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The Implementation Challenges Of Six-Sigma In Service Business

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Abstract

The drive to constantly improve quality culminated with the creation of the six-sigma strategy by Motorola. However, most service companies still do not use the rudimentary aspects of Statistical Process Control (SPC), although they could benefit significantly from the implementation of both SPC and six-sigma, as evidenced by the unqualified success of GE Finance and a few other service companies in using these processes to drive defects/errors out of their delivery processes. In this paper, we explore the reasons for this state of affairs and conclude that the culture of service that predominates in most companies, coupled with the distinctive characteristics of services and the unique requirements of the six-sigma process, create strong barriers to the implementation of the six-sigma strategy. The paper culminates with an analysis of how the innate characteristics of services can be used by managers to leverage the six-sigma implementation process.

Key Words: Services, service recovery, six-sigma, quality measurement, barriers, implementation, culture, values, non-evidentiality

Introduction

Six-sigma is credited with helping GE maintain a leadership position in each of its markets and with generating increased profits of over \$2 billion over a ten-year period (Quality Digest, 1999; Welch, 2001). Moreover, six-sigma is a logical extension of the work of leading quality thinkers that have been proven to produce superior quality performance. Deming's emphasis on Statistical Process Control and continuous improvement of the quality system and the need to study the process itself is legendary. Crosby's fourteen-point program for implementing TQM emphasize rigorous quality measurement and the pursuit of zero defects through vigorous prevention have been embraced by a good number of highly successful, world class companies. Crosby's zero-defects through prevention is the ultimate goal of the six-sigma strategy. Feigenbaum's quality control cycle and Juran's core concepts of the breakthrough sequence and quality cost analysis dovetail very well with six-sigma thinking (Crosby, 1979; Feigenbaum, 1991; Juran, 1981;1986;1992,). Moreover, the thinking of these pioneers has been seamlessly integrated into the Baldrige framework, a modern TQM benchmark.

The case of GE Capital demonstrates that service companies can use six-sigma to achieve breakthrough levels competitive quality performance that are as significant as the results achieved by manufacturing companies. However, a broad search of the academic and practice-based literature has revealed that few service companies have successfully implemented the six-sigma strategy. While there are a number of claims made by consulting companies that they have successfully implemented six-sigma in some of their client-companies, it is difficult to differentiate fact from promotion and ascertain whether these claims are true examples of successful six-sigma implementation. Moreover, on closer examination, the cases that have been touted as successful six-sigma programs appear to be little more than standard TQM principles repackaged using six-sigma concepts. The status of the six-sigma landscape in service businesses is further muddled by the very real and unavoidable measurement problem that presents a formidable challenge for service companies that want to pursue six-sigma performance. We argue that, in contrast to a manufacturing system where the sigma performance of every process can be measured unambiguously and predicted, there are very few processes in the delivery system of most service companies that are amenable to six-sigma measurement and prediction to the degree found in manufacturing. But, the very nature of services makes it imperative to implement and achieve six-sigma on a routine basis. Services are

characterized by simultaneous production and consumption, the presence of the customer in the Service Delivery System (SDS), visibility of service creation activities and parts of the process to the customer, and direct customer contact with the service creation process, all of which make it strategically advantageous, if not competitively mandatory, for these businesses to pursue rigorous defect/error prevention through six-sigma approaches. There is thus disconnect between the competitive need for service companies to pursue zero errors/defects and their slow pace of adoption of six-sigma. We conjecture that the innate characteristics of services and service delivery systems (SDS) coupled with the culture, values and attitudes that these unique characteristics have ingrained into the mindset of traditional service managers, have created some formidable barriers to six-sigma implementation.

Much has been made of the six-sigma performance of airline companies. But, we note two things which reinforce our central thesis. First, that performance is largely due to technological advances and six-sigma performance of aircraft manufacturers, the maintenance systems and crash cause analysis and control procedures developed by these manufacturers and the FAA and mandated and enforced by the latter. Second, in areas like baggage handling, reservations, in-flight services and on-time departure/arrival where the airline companies have complete responsibility and control, performance is far from six-sigma, has not improved in a decade and, in fact, has recently deteriorated.

