Six Sigma and Business Process Management

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Abstract Business process management lacks an integrated set of analysis methods for removing unneeded process steps, identifying inefficient or ineffective process steps, or simply determining which process steps to focus on for improvement. Often, tools and techniques from Six Sigma, an orientation to error-proofing that originated in the quality movement of the 1980s, are borrowed for those tasks. This chapter defines several Six Sigma techniques and shows through a case study how they can be used to improve deficient processes. Six Sigma combined with lean waste removal techniques can add significant value to a process improvement project.

1 Introduction

Organizations should constantly improve their functioning to remain competitive. Yet, problems develop in the translation of strategy to actual business processes, which accomplish some work (Kaplan and Norton 2001). Further, by improving business processes, the intellectual capital of workers increases through added understanding of their role in the organization and through removal of resource gaps (Herremans and Isaac 2004).

Business organizations are comprised of people who conduct daily business through process enactment. Organizations that do not manage their processes are less effective than those that do (Rummler and Brache 1995). Further, organizations that allocate information technologies to processes, but do not manage the process, are mostly wasting their money.

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As Dorgan and Dowdy (2004) demonstrated in their study of the intensity of IT deployment versus the intensity of process management, companies that neither actively manage processes nor invest in technology to support work return 0 % on any investments in either. Companies that invest in technology but do not manage their processes, in essence who throw technology at a situation, can return as much as 2 % on their investments. Companies that actively manage their business processes but have a low intensity of technology for supporting work can experience as much as 8 % gain from their investment. That is, simply managing business processes improves return on investment over blindly using technology. And, companies that both actively manage business processes and have a high intensity of technology support for work can experience as much as 20 % gain from their investment. Thus, the maximum gain accrues from intelligent process design followed by strategic, intelligent technology deployment to support those processes.

The first step in process management is to understand the processes, the work those processes accomplish, and how that work relates to the organization strategy (Rummler and Brache 1995). Any process, process step, or process product (e.g., document, email, data, or other product of a process step) that does not contribute to the organization strategy or its ability to meet its strategy is waste. Process value accrues to the extent that it fulfills some aspect of the organization's customer value proposition (Kaplan and Norton 2001). Thus, the overall goal of business process management (BPM) is to improve processes in optimizing customer value fulfillment (Hassan et al. 2012; Martinez et al. 2012; Rummler and Brache 1995).

BPM uses techniques to measure, analyze and improve processes, however, there is no single body of knowledge or techniques that apply to BPM. Lean Six Sigma provides useful techniques for BPM analysis and improvement (See also chapter by Paul Harmon).

1.1 Six Sigma

Modern quality programs have their roots in the 1950s in the U.S. and in Japan where Walter Shewhart and W. Edwards Deming popularized continuous process improvement as leading to quality production. Six Sigma is the practice of continuous improvement that follows methods developed at Motorola and is based on the notion that no more than 3.4 defects per million are acceptable (Motorola 2009). This means that a company fulfilling one million orders per year, and having only one error opportunity per order with 3-sigma correctness (99.95 %) will experience 66,738 errors versus a 6-sigma (99.9997 %) company, which would experience 3.4 errors. As engineered product complexity has increased (in telecommunications, for instance, the potential for over 50,000 errors per product are possible), without the type of quality management provided through Six Sigma tenets, virtually every product would experience defects.

The purpose of Six Sigma is to improve predictable quality of developed products and services through the removal of normally distributed errors. If error outcomes of a process are normally distributed, errors vary from the mean, or

1σ	690,000 per million opportunities (69% error rate)
2σ	308,000 per million opportunities (30.8%)
3σ	66,800 per million opportunities (6.7%)
4σ	6,210 per million opportunities (.62%)
5σ	230 per million opportunities (.02%)
6σ	3.4 per million opportunities (.00003%)

Fig. 1 Six sigma errors and error rates (iSixSigma Staff (2002))

average. A standard deviation, or sigma, is a measure of variance from the mean with equal areas on either side of the mean line. The error rates for sigma levels one through six are listed in Fig. 1 (σ is the Greek symbol for sigma). Six Sigma practice strives for 99.9997 % accuracy in the process.

Six Sigma can be combined with lean manufacturing tenets to error-proof and remove waste from processes (Martinez et al. 2012). The guiding principles of lean are not to make defects, accept defects, create variation, repeat mistakes, or build in defects (Ohno 1988). Lean Six Sigma combines lean manufacturing waste removal discipline with Six Sigma's defect prevention goal.

Six Sigma project life cycles are named DMAIC and DMADV, which translate to define – measure – analyze – improve – control and define – measure – analyze – design –verify, respectively. In general, DMAIC is the approach recommended for improving an existing process and DMADV is the approach recommended for new process design. But, these sets of methods are more similar than different and all activities tend to be done for all projects (Linderman et al. 2006). This paper focuses on the analyze-improve parts of the DMAIC life cycle. When applied to business processes and combined with lean tenets, Six Sigma is useful for eliminating unnecessary or inefficient steps from a process through the application of techniques such as process mapping, SIPOC, value-added analysis, root cause analysis, Pareto analysis, brainstorming, bureaucracy reduction, simple English, and so on (Johannsen et al. 2014; Rasmusson 2006). These are only a few of the hundreds of techniques useful for identifying, prioritizing, analyzing, and fixing errors or inefficiencies in processes.

