radical organizational reform; (ix) Does not demand changes in management compensation; (x) Does not demand entirely now relationship with outside partners; (ix) Applies to faddism, egotism, and quick-fixism; (xi) Drains entrepreneurship and innovation from the organization cultures; (xii) Has no place for emotion and soul, but mechanical approach; and (xiii) Tries a one-size-fits all solution.

Decision Time

Capability Maturity Model - Integration (CMMI)

There was clearly a strong correlation between CMMI and the ISO 9001 but the level of details differed significantly. The biggest similarity both the CMMI and ISO 9001 was "say what you do", "do what you say and document it". The biggest difference between the two was the emphasis of the CMMI on continuous process improvement. ISO 9001 described the minimum criteria for a quality management system whereas the CMMI provided more detailed guidance and greater breadth for process improvement. A level one organization would have been certified as compliant with ISO 9001 although surveillance audits would have identified deficiencies. A level one organization that obtained and retained ISO 9001 certification would have been close to level 2. An ISO 9001 compliant organization would have met many CMMI level 2 and 3 goals and conversely a CMMI level 2 or 3 organization would have had little difficulty in obtaining ISO 9001 certification. The CEO stated that the implementation of a new process improvement model will not only give STL a competitive advantage over its competitors but also increase the shelf life of their software products. "Although the implementation will be costly, when the market understands the value for proven processes, they will buy their product, and hence pay off the initial costs", Jyoti continued. However, some members of the board were not convinced. The finance director argued that the cost of US$150,000 expenditure required in one and half years was a major challenge. "We shall also need to hire 3-5 people from India, since we have zero skill set for CMMI and buy some tool", the fiancé director stated. The manager, Mr Sing on the other hand felt that STL was still a small company. He wrote a list of all the problems associated with not following a good process. He stated that " we need to have a very good process improvement model", however he argued that to met Jyoti's vision of making STL feature in international scene and achieve our marketing goals, STL does not need to spend money on CMMI or other SPI, instead more money should be spent on marketing, advertising, personnel and product development.

ISO 9000

The board had deliberated the pros and cons of each model. The ISO 9000 was considered a useful paradigm as it would lead to "sensible" procedures, reduction error, customer complaints and costs of quality. It would provide evidence of the quality of the outputs, and of the control of STL operations. Further it would aid in elimination of unnecessary procedures. Above all it is " a big name" and a business buzz word which is ideal for marketing benefit for STL products and services. Despite this, some members of the board were hesitant to select it. They argued that its style of "Management by manual" and over systemized decision making was problematic. It was difficult to choose the right Standard

from the series. Further, it was labeled as time consuming and expensive to gain/maintain registration. To make it worse, it had little encouragement for continuous improvement.

"Implementing a quality management system and getting it certified to one of the ISO 9000 standards is not a piece of cake. While the actual costs involved differ from company to company, the certification process inevitably requires significant effort with respect to designing, implementing and documenting appropriate processes, entailing both direct and indirect costs associated with consulting and audit fees, employee training, etc. Is it worth it ? Specifically, how might investing in ISO 9000 certification pay off? Mr Prakash asked. M/s Jyoti argued that it would lead to improved internal processes, which in turn enable higher productivity and lower costs. Mr Vivek argued that customers increasingly required ISO 9000, as certification would help maintain or increase a firm's market share. Yet one of the directors M/s Rina disputed these benefits, claiming that the standard is too general to lead to genuine improvements in STL. In her view, if any positive correlation exists between ISO 9000 certification and a company's financial performance, that could be as a result of the fact that firms that are better managed are also more likely to seek ISO 9000 certification.

Six sigma

Mr Vivek stated "Six Sigma *is structured methodology for diagnosing and executing defect and variation reduction projects in any process. In addition it has:- dedicated roles, responsibilities, and program infrastructure, top-to-bottom organization training and development, highly structured problem solving approach (DMAIC), level 1-4+ variation and defect reduction techniques, concurrent training / projects applied skills development, customer and data driven decision making, unique methodologies for product development, operations, transactional applications, and rigid project tracking and financial accountability for results.* However the board had four major concerns on Six Sigma. First it had no specific methodology for aligning strategic and operation priorities with project execution and candidate selection. Secondly, it had no methodology to develop understanding of the confounding relationships between projects. Thirdly, its inadequate "macro-level" analytical techniques to validate projects; and fourthly its data dependent tools and techniques were difficult to use in poorly controlled and wasteful operating environments.