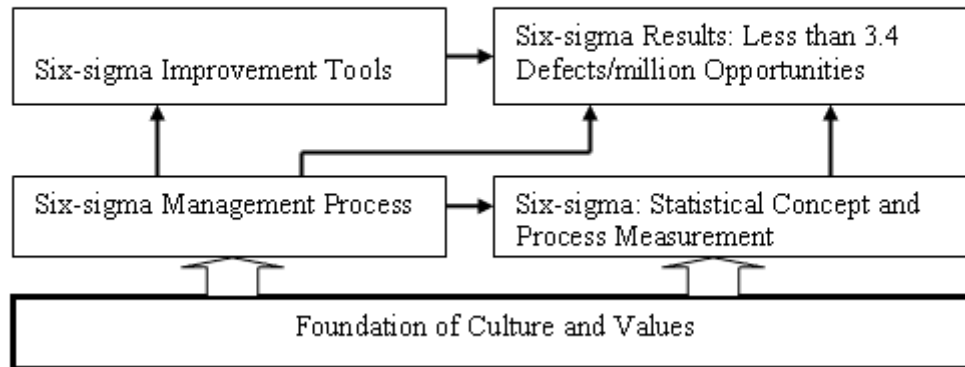
In what follows, we model the Six-sigma process, examine the barriers that are innate to service offerings and the culture, values and development of service businesses which slow down adoption of six-sigma thinking by service companies. We conclude by proposing actions that management can take to overcome these barriers and to accelerate the adoption and implementation of six-sigma.

Model Of The Six-Sigma Process And Review Of Its' Core Concepts

Figure 1 presents the model of the Six-sigma strategy, as synthesized from the literature. Although there is a strong tendency in some quarters to place much emphasis on the statistical concept at the base of six-sigma, the figure shows that statistics are only one part of the six-sigma strategy, albeit an important one. The model is based on the key idea that six-sigma constitutes an overall strategy for systematic defect removal and that the foundation culture and values and the management process that drive the application of the statistical concept are paramount to successful achievement of six-sigma quality. In fact, the driving role that foundation culture and values and the management process play in six-sigma quality constitute the major barrier to the implementation of six-sigma in service businesses.

Six-sigma-The statistical Concept: Six-Sigma is a logical extension of Statistical Process Control, (SPC). The concept behind SPC is simple enough but powerful, indeed. Variation is present in every production/operations process and such variation is due either to common causes or special causes. Common causes are endemic and can only be eliminated by improvement in the process itself and its underlying technology and partly exist because of

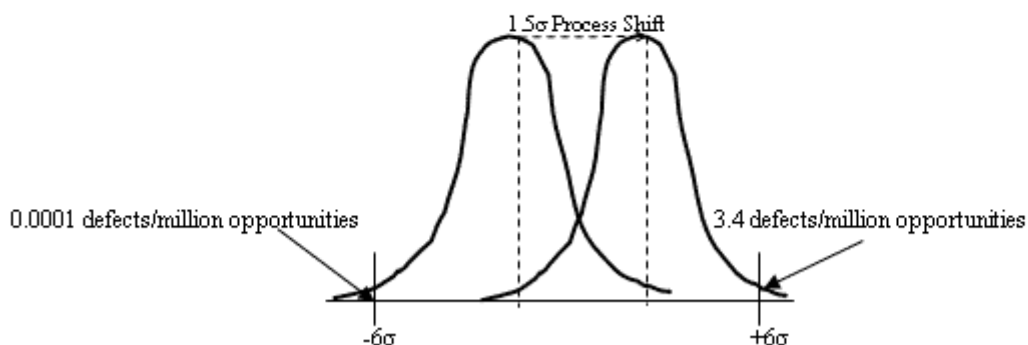
Figure 1
Model of the Six-Sigma Process



in technology. Special causes arise from sources that are not an inevitable aspect of the process and are either the result of process degradation, operating conditions or environmental factors. These causes can be identified by control measures and eliminated by management action. Improvement in the underlying process technology shifts the source of variation away from common causes and into the special causes category, thus increasing the number of causes that can be brought under managerial control. The breakthrough made by Shewhart was the statistical definition and measurement of variation, where variation within three-sigma limits was deemed to be random and produced by common causes, and variation outside of the three-sigma limits was produced by special causes, indicating a process problem (Shewart, 1931). The $+3\sigma$ process limits mean a defect rate of 2.7/1000 or 2,700/1,000,000 opportunities, if one ignores lateral shifts in the process, and the capability of the process is thus defined as the range of natural variation, that is, $\pm 3\sigma$, or $C_{pk} = 6\sigma$. Six-Sigma doubles the range of normal variation to $\pm 6\sigma$, and allows for a 1.5σ lateral shift in the process average. The result is a dramatic tightening of acceptable defect rate target to 3.4/1,000,000 opportunities. The following diagram shows the six-sigma statistical concept.