1.2 Process Management

Process management and improvement requires leaning – that is removal of unneeded steps for improvement, cleaning – that is the simplification and improvement of remaining steps, and greening – that is the potential use of outsourcing, co-production, or automation (Conger 2011). The application of several techniques to each process improvement step is demonstrated through the analysis of a service desk. A typical process improvement initiative undergoes the following steps:

- Map the target business process
- Identify and remove wastes

- Identify problems
- Prioritize problems
- Identify problem root causes and remediations
- Analyze alternatives
- Redesign the process

Within these steps, techniques from lean and six sigma are applied to tasks as appropriate. Techniques included in this chapter are process mapping, identification of input, outputs, and contributors via SIPOC, value-added analysis, root cause analysis, outsourcing, co-production, and automation analyses, and process redesign. These techniques are commonly applied to a wide range of problems or process types and are representative of the reasoning used for process improvement. This chapter focuses on the description and exemplification of these techniques rather than on actually measuring their effect in terms of six sigma performance. In this sense the process improvement techniques presented in this chapter generally contribute to detect and remove errors and waste production within processes. Each of these methods is demonstrated in the FLCo process improvement case.

2 Service Desk Process and Problem Analysis

The purpose of a service desk is to take requests that may be outages, service, or access requests, and satisfy them according to type and priority. Service desk processes can be formalized following the IT Infrastructure Library, (ITIL®, Rudd and Loyd 2007). In the case, the current process is known to be error prone with lost requests, many open requests that are known to have been resolved, overlap of work, and other issues. The case process and its analysis are discussed in this section.

2.1 Process Map

To enable an analysis of the process, a process map is developed. Process maps depict the activities and interactions of all participants in a process. Participants might include people, roles, departments, computer applications, and external organizations. If the focus is the information technology support for a process, more granular analysis showing individual databases accessed and/or updated by a process might also be shown. The case from which the examples were developed is below.

> FL Company (FLCo) is a 4-year Company with both at-work and at-home workers in five lines of business. The company has about 40,000 staff in total spread over six geographic locations with as many as 18,000 staff working at-home at any one time. Ann E. is the newly appointed manager of support responsible for the Computing Services Service Desk function (CSSD). There is at least one CSSD employee at each site; the headquarters has seven permanent employees and many people who are considered local gurus. In addition, work is outsourced to Guardian Help Desk Services (hereafter Guardian).

There are three levels of tech support: Tier 1 (T1), Tier 2 (T2), and Tier 3 (T3). All requests start at T1, the lowest level of support. Guardian is expected to handle 95 % of the 1,000 daily contacts but is handling about 750 calls per day. The other 5 % of contacts and any overflow from Guardian begin at CSSD T1. About 1 % of contacts are sent for T2 resolution. T3, vendors account for about two contacts per week.

Telephone, email, and web forms are the prevalent methods used to initiate contact for the service desk. In-person contacts are rare and are handled by CSSD T1. Typically, the method of contact back to a client is chosen to match the method used to make the request unless some other media is specifically requested. In addition, the IMS ticket management system should be updated with status but it does not always happen.

The general process is that a user initiates contact with an outage, request, or question. The caller is validated as staff and, if needed, the Staff Contact Database (SCDB) of email and phone information is updated. The contact is logged into Information Management System (IMS), a home-grown incident tracking application to which both the Company and the outsourcer have access. A known errors database (KEDB) is checked to determine if there is a known problem with resolution readily available. If an entry is in the KEDB, either a solution or workaround is passed to the user to try to fix the problem. If possible, the request is serviced in the first phone call and the logged request is closed by the individual logging the contact. About 75 % of all calls are resolved in the first contact.

If the request is not serviced in the initial contact, Guardian is supposed to perform some troubleshooting to see if they can fix all problems not in the KEDB; however, they pass on problems when no KEDB entry is found. If troubleshooting is performed, the actions tried should be documented in the IMS software. Guardian transfers calls via an automated call director (ACD) to CSSD T1. Transfers from Guardian usually go to T1 CSSD support which retries the KEDB and troubleshooting, documenting the steps taken. If the individual cannot find a solution, the problem is transferred to T2 support. Only T2 CSSD can escalate to T3, vendor support.

Transfers of responsibility through IMS are automatic. As a service contact is saved, the software checks to see if transfer to another organization is checked. If so, the item is placed on a queue for automated delivery to the next available person in that area (this areas to which electronic delivery is done include CSSD staff (T1 internal) and Technical Services (T2)). If T2 escalates to a vendor (T3), the individual managing the contact also manages all interactions with the vendor(s). Any vendor interactions are supposed to be documented in the IMS but there is no requirement or coercion available to ensure that this is done.

All forms of interaction (phone, email, Internet, or none) can be used for contacts after the first, depending on the nature of the problem (e.g., an item that is on FAQs on the web site is routed there via the initial contact method or email).

IMS is a package for request ticket tracking and routing between tiers. In addition, it is the basis for the web application that provides status, resolution information, and so on via the company web site. Interactions after the first are all supposed to be logged into the IMS software but there is no mandatory entry nor is there automated escalation (e.g., to a high level of support or manager based on time from request to expected resolution or type of request). As a result some requests are lost and others are never closed.

There is no formal classification of users or requests to facilitate resolution or tracking. Thus, when forwarding is done, a request is generically sent to the next level. Items sent to vendors for resolution are not tracked for timely resolution unless the outage affects many users. The last person touching a request *should* be the person who monitors a request and closes it; however, Guardian closes only phone calls resolved during the call. CSSD is responsible for closing requests that are passed to them but there is no clear policy for tracking responsibility. Similarly, vendors do not close requests. Thus, many requests go unclosed with an unknown resolution.