TQM

Total Quality Management (TQM) had become one of the competitive strategies of choice during the '90s. Despite some new research that showed positive results, there is simultaneously growing concern that TQM has had major problems in the so called soft areas and in particular culture, involvement and communication. "It is difficult to construct a model for choosing and implementing a culturally suitable TQM approach to avoid some of these problems in STL" M/s Jyoti said. For us to be successful we must answer the questions:- (a) What kind of general, archetypal STL cultures are there ? (b) How will these cultures and their central underlying assumptions affect the implementation of TQM tools, strategies and approaches in STL? and (c) What kind of strategy or approach would give the best TQM results in each type of organizational culture? These were identified as obstacles associated with managing a successful quality transformation. Factor analysis on managers' ratings of frequently cited barriers to TQM revealed five underlying constructs: (i) inadequate human resources development and management; (iii) lack of planning for quality; (iii) lack of leadership for quality; (iv) inadequate resources for TQM; and (v)lack of customer focus.

Moreover, these empirically derived obstacles were found to be significantly related, in varying degrees, to specific potential outcomes that can be used to measure TQM success (or failure). The potential outcomes considered were frequent turnover of employees, frequent turnover of management, the high cost/benefit ratio of implementing TQM, and quality improvement results rarely meeting expectations. These have provided a useful framework for evaluating the relative significance of management-related obstacles to TQM success, and, consequently, for providing direction and guidance in developing strategies for an effective quality transformation.

Conclusion

The CEO and her team presented their pros and cons as well as the cost benefit analysis of each method to the board. The chairperson of the board who was also the Director of Business Development, was of the opinion ISO 9000 was the better choice on it would give him a mileage in his marketing work. On the other hand the Finance Director favoured TQM since it had the least implementation costs. Other members of the board had made up their mind that Six sigma would do the magic as it did for Motorola and other companies like GE and achieve both goals of quality process improvement and save costs in the long run. The finance director had done cost benefit analysis of each model, but was non committal to advice the CEO based on figures obtained as estimation. The board meeting was scheduled for January 4th, 1999. Although M/s Jyoti was convinced that CMMI was more appropriate, although she feared being shot in the board meeting since it had the highest cost of implementation. She wondered which of the software process improvement models among Capability Maturity Model - Integration (CMMI), ISO 9000, Six Sigma, and Total Quality Management (TQM), that she would recommend to the board.

Exhibits

Exhibit 1: Brief Profiles of Directors

M/s Jyoti Mukherejee: CEO

M/s Jyoti Mukherejee is the CEO of STL and project leader for the eHorizon ERP system and six sigma programmes. Before founding STL in 1991, she had been the deputy director for systems engineering since November 1984 at Oracle South Africa in Johannesburg where she was responsible for policy and implementation of systems engineering, technical risk management, design for software development, quality, reliability and maintainability. testing and acquisition logistics. She had held senior management positions in large Indian-based international Software engineering companies and had a background in general software engineering, management, research and education. For the past five years, she had been a supporter of the Software Engineering in Education Scheme, serving as panel chairperson for the East African IEEE Chapter. She is a member of the IEEE as well as the Chartered Quality Institute. Jyoti is a certified Black Belt for the Quality & Productivity Department at STL. She is involved in business specific and enterprise wide Process Improvement efforts at the company. She holds a B.Sc. in Information Technology, in addition to both a Masters degrees in Business Administration and in Software Engineering. She had 10 years of continuous improvement experience in service delivery as well as in software development.

David F. Prakash: Director Business Development

Before joining STL IN 1997, Prakash was an SPI consultant specializing in cost and benefit analysis. As an SPI strategist he consulted in cost, benefit, and Return-on-Investment (ROI) economic analyses of Software Engineering standards, design, deployment, and measurement of software cost, quality, and reliability metrics and models, and design of measurement-intensive Software Quality Management Systems (SQMS). His work included; helping to design a $250M Software Engineering Toolset and the spacecraft software for NASA's $20B space station in the 1980s, performing graduate studies under SEI Level 5 space shuttle managers, aiding a $40B Japanese corporation to design a CMMI self assessment tool in 1993, and designing a software cost model for 37 kinds of U.S. Navy fighter aircraft, helping to reengineer 36 logistics depots for America's largest foreign military customer. Prakash also played key roles in the design of U.S. military intelligence satellites, and has supported 15 Software Engineering Process Groups (SEPGs) over the last decade. Prakash had over 19 years of Software Engineering experience. He had been an international keynote speaker, published numerous articles, and held a B.Sc. in Computer Science and Master's Degree in Software Engineering.

Mr Vivek Shah: Finance Director

Vivek had over 20 years' experience in finance and business administration. He had a Bachelor of commerce degree graduate of Cambridge university, and a Masters of business administration (MBA) from the Harvard business school. He was a certified public accountant (CPA) III holder, and also qualified as a chartered accountant. He was a Group finance director with Nation media group and Finance and Administrative at The Kenya airways company prior to joining STL as a director of finance. Before returning to Kenya after completing his MBA in 1990, He spent nine years as a partner with the Cambridge office of Ernst & Young LLP, the international accounting and advisory firm. Previously he was the Finance Director of Software Applications Limited (SAL). By trade, he was a dealmaker at SAL but ended up being promoted to director at the firm which was fighting to survive after the Kenya economic decline of the nineties after the gold bug grand corruption scandal. However he had managed to bring huge business deals within the first year making a turn around in the firm. Softly spoken and seemingly unflappable. Colleagues at SAL had admitted they could tell when the 42-year-old was getting angry when he speaks even more quietly than usual. In all the organizations he had worked for namely Nation Media group, Ernst & Young LLP and SAL, he was involved in the implementation task force of their respective Enterprise Resource Planning (ERP) systems.