Six-sigma-The Management Process: The second dimension of six-sigma strategy is the management process through which the statistical concept and other supporting tools are deployed to identify quality problems and to implement improvement projects that drive quality performance systematically and methodically towards the ideal (Pyzdek, 1999; Quality Digest, 2000; Mikel and Schroeder, 2000).

Figure 2
Six-Sigma Process Control



The six-sigma management process varies from author to author but includes some or all of the following aspects; 1. Six-sigma improvement method conceptualized as 'Define, Measure, Analyze, Improve and Control' (DMAIC) (Eckes,2001; Harry and Schroeder,2000); 2. Eight steps to process improvement as outlined by Business Process Innovation/Re-engineering and adopted by the six-sigma strategy (Eckes, 2001; Davenport, 1993; Hammer and Champy,1993); 3. The Benchmarking process (Camp, 1989; Eckes,2001; Harry and Schroeder, 2000); 4. Six-sigma unique team building deployment process through Sponsors and Champions, Team Leaders (Black Belt or Green Belt), Team Consultant (Master Black Belt) and Team Members (Eckes,2001; Harry and Schroeder, 2000).

Six-sigma: The Improvement Tools: The six-sigma strategy has adopted all the established tools of quality improvement and defect removal and prevention. These include Pareto charts, cause and effect diagrams, Ishikawa diagrams, Failure Mode Effect and Criticality Analysis (FMECA), Quality Function Deployment (QFD), Poka-Yoke devices, and Taguchi methods or robust quality.

Six-sigma: The Foundation of Culture and Values: Like all other major quality improvement paradigms, six-sigma recognizes that the actions and energy to achieve and sustain breakthrough levels of quality over the long haul must rest on a solid foundation of culture and values. The values that lead to quality superiority are well recognized in the literature. These are; 1. Organization wide customer consciousness that is deeply embedded; 2. A passion for quality; 3. High value on human resources; 4. A maniacal search for continuous improvement, or the 'Kaizen Reflex'; 5. High value placed on experimentation and innovation; 6. Strong competitive spirit; 7. Deep, mutual trust woven into the organizational mindset 8. Top management assuming leadership responsibility for quality improvement (Deming, 1982; Deming, 1986; Peters and Waterman, 1982; Peters, 1986).

The model of the six-sigma process presented in Figure 1 lead us to anticipate the two critical areas in which the unique characteristics of services and SDSs potentially clash with six-sigma requirements and will create barriers to six-sigma implementation. The first is in the area of culture and values. As we will argue, the fact that six-sigma was completely nurtured in a manufacturing cultural milieu predisposes service managers to rejecting its applicability on the grounds that services are different from manufacturing. The second relates to the measurement requirements of six-sigma. As we shall see, successful six-sigma implementation is critically dependent on vigorous statistical quality analysis and measurement based on continuous, objective data. Extensive measurement requirements permeate the benchmark six-sigma results (less than 3.4 defects/million opportunities), the improvement tools and the management process (Figure 1). Where service outputs and delivery process are not amenable to vigorous measurement, service managers are less likely to accept six-sigma as a quality management paradigm. At best, substantial effort must be deployed to find measures that are conducive to six-sigma processes. Failure to find six-sigma friendly measures leads to compromises and the implementation of a kind of subjective six-sigma process measurements that are poor proxies for authentic six-sigma.. Moreover, critical six-sigma improvement tools such as FMECA, QFD and Taguchi Methods have either not been tested in services or have been at a very rudimentary level.