Known problems with the CSSD service desk include duplication of process steps after hand off of work from Guardian to CSSD T1. Status, including resolution is not

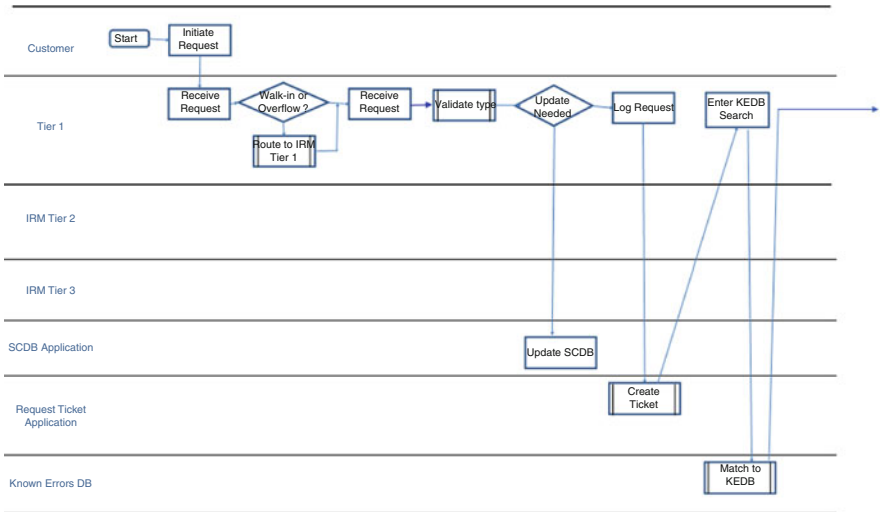

Fig. 2 Current CSSD process

tracked and therefore, is prone to error. There is no reminder system, automatic escalation, and no assigned responsibility for ticket closing. Therefore, lost and unclosed tickets are common. Web forms are used but there is no self-help capability beyond frequently asked questions and no automated help actions. Other problems will become visible through the analyses. Figures 2, 3, and 4 depict the process described above.

2.2 Process Elaboration

Complex processes may require more elaborate information. One such Six Sigma technique is SIPOC process analysis. SIPOC stands for **S**uppliers, **I**nputs, **P**rocess, **O**utputs, **C**ustomers (Rasmusson 2006) and a SIPOC analysis is a tabular summary of all related information to each process step (see Fig. 5). Suppliers and Customers are shown on the process map as roles with interactions, but the SIPOC details the actual documents, files, data-bases, and actual data affected by or used in the process.

Obvious as the problems may be, formal review and analysis is needed to avoid missed problems. The first action is to determine required and other process steps using a technique such as value added analysis.

2.3 Remove Waste via Value Added Analysis (VAA)

The first step is to remove waste from the process. Some types of waste, e.g., waiting for automated actions to complete, are not able to be removed but might be redesigned to reduce their impact on the process. Value-added analysis (VAA) is a

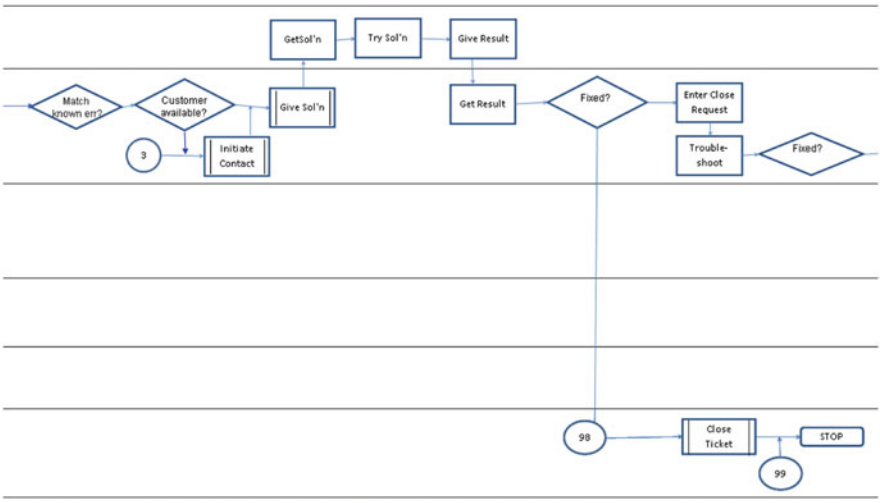

Fig. 3 Current CSSD process – continued

technique that highlights process steps to be evaluated for elimination. VAA is not strictly part of the Six Sigma training but is often used in leaning waste and is a useful complement to Six Sigma analysis. There are four types of event-driven processes: Management, customer affecting, primary (relate to customer affecting, e.g., design engineering), and support (e.g., HR, legal, IT). A single process can have elements of more than one process type within it and, when conducting analysis, part of the task is to tease out each step's type.