Exhibit 2: Elements of CMMI

Maturity Level 1	Maturity Level 2	Maturity Level 3		Maturity Level 4	Maturity Level 5
No process area associated with the maturity level 1	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurements and Analysis Process and Product Quality Assurance Configuration Management	Requirements Development Technical Solution Verification Validation Product Integration Organizational Process Focus Organizational Process Definition Organizational Training	Integrated Project Management for IPPD Integrated Supplier Management Risk Management Decision Analysis and Resolution Integrated Teaming Organizational Environment	Quantitative Project Management Organizational Process Performance	Causal Analysis and Resolution Organizational Innovation and Deployment

Exhibit 2b: Cost Benefit Analysis of CMMI

	CMMI: Cost Benefit Analysis			
1	**COSTS**	**Units**	**Rate**	**Amount**
1.1	**Implementation Costs**			
	• CMMI Policies and Procedures:			$293,100.
	• CMMI Evidence of Use:			$1,541,850.
	CMMI Implementation Costs:			**$1,834,950.**
1.2	**Assessment Costs**			
	Indoctrination courses	1600		
	Response conditioning courses	1600		
	Mock assessment hours	1600		
	Total assessment hours	4800	$100	$480,000
	Half is software engineering,			$240,000
	Total deployment costs for level 2 & 3			**$2,074,950.**
2	**BENEFITS**			
	Total Life Cycle Benefits:			
	Maintenance Hours Saved	111466		$2,508,000
	Development Hours Saved	10,176		$264,600
	TOTAL BENEFITS	121,642	$100	$12,164,200

Exhibit 3: Elements of ISO:9000

The elements of ISO 9000	ISO 9001	ISO 9002	ISO 9003
1 Management Responsibility	✓	✓	✓
2 Quality System	✓	✓	✓
3 Contract Review	✓	✓	✓
4 Design Control	✓		
5 Document and Data Control	✓	✓	✓
6 Purchasing	✓	✓	
7 Control of Customer-supplied Product	✓	✓	✓
8 Product Identification and Traceability	✓	✓	✓
9 Process Control	✓	✓	
10 Inspection and Testing	✓	✓	✓
11 Control of Inspection, Measuring and Test Equipment	✓	✓	✓
12 Inspection and Test Status	✓	✓	✓
13 Control of Non-conforming Product	✓	✓	✓
14 Corrective and Preventive Action	✓	✓	✓
15 Handling, Storage, Packaging, Preservation and Delivery	✓	✓	✓
16 Control of Quality Records	✓	✓	✓
17 Internal Quality Audits	✓	✓	✓
18 Training	✓	✓	✓
19 Servicing	✓	✓	
20 Statistical Techniques	✓	✓	✓

Exhibit 4: Cost Benefit Analysis of ISO:9000

	ISO:9000: Cost Benefit Analysis			
1	**COSTS**	**Units**	**Rate**	**Amount**
1.1	**Training Costs**			
	Deployment Costs			$218,396
	Assessment Costs			$112,000
	Total Training cots for Four person			**$330,396**
1.2	**Implementation Costs**			
	Assume ERP project SLOC	100,000		
	Assumed SLOC Per Hour	6.12		
	Total ERP Project Hours	1,634		
	Total Implementation costs			$163,400
	TOTAL DEPLOYMENT COSTS			$493,796
2	**BENEFITS**			
	Total Life Cycle Benefits:			
	Maintenance Hours Saved	25,080	$100	$2,508,000
	Development Hours Saved	2,646	$100	$264,600
	TOTAL BENEFITS			$2,772,600