Fundamental Nature Of Services : Barriers To Six-Sigma Implementation

The Manufacturing Origins of Six-Sigma: The supporting tools of six-sigma -QFD, cause and effect diagrams, Fault Tree Analysis, Design of Experiments and Taguchi Methods- were all developed and still predominantly applied in the manufacturing industries. After over seventy years of proven results, rigorous and broadly deployed SPC, the precursor of six-sigma, has still not found a fertile ground in services. Six-sigma has suffered a similar fate, and after eighteen years of development and proven application by corporate heavyweights like Motorola, GE, and GE Capital, in particular, it is still strongly associated with manufacturing.

There are two fundamental reasons for this.

First, where a new technology is cradled gives it its distinctive culture and underlying philosophy. For example, JIT was born in Japan and inherited the Japanese view of management- backward scheduling, Kanban, supplier partnerships, waste elimination, deep mutual trust between supplier and customer. Because of these cultural elements, Western companies, for a long time, either ignored the power of JIT or resisted its implementation, often with the argument that it is not the way things are done in the West. So, too, from the perspective of many service managers, six-sigma carries some cultural baggage, so to speak. Service managers have a tendency to dismiss six-sigma as a creature of manufacturing and they will find arguments like 'you cannot treat serving people like you do when you're building widgets'. Second, as a result of its manufacturing heritage, adoption of six-sigma by service companies will be viewed as technology transfer, a very slow process from manufacturing to services. A major book on Total Quality Control (TQC) of Services (Rosander, 1985) appeared almost thirty years after TQC emerged in the manufacturing (Feigenbaum, 1958). In fact, TQC transfer was much easier between the US and Japan through the work of Deming and Juran than between manufacturing and services in the US.

Six-sigma Factual Quality versus Service Perceptual Quality: Six sigma is based on quality in fact, the palpable dimensions of a product that can be specified and measured, an emphasis that comes from the seminal works of Dodge, Romig, Shewhart, Deming, Feigenbaum, Juran and Crosby. Quality in fact says that there are physical, measurable characteristics of a product that can be unequivocally shown to have a strong and direct correlation with or determine the quality of the product and customer satisfaction. Obviously, manufacturers would easily embrace six-sigma, since their output is something tangible and precisely measurable, and these same physical aspects largely determine quality. In manufacturing, the factual quality creates the perception and the operative maxim can be, "Produce the quality and the quality will produce the image". When a product has or does not have quality, a well-designed quality control system can verify that fact unambiguously. Moreover, the manipulation of the customer's perception is extremely difficult if the factual quality is not present in the product.

In service, on the other hand, quality has a significant perceptual dimension. While an astute management can find elements of factual quality in any service, the fact is that these factual dimensions alone are not enough to completely or even substantially determine the quality of the service, and sometimes, the negative impact of factual quality can be somewhat mitigated by vigorous management of the factors that influence perceptual quality. Moreover, most cases of management based on factual quality take place in the back-office, which gives credence to the conjecture that six-sigma process requires substantial change to adapt it to services. The identification of moments of truth and the

emphasis on service recovery are measures that have been designed by astute service companies to manage perceptual quality and assuage the impact of negative quality in fact. In services, there are facts, hard facts and perception, the latter modifying the assimilation of facts to reinterpret and make them conform to what the mind would prefer the facts to be. Thus, in a restaurant, a meal tastes more wonderful if the ambiance is great and if the reception prepares the customer to get a favorable impression of the dining experience, as is the case of some Japanese steakhouses in the US. Specifically, the waiting area in some restaurants is strategically positioned close to the bar, enticing customers to take a drink or two while they wait, thereby extending the customer's patience and preparing him/her to relax and enjoy the show produced by the chef. This makes the food tastier than it would otherwise be to a completely sober customer. So, by strategically rearranging the service experience, one can convert a longer-than-expected wait time, a negative quality characteristic, into a positive dining experience and driver of perceptual quality. Again, a late flight is a factual piece of information with negative quality connotations, but the way that information is presented and the actions taken to assuage customer disappointment can make a telling difference between disgruntled customers and thoroughly satisfied ones. Airline company A may be as safe as airline company B, but if B has astutely designed on board videos that remind you over and over again how they are concerned about your safety, you may come away with the impression that airline B is indeed safer. True it means that managing the perception is part of the task of delivering service quality, but it also means that because six-sigma was not designed to deal directly with issues of perceptual quality, service managers find it difficult to relate to its core methods.