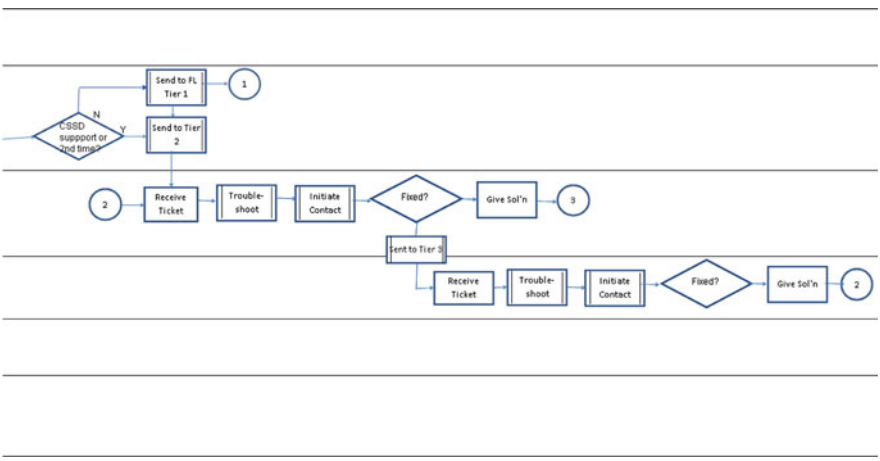

Fig. 4 Current CSSD process – continued

Suppliers	Inputs	Process	Outputs	Customer
Customer	Issue, or request	Initiate request	Open ticket, Updated personal information	T1 Support Staff
T1 Support	Request Information	Receive Request	Request	Customer
T1 Support	If known	Validate cust information	Updated SCDB, as needed	FLCo
T1 Support	Request Information	Log Request	Created request ticket	All support levels, FLCo
T1 Support	Request information	Enter KEDB search	Possible KEDB solution	Customer … to end

Fig. 5 FLCo help desk partial SIPOC Diagram

To conduct value added analysis the following steps are conducted (Conger 2011):

1. Map the process
2. List all process steps and place them in a table with columns for duration, value adding activities (VA), non-value-adding activities that are required (NVA), and non-value adding activities that are unnecessary (NVAU, can be combined with NBVA), and the type of waste for NVA and NVAU activities.
3. Review each process step, asking the questions:
   (a) Does an end Customer require this activity, and will the Customer pay for this activity? If yes, then it is value adding (VA).
   (b) Could a customer-facing activity be eliminated if another activity were done differently or correctly? Is this activity required to support or manage the value adding activities, e.g., legal, HR, etc.? If yes to either, then it is non-value-adding (NVA).
   (c) Could this activity be eliminated without impacting the form, fit, or function of the Customer's "product?" If yes, then it is non-value adding and unnecessary (NVAU).
4. For each NVA and NVAU activity, analyze which of the DOWNTIMe wastes is identified. DOWNTIMe is the acronym for D-efects, O-ver production, W-aiting, N-on-utilized talent or resources, T-ransportation, I-nventory, M-otion, e-xcess processing. This allows discussion with management to determine their ultimate disposition.
5. With key stakeholders, evaluate all NVA and NVAU activities for elimination.
6. Evaluate activities remaining as needed for automation, outsourcing, or co-production

NVA and NVAU activities that don't appear able to be automated or eliminated are marked for further analysis for streamlining, outsourcing, or some other replacement with VA activities. Notice that several steps have both VA and NVA

designations. These are because the time is not wasted if a solution is found, but when an escalation is needed, the time spent trying to resolve the issue can be thought of as wasted and therefore, something to minimize or eliminate. Also, the DOWNTIMe designations need some explanation. First, DOWNTIMe designations are decided from the perspective of the person performing the task, not the customer. This is because the customer may not be aware of the activity nor would they care. Customers 'pay' for an answer, not the time leading to getting an answer. From the company's and help desk staff perspective, the time getting to a correct resolution would be VA, but the time to no resolution would be an NVA. Also, DOWNTIMe assignments might have alternate answers or more than one designation. As long as the assignment is defensible, it is acceptable; however, the more accurate, and complete the better as clues to how to minimize the effect of the step if it is required can be gotten from the DOWNTIMe assignment.

Figure 6 reveals a significant number of NVA and NVAU activities. The goal of analyzing this information is to completely eliminate as many of these activities as possible or minimize their impact on the process if elimination is not feasible. The times associated with each step establish a baseline against which to measure changes for improvement. As Fig. 6 shows, a successful resolution on first call (steps up to 'Stop') would take from 2.3 to 5.3 min but only 35 s of that time is designated as value adding. The challenge to the process improvement team is to either eliminate or minimize the effects of the activities in the NVA/NVAU column.

By close analysis of every request type and a determination of which might be redesigned in some way much of the impact of the NVA/NVAU time can be removed. This topic is continued in the next sections.

2.4 Process Cleaning

During the 'cleaning' phase of process improvement, each VA process step remaining after the VAA analysis is evaluated to ensure that it is as efficient and effective as possible. Often the types of analyses performed on NVA/NVAU activities overlap this one as many of those steps also remain. In addition to other 'cleaning' activities, such as brainstorming, streamlining, bureaucracy reduction, and simple English, each known process problem is also analyzed to determine all of its possible root causes and evaluate each of them for improvement. This technique, root cause analysis (RCA) is the topic of this section. Then, the Pareto method for easily prioritizing problems for resolution is discussed.

2.4.1 Root Cause Analysis

The purpose of RCA is to find all potential causes for some problem then ensure that sufficient changes are made to prevent the problem from recurring (Martinez et al. 2012). RCA starts with a problem identified from, for instance, a client brainstorming session, to probe further into the root causes of problems and to ensure that all aspects are evaluated and mitigated.