Exhibit 5: Elements of Six Sigma

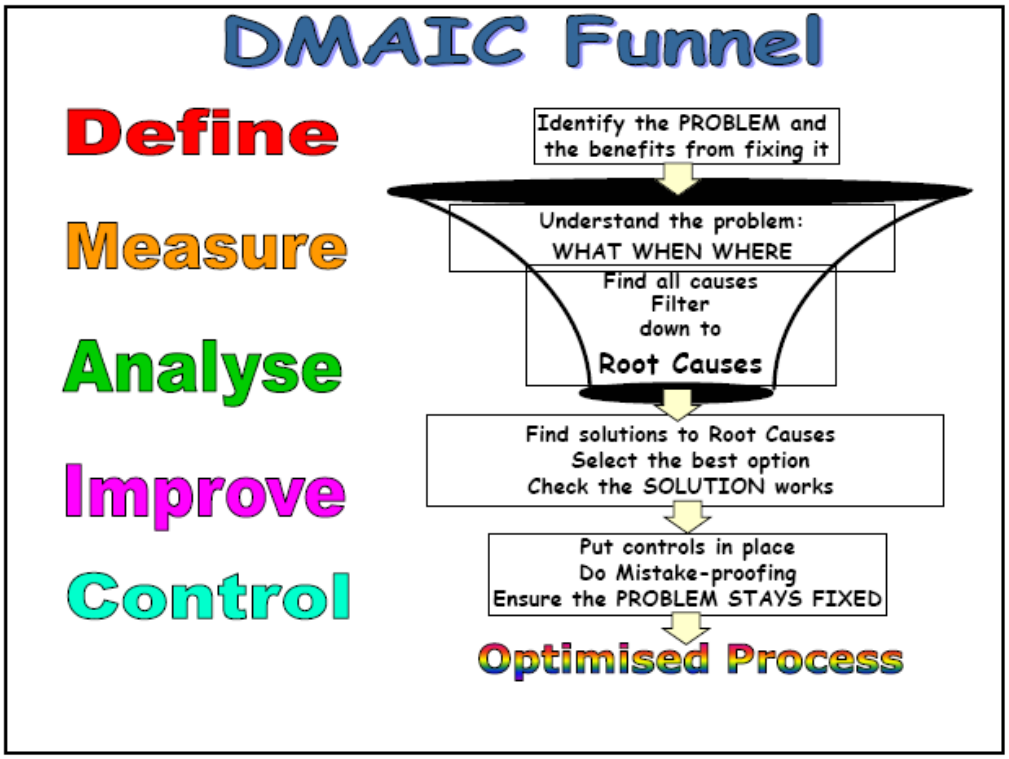

Exhibit 6: Cost Benefit Analysis of Six Sigma

	SIX SIGMA: Cost Benefit Analysis			
1	**COSTS**	**Units**	**Rate**	**Amount**
1.1	**Training Costs**			
	Six Sigma training COST			$5,000
	Airline, hotels, meals, and parking			$5,400
	Training time away in Hours cost			$16,000
	Six Sigma-specific training.			**$26,400**
	Total Training cots for Four person project			**$105,600**
1.2	**Implementation Costs**			
	Assume ERP project SLOC	100,000		
	Assumed SLOC Per Hour	25		
	Total ERP Project Hours	400		
	Total Implementation costs			$40,000
	TOTAL DEPLOYMENT COSTS			$145,600
2	**BENEFITS**			
	Total Life Cycle Benefits:			
	Maintenance Hours Saved	41,800	$100	$4,180,000
	Development Hours Saved	4,846	$100	$484,600
	TOTAL BENEFITS			$4,664,600

Exhibit 7: The Key Principles of TQM

- Management Commitment
    1. Plan (drive, direct)
    2. Do (deploy, support, participate)
    3. Check (review)
    4. Act (recognize, communicate, revise)
- Employee Empowerment
    1. Training
    2. Suggestion scheme
    3. Measurement and recognition
    4. Excellence teams
- Fact Based Decision Making
    1. SPC (statistical process control)
    2. DOE, FMEA
    3. The 7 statistical tools
    4. TOPS (FORD 8D - Team Oriented Problem Solving)
- Continuous Improvement
    1. Systematic measurement and focus on CONQ
    2. Excellence teams
    3. Cross-functional process management
    4. Attain, maintain, improve standards
- Customer Focus
    1. Supplier partnership
    2. Service relationship with internal customers
    3. Never compromise quality
    4. Customer driven standards

Exhibit 8: Cost Benefit Analysis of TQM

	TQM: Cost Benefit Analysis			
1	**COSTS**	**Units**	**Rate**	**Amount**
1.1	**Training Costs**			
	TQM training COST			$4,000
	airline, hotels, meals, and parking			$2,700
	Training time way in Hours			$4,000
	TQM-specific training.			**$10,700**
	PSP training			**$26,400**
	Cost per training one engineer			**$37,100**
	Total Training cots for Four person project			**$148,400**
1.2	**Implementation Costs**			
	Assume ERP project SLOC	100,000		
	Assumed SLOC Per Hour	6.12		
	Total ERP Project Hours	1,634		
	Total Implementation costs			$163,400
	TOTAL DEPLOYMENT COSTS			$303,800
2	**BENEFITS**			
	Total Life Cycle Benefits:			
	Maintenance Hours Saved	41,800	$100	$4,180,000
	Development Hours Saved	3,454	$100	$345,400
	TOTAL BENEFITS			$4,525,400