The importance of customer perception also means that there is potentially a plethora of Critical-to-Quality (CTQ) characteristics, since each dimension of quality is subject to the customer's interpretation. The large number of CTQ characteristics means that it is difficult to isolate a few, quality drivers on which to focus the six-sigma improvement effort. Customer subjectivity in perceptual quality compounds the problem. How salty is 'too salty' and 'how sweet is too sweet'? How fire hot is 'too hot' and how spicy hot is 'too spicy'? "De gustibus non est disputandum" (We cannot argue about tastes) still holds true in services. Measurement and factual quality are pillars of the six-sigma strategy, but service managers are likely to dismiss these as an impossible ideal for a service business. You can segment the market and focus the service so as to minimize the need for measurement, but segmentation is far from being an exact science and a wide range of customers are likely to enter the service process, even if your service offering is not targeted at them.

Process Orientation versus Service Servitude: A fundamental tenet of six-sigma is that variation in the process is the primary cause of product defects and service delivery errors and, therefore, process improvement is the key driver of defect removal. The defect rate can be driven to near zero levels only to the extent that the range of normal process variation is well within the upper and lower tolerance limits for the product. In a six-sigma process, the normal range of variation is $\pm 6\sigma$. An often overlooked fact is that a six-sigma process does not automatically guarantee a defect performance of 3.4/million opportunities. That performance is only realized if the six-sigma range of normal variation is smaller than the total tolerance of the part or product, and the innate level of process drift and level of control result in process drift of 1.5σ or less. That low level of variation presupposes machine processes that are predominant in manufacturing systems. In fact, the vast majority of transformation processes are machine based and can be engineered and controlled to these tight variation and process drift limits dictated by six-sigma. Service processes, on the other hand, are predominantly human and are difficult to hold to tight variation/drift limits. Even when workers are trained to the same extent and intensity, they will produce wide variations in performance. Process drift is inevitable and high in a human process if only because of physical and mental fatigue that set in after any sustained period of work. In the classical work design framework, one can reduce innate variation in the

performance of work elements by breaking down the task (division of labor). But that very strategy increases the level and rate of job fatigue and monotony, which increases process drift. Some SDSs can be automated which reduces the innate level of process variation and drift. But, partly because of the innate nature of services and the traditional way they have been conceived of, designed and managed, there are still few, completely automated service systems, which severely limits the opportunities and potential to achieve true six-sigma performance.

Customer contact can be a major six-sigma headache for service businesses, particularly where customers participate in the SDS. No matter how much it tries, a service company cannot train, motivate and control customer participation in service tasks as rigorously as its own employees. So, customer contact and participation introduce errors into the service process, thus magnifying the range of process variation and making the attainment of six-sigma quality more difficult. For example, 50% of the packages delivered by FEDEX to the wrong address are the result of errors made by the customer, in the first place.

In a classic paper, Levitt developed fundamental insight as to the reasons for the general inefficiency of service businesses as compared to manufacturing (Levitt, 1972). He observed that the culture of service in many companies led managers to view service as servitude, bowing obsequiously to customer whims, focusing on the output to the detriment of the process, having ingrained aversion to technology as a potent means of increasing service quality and value delivered to the customer. Levitt argued that low service performance had less to do with the innate nature of services and more with the way management viewed the service delivery task. Service management thinking was enslaved in a culture of service as servitude which provided rationalization for the aversion to automation and low process technology intensity which resulted in low productivity. The evidence suggests that Levitt's observations made more than two decades ago still largely describe service management culture. The level of process orientation and the vision of process automation and improvement as a cornerstone of competitive strategy have not penetrated deeply into prevailing service management paradigms. Many more manufacturing than service companies are effective global competitors despite the fact that there are at least ten times as many service as manufacturing companies in the US economy. Process focussed improvement tools such as QFD, SPC, Single Minute Exchange of Die (SMED), Process Benchmarking, Business Process Re-Engineering (BPR) are now mainstays of manufacturing management, but have barely begun to have significant impact in service businesses. In particular, BPR, a process improvement tool that is broadly applicable to both manufacturing and service systems has found much broader acceptance in manufacturing than in the service sector. Examples of true process automation in the services are still rare, exceptions being FEDEX's central hub operations, ATMs and automation of sushi production process, all three of which are at least two decades old.