	Duration	Evaluation		
Process Step	In Ms	**VA**	**NVA/NVAU**	**DOWNTIMe**
Initiate request	3000		NVA	N
Walk-in or overflow?	.5		NVA	N
Route to FL Tier 1	1.5		NVA	M
Receive request	1.5		NVA	O
Validate staff type	4000		NVAU	e
Update needed?	2000		NVAU	e
Update SCDB	10000		NVAU	e
Log Request	10000		NVA	N
Create ticket	5000		NVA	e
Enter KEDB search	10000		NVA	M
Match to KEDB	5000	VA	NVA	W
Match known err?	5000	VA		
Customer available?	2000		NVA	W, N
Initiate contact	20000		NVA	N, M
Give solution	20000	VA		N, M
Get solution	2000		NVA	O, W
Try solution	20000 – 200000		NVA	W
Give result	2000	VA		
Get result	1000	VA		
Fixed?	2000	VA		
Enter close request	5000		NVA	N, M
Close ticket	10000		NVA	W, N
Stop... Continue to end	50	VA		
Total Time each activity (shown)	2.3--5.3 Min	35 Sec	NVA: 1.5 -- 4.6 Min	NVAU – 16 Sec

Fig. 6 Partial value added analysis

The RCA process is used to identify the true root (most fundamental) cause and the ways to prevent recurrence for significant issues for which outcomes can be affected (Martinez et al. 2012). This technique also called "why-why chart" or "five whys." Attention in each level of analysis is drawn to all possible contributing factors through repeatedly asking questions that build on answers to prior questions. The steps to RCA are:

1. *Immediate action*: If the problem is still active, it should be resolved so that a normal operational state is achieved before anything is done.
2. *Identify the problem*: At this stage the problem should be completely, clearly articulated. The author should attempt to answer questions relating to Who? What? Why? When? How? and How many? each relating to the problem to be analyzed.
3. *Identify the RCA team*: The team should include 4–10 subject matter and RCA experts to ensure analysis addresses all issues. The team should be given authority to correct the problems and empowered to define process changes as required.

4. *Root Cause analysis*: The method is applied to ask progressively more detailed levels of probing to determine the root cause. Although called the 5-whys, there is no number of levels that is correct; rather, the probing continues until one or more root causes for each problem are found.
5. *Action Plan*: The corrective action plan should eliminate the problem while maintaining or improving customer satisfaction. In addition to the plan, metrics to determine the effectiveness of the change are also developed. Once complete, the action plan is implemented.
6. *Follow Up Plan*: The follow-up plan determines who will take and who will evaluate the measures of the revised process, how often the metrics will be taken, and the criteria that will be applied to determine that the problem is resolved. The follow-up plan can be created while the action plan is being implemented; follow-up begins immediately upon action plan implementation.

The RCA for the "inadequate training" problem that caused requests to be lost is evaluated here. The RCA would be conducted for each of the problems with appropriate mitigations developed.

1. *Identify the problem* – On December 15, 2012 at a company town meeting, numerous internal customers complained to the CIO about lost and unsatisfied requests. Upon inspection, the CSSD was found to be operating with no written processes. The problem was highlighted by the short tenure of most of the Help Desk staff; 75 % of staff members had been on the job less than 6 months. Neither Guardian nor CSSD took ownership for the lost requests problem so the cause was unknown. No one in CSSD had attended any formal job training. CSSD staff learned problem resolutions on the job from each other. All CSSD staff members were affected by this problem. Further, no Guardian staff had had any FLCo training since the original contract was signed 2 years ago.
2. *Identify the RCA team*: The team consisted of two RCA specialists, two T1 and two T2 CSSD staff, one operations and one application support staff.
3. *Immediate action*: The immediate action was to identify and resolve the lost problems. The CSSD Manager sent an email to all users identifying the loss of service requests and asking anyone with outstanding requests to call, verifying their requests. Two CSSD staff manned phones for 3 days to verify requests and add them to the ticket database, as needed. As a result of this action, 400 requests were identified as outstanding; 100 of those requests had not been in the ticketing system.
4. Action plan: Training, turnover, and lack of multi-user software were key issues. A partial root cause analysis of training issues is shown in Fig. 7. In addition, the team devised a plan to identify and resolve the lost ticket problems.
5. Action Plan – The RCA resulted in many issues being identified. The recommendations for those issues are below.

    - Require the CSSD Manager to remain in the position a minimum of 1 year.
    - Create a process for the CSSD so that there is accountability for all requests with metrics to verify that all requests are logged as received and monitored for daily completion.

Fig. 7 Partial root cause analysis

Root Cause Analysis: Why are CSSD tickets lost?
A. There is no requirement for ticket logging and no follow-up to ensure logging.
Q. Why is no requirement for ticket logging?
A. There is no CSSD written process and high supervisor turnover
Q. Why is there no written CSSD process?
A. High supervisor turnover and lack of interest
Q. Why has there been high supervisor turnover?
A. …
…

- Develop in-house training for CSSD staff that the Manager also attends. In the development of training, use the CSSD process as the basis for the training.
- Create a career path for staff to stay in the CSSD area, if desired, to reduce constant staff change.
- Provide for senior Level-1 staff to mentor junior staff.
- Change job descriptions of the Manager and CSSD staff to provide merit pay for single-call request completion, short times from open to close of requests, etc.
- Create measures to monitor CSSD operation that become the responsibility of the CSSD Manager.