Quality Measurement: Service is a performance, an act to be observed and experienced, not a thing to be calibrated like a piece of steel as service managers perceive that six-sigma demands. The constant emphasis on performance in the sense of a piece of theatre, as the necessary aspect of service delivery, has created in service managers the mindset that service delivery is an art-form and not a technological process. An art-form cannot be precisely calibrated and subjected to the scientific method because, in art, beauty is in the eyes of the beholder. Judging the quality of service, like that of art, is a subjective, idiosyncratic process that is anything but predictable. In the culture of many companies, measuring and calibrating service quality to the precise tolerances of six-sigma is impossible to do, since most service companies are still measuring quality at the errors-per-hundred-opportunities level. Measurement requires that you capture what it is you want to measure and keep it captive for a time, but because it is a performance, a service is fleeting and perishes the moment it is delivered. In many cases, the only trail of evidence

left by the service process exists in the psyche of the customer, and no one has as yet found a way to measure psychological phenomena to the precision of six-sigma.

This operating vision of service as artful performance conditions service managers to view quality as being dependent on people who master the art of service. Service managers assert that “to err is human,” meaning that you cannot control a human process with the precision required to reduce errors to near-zero. The culture of artful performance has conditioned service managers to accept error rates of ‘errors per hundred opportunities’ as an inevitable consequence of service delivery. These managers will argue that even the very best people will have error rates that are greater than one per hundred because that is simply how things are. Hence, 3.4 errors per million opportunities is simply unrealistic.

The development and deployment of a broad set of robust measures of CTQ characteristics is a cornerstone of the six-sigma (Harry and Schroeder, 2000; Eckes, 2001; Evans and Lindsay, 2005). Harry and Schroeder provide a list of twelve reasons why measurement is fundamental to the six-sigma strategy. Six-sigma is a culmination of the work of the quality control pioneers such as Shewhart, which lay the groundwork for developing scientific methods to control the quality of a process. Deming, with his emphasis on SPC (his famous red-bead experiment is legendary) is a disciple of that early movement. The core concept in SPC and six-sigma is the recognition that the quality produced by a process is a function of variation, that acceptable/unacceptable variation are statistical phenomena and can be scientifically measured. Six sigma uses measures to identify processes that present the biggest potential for improvement, and to drive and evaluate progress towards the achievement of breakthrough quality levels.