6. Follow Up Plan

- The CSSD Manager should be tasked with monitoring training effectiveness as evidenced through measures to be defined. Metrics and an analysis of them should be in the monthly report (or dashboard if created) to the CIO and Manager of Operations.

As can be seen from the partial RCA of CSSD problems, the technique is useful but requires significant analysis and takes time. It assumes skilled staff is conducting the analysis who minimize opinion and maximize the potential for complete problem mitigation. In addition, the technique focuses on only one aspect of a problem, rather than a whole problem. Thus, many such analyses are required to fully analyze all issues relating to a complex process and all recommendations must be integrated. Next, Pareto analysis can be used to determine priorities for remediation of problems.

2.4.2 Pareto Analysis

A Pareto distribution is a special form of distribution named for Vilfredo Pareto who discovered its 80–20 rule properties (Conger 2011). The Pareto distribution has since been recognized to apply to a wide range of social, geophysical, and scientific situations such as sales revenue from number of customers, error rates in software modules, and manufacturing defects in a process.

A Pareto diagram, in this case, represents problems to be prioritized for further action. Items to be compared are sorted from highest to lowest frequency and placed across the x-axis of the histogram. Item frequencies are on the Y-axis. A cumulative percentage line shows where the 80 % point is found.

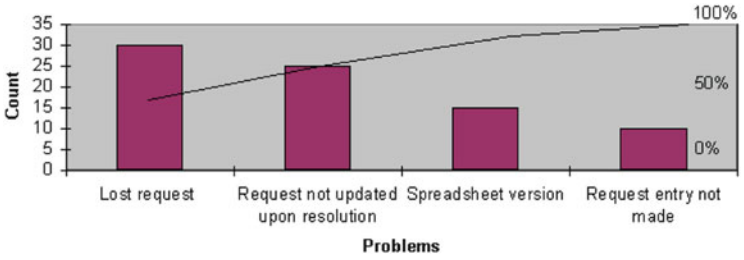

Fig. 8 Pareto analysis of help desk problems

According to classic Pareto analysis, the breakdown is 80–20. However, in reality, many problems show a clear break point at some other distribution such as, 60–40 or 70–30. Variations of Pareto analysis, called ABC and XYZ, look at different distributions for errors or management. ABC concentrates on consumption value of raw materials in different combinations while XYZ analysis evaluates classes of finished goods in terms of their demand qualities as high, medium, low or sporadic (Bhattacharya et al. 2007; Canen and Galvio 1980; Katz 2007; Kumar et al. 2007).

The Pareto diagram for the service desk (Fig. 8) can be interpreted in two ways. The first two categories represent 69 % of the total problems counted; however by adding the third category, 87 % of the problems are presented. Either analysis could be defended, but regardless, the highest priorities would be the focus of immediate remediation. The other items would be considered at a future date. One would not redesign the process without analyzing all of the problems in any case.

The next phase of analysis focuses on the removing or minimizing the impact of process steps on the process. Three kinds of 'greening' analysis for this are discussed in the next section.

2.5 Process Greening

All of the techniques in this section are oriented toward removing or minimizing CSSD responsibility for and the carbon footprint of the process tasks at the case organization FLCo. The techniques – outsourcing, co-production, automation, and environmental greening are each discussed in this section.

2.5.1 Outsourcing

Outsourcing is the movement of a function or its related automated support to another company (Conger 2011). Benefits can relate to increased innovation, upgraded technology, reduced operating costs, and increased work quality (Hassan et al. 2012; Martinez et al. 2012). Since FLCo is already outsourcing T1 support for its Service Desk, the service as provided should be evaluated here.

FLCo has about 25 % of tickets either originating or being passed to its internal T1 service. About 5 % of T1 tickets were planned while the others are overflow that cannot be handled by Guardian. When the tickets are escalated to T1 because Guardian cannot find a solution, duplication of activities in the form of checking the KEDB for a solution takes place. As a result there is wasted effort in that duplication. Some analysis should be performed to determine the reasons why tickets are passed to FLCo T1 and their frequency. If most tickets are passed because the solution cannot be found, further training should be given to Guardian staff to ensure that they search for terms correctly and imaginatively. If that effort fails, further analysis of the whether sought after benefits from Guardian are being gained and, if not, their services should be severed.

The reasons for peak periods should be evaluated to determine if Guardian should add more people to the FLCo account. Escalations to FLCo T1 should be investigated to determine how many are actually solved by FLCo T1 staff and how many are passed to T2. If most are solved by FLCo T1 staff, Guardian staff may need training to improve their resolution and solution finding skills. If most are escalated to T2, one might ask why FLCo T1 is not bypassed to speed the overall resolution process. If there are patterns to the problems, other recommendations might include improving search terms for the KEDB or expanding the KEDB. If an unacceptable number of escalations from Guardian to FLCo T1 occur, e.g., over 40 %, perhaps Guardian is not performing as expected and service level agreements or contracts should be rewritten to establish a threshold and penalize Guardian when performance is unacceptable. In addition, if the number of escalations is not acceptable, perhaps in-sourcing and ending the Guardian contract might be in the company's best interest.

2.5.2 Co-Production

Co-production is collaboration to produce some outcome. In business, co-production typically means off-loading work to customers, vendors, or outsourcers ideally, with no pay for the activity. In the case of a help desk, pushing as much of the help desk process to the user constituted co-production. Off-loading in the form of providing self-service to CSSD customers is the most obvious method of co-production. Allowing read-only access to the KEDB so users might find their own solutions to problems thus, reducing the number of requests that reach CSSD. Self-service ticket creation and entry of contact information removes those steps from the CSSD process.

Every service desk request should be analyzed to determine how human interaction might be removed. Since this also results in automation of CSSD, this analysis is discussed further in the next section.

2.5.3 Automation

Activities remaining after co-production decisions should be considered for further or improved automation. Legacy applications support much of large organizations' work and could often benefit from redesign of databases, screens, or even some of the process steps. In addition, any steps not automated should be evaluated for automation. With process automation software now affordable for even small-sized companies, providing all paper-work movement digitally with automated follow-up, feedback, and escalations can improve processes radically.

For CSSD work, every type of request should be analyzed to determine if an automated solution might be created to add to co-production in the form of self-service. For instance, password resets could easily be automated. Requests for access to applications and data with automatic emails to request and receive authorizations, storage of authorizations for audit purposes, and automated emails to notify access approval or denial all can be automated. Automating such activities could reduce the number of requests that reach CSSD by as much as 30 %. Outcomes of such automation have side effects that also need analysis, for instance, by eliminating all automatable or co-produced CSSD requests, could require a higher level of company knowledge for Guardian and CSSD employees, thus, altering the burden of knowledge needed by the outsourcer or mitigating the outsourcer need altogether.

Specific automation (and co-production) recommendations for the case include:

- Type of requests should be defined for automation
- Web forms and the programs behind them should be expanded to identify type of request and automatically route to automated services and to the most knowledgeable staff.
- Ticket creation, ticket priority, SCDB updates, password resets, and access requests should be fully automated.
- All FLCo staff should be provided with access to the KEDB so they can try to resolve their own problems. Incentives might be considered for the 'solution of the month' to encourage self-resolution.
- As the CSSD ticket is created, the user should be presented with current location and contact information and requested to update it before continuing.
- The IMS ticket system should be updated to automatically escalate any ticket in a queue for longer than 15 min without resolution or comments or a change to 'wait' status (which may also be needed).
- IMS escalation should include a dashboard that shows year to date, month to date and day to date information that can be traced to individuals regardless of company (i.e., both Guardian and FLCo staff) to show first call resolution, average times of resolution, phone wait times, number of contacts per ticket, tickets by priority, self-service usage statistics, and so on.

2.5.4 Environmental Greening

Sustainability, in the sense of reducing a process's carbon footprint, is the focus of environmental greening activities. Before this is performed, all of the recommendations from all prior tasks are listed, grouped by similarity or function, and reduced as needed to remove duplication or inconsistencies. The list and rough process redesign are evaluated to determine opportunities for recycling, use of environmentally favorable technologies, or other aspects of the process that might result in savings to the organization and the environment. These suggestions are then discussed with the project sponsors, along with the other recommended changes to arrive at the accepted set of changes for process redesign.

For the FLCo case, the recommendation would be that the computing operations organization evaluate technology replacement to reduce ventilation and air conditioning, electrical, costs, and space requirements.

3 Process Redesign

Recommendations are summarized then used to develop an ideal process considering different perspectives, for instance values, costs, benefits, current and future customers, and so on (Conger 2011; Linderman et al. 2006; vom Brocke et al. 2010). The final process is derived after discussion with customers to determine what is actually feasible in the target environment.

The case recommendations are:

- Enhance the web applications to expand their capabilities
- Implement automation and co-production recommendations (See recommendations for automation and co-production above)
- Implement incentive programs to encourage staff to self-resolve issues
- Implement a CSSD ticket dashboard
- Remove T1 duplication of effort by passing some Guardian escalations directly to T2 staff
- Evaluate the need vs. cost for Guardian based on percent and type of escalations; tighten the contracts if Guardian support is to be continued
- Require CSSD managers to stay in the position at least 1 year
- Create a process for all CSSD activities, including a requirement that all tickets be closed by the last Guardian or CSSD staff to 'touch' the ticket
- Implement training programs for all Guardian and CSSD staff and managers
- Create a CSSD career path plan
- Alter CSSD job descriptions such that some number of unclosed tickets would constitute a fireable offense
- Initiate a metrics program with drill-down dashboard for CSSD activities

An ideal process would include all of the recommendations but constraints in terms of resources and political realities often intrude to make the ideal infeasible.

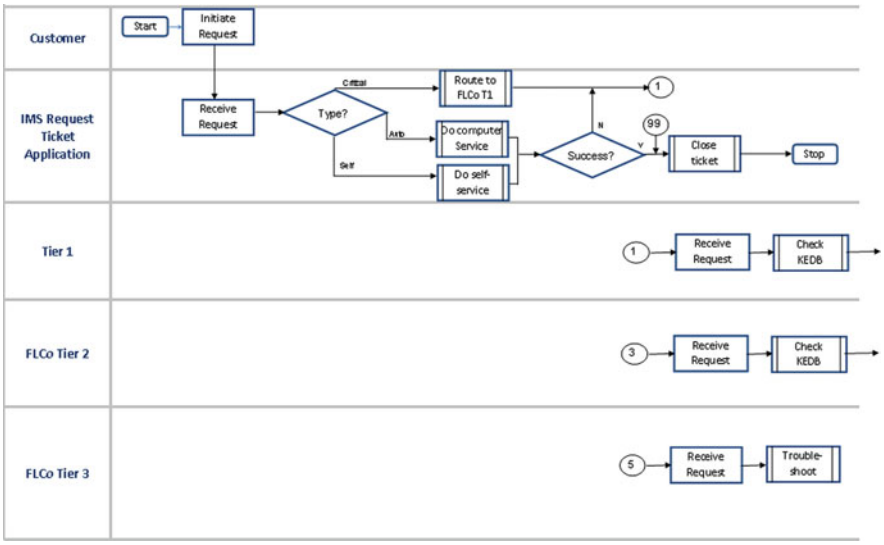

Fig. 9 Recommended FLCo process

Therefore, discussion with clients is done to develop compromises that will work in the target environment.

From that discussion the recommended process is developed. The FLCo recommended process summarized, incorporates the changes that directly affect the process is shown in Figs. 9 and 10.

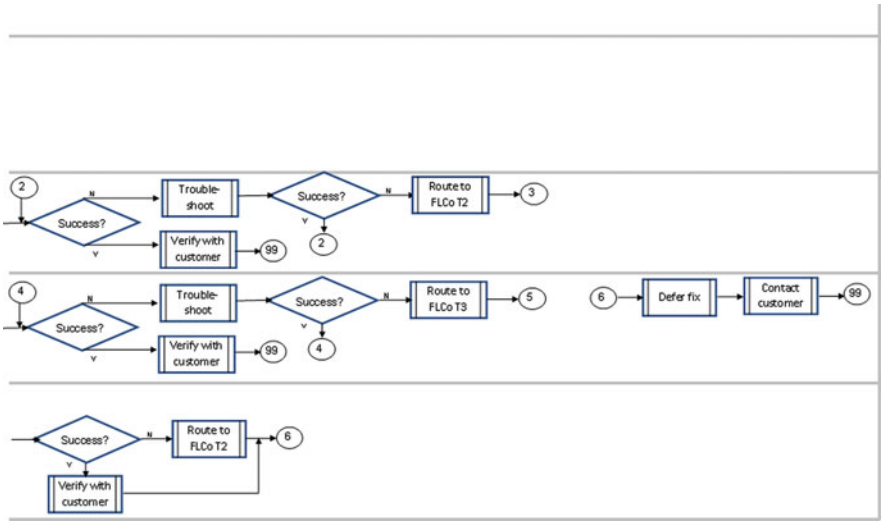

Fig. 10 Recommended FLCo process – continued

4 Discussion

This chapter presents only a few of many techniques available for problem analysis and, while they provide adequate expert guidance to obtain an efficient process redesign, often such simple tools are not adequate.

BPM is critical to organizational success. Six Sigma is a proven, globally accepted technique that facilitates the analysis and improvement of processes (Antony 2006). As demonstrated through the FLCo case, application of numerous techniques is needed to fully analyze a process and determine the importance, priority, causes, and possible solutions to a process's problems. As process areas are more complex, the tools like-wise become more robust and complex. One such technique is failure mode event analysis (FMEA) through which all possible errors for every possible eventuality and stage of a process, usually manufacturing, are analyzed for breadth and depth of impact, expected frequency, and cost (Casey 2008). Thus, many RCAs might be performed to define all possible problems for a single product or process. Then, FMEA analysis would design mitigations based on prioritizing based on potential damage to the organization. Thus, the more complex the problem, the more elaborate the tools and techniques to remove and manage the process and its risks.

There are two main drawbacks to Six Sigma practice. The first drawback is organizational and the second relates to the techniques. Six Sigma can develop its own bureaucracy that risks overpowering the importance of 'getting product out the door.' This is not unique to Six Sigma; the tendency of organizations is to grow or wither. However, companies need to guard against becoming cultist about following Six Sigma and remember that producing products or services for their customers must always come first in importance.

The second issue relates to the techniques. Without Six Sigma, business process management is a set of concepts without an organizing core. However, even with Six Sigma as an organizing theme, there are hundreds of Six Sigma techniques that can be applied to aspects of areas under study (Johannsen et al. 2014). There is little organization of techniques into a cohesive body of knowledge. The various Six Sigma certification levels – yellow, green, brown, black – discuss toolkits from which technique selection is made at the discretion of the user (Andersen 1999). Yet, there is no fixed set of techniques with variation of what is taught from one person to another (Antony 2008).

Within a process improvement project, there are about four key thought processes relating to problem recognition, analysis, redesign, and metrics definition yet Six Sigma is unclear about which methods are best in any given phase or situation. And, occasionally, a method that might be used, such as cause and effect diagrams, is overwhelmed by the complexity of the situation and proves unusable (Conger and Landry 2009). Six Sigma also offers little guidance on how to customize or improvise tools to make them usable in such situations.

Finally, while Lean Six Sigma is useful for removing errors and waste from a process, the techniques do not assist in developing recommendations for change or for designing new processes. Recommendations and design still rely on the skill and

insight of the people conducting the analysis. Thus, Six Sigma is a useful way of focusing attention on elimination of waste and the reduction of errors but it can be an overwhelming toolkit without much guidance for developing project outcomes (Johannsen et al. 2014).

5 Conclusion

Process management is a management imperative that is not done once. Either on-going or periodic assessment of processes with improvement analysis is required for businesses to stay competitive. Analysis techniques from Six Sigma complement process management by introducing rigor to waste reduction and quality improvement. This chapter demonstrates how Six Sigma techniques can be applied to process analysis to improve its operation.

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