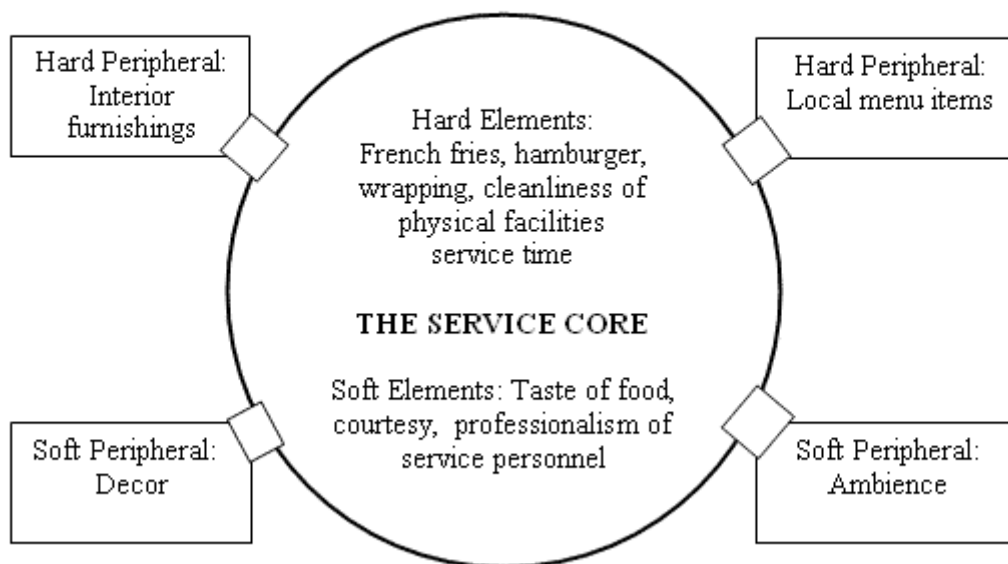
The Six-sigma emphasis on quality measurement was fully deployed in the Baldrige, which gives the highest weight to measurable quality results. However, service managers associate measurement with a physical reality, which they see as being counter to the fundamental nature of services. A service has a hard core of either physical or performance requirements, or both, that are unambiguous. They argue, however, that the service offering almost always contains soft elements both in the core service and, usually, at the perimeter (periphery) of the core, as shown in Figure 3. These soft elements are usually subjective and high levels of performance on one or more of them can compensate for low performance of the others (Fitzsimmons and Fitzsimmons, 2004). For example, you go to a restaurant where, according to your subjective evaluation, the lighting is not bright enough, although that same lighting is just great for the dining experience of other customers. However, the courtesy and charm of service personnel are excellent, and you leave with a very positive overall experience because these latter elements, in your mind, compensate for the effects of poor lighting. Because of this partial substitution effect, service managers, instead of isolating and driving hard on a few CTQ characteristics as six-sigma requires, push in all directions with the conviction that if they cover all the bases, they more likely to satisfy a broad range of customers. Hence, they try to become all things to all people and the SDS loses focus and sacrifices a large part of the quality excellence that it seeks to achieve. The hard elements, service managers argue, can be managed with hard technology and the measurement systems associated with it, but the soft elements which service culture views as being really critical to the quality of a service require the soft touch. This service culture point of view has much validity to it since it is at the heart of concepts like service recovery and moments of truth. Service recovery makes sense and an incident of poor service is recoverable only if there are elements of the service offering that can compensate one for another. And recovery is art, and has been recognized as such (Hart, 1990; Hart et al., 1990; Albrecht and Zemke, 1986). Most importantly, a service recovery is a defect or error in the six-sigma sense. Recovery means that a defect has been produced and subsequent actions assuage the immediate impact on the customer. The manufacturing counterpart of recovery is the successful repair of a

defective product, while the six-sigma quality level measures first-time-defect performance where the operative maxim is 'it right the first time'

Some customer requirements are specific, reasonably stable and measurable, but others are characterized by a certain degree of fuzziness, vary somewhat from one customer to another, and even from one period to the next for the same customer. For example, for a customer who is very hungry and really pressed for time and goes to a fast food outlet, the performance of the service delivery process will be judged uncompromisingly by the speed of service delivery, as long as performance on the other critical service parameters such as quality, courtesy and cleanliness of surroundings is reasonably acceptable. If that same customer is just looking for a place to chat and kill time with a friend, the speed dimension is not nearly as critical and a longer service time will not likely affect his/her perception of the service. The quality of the food and the ambiance/cleanliness of the service environment become critical. Clearly then, no matter how well the elements of the service offering are specified, a high performing SDS must have the flexibility to deal with these individual, temporal differences in customer requirements. In many service situations, management cannot or should not specify strict parameters for the process in advance, since customization and the commensurate process flexibility are an integral part of the service offering and customer requirements. You must specify performance and process parameters in order to effectively manage the service delivery process, but you have to allow some leeway for responding to variability in customer requirements. As it exists today, six-sigma technology has no prescription for building instantaneous, short horizon, temporally changing customer requirements into either the measurement of six-sigma parameters or the design of processes for responding to them.

Figure 3

Hard and Soft Elements of a Service Offering: A Hamburger Based Fast Food



Some companies have tried to deal with the difficulties associated with service fuzziness by standardizing the service offering, the delivery process and methods, as proposed by Levitt (1972) and Chase (1978). However, some services require high levels of customer care or contain high contact service elements. No matter how much a company standardizes, measures and specifies the service and delivery process, service personnel must be allowed some discretion to customize the service to fit idiosyncratic customer

wants that almost always manifest themselves even for a narrowly segmented, highly focused service offering. Discretion cannot be completely automated away, and there will always be a nuance, a special need that must be responded to in some way. One can automate the delivery process if a very narrow set of needs of all customers can be pinned down in advance, and if these needs are invariable during all service encounters. There is no discretion and there can be no empathy in an automated process. When the customer goes to the automatic dispensing machine, puts his money in, presses the right buttons, and the process fails to deliver what he ordered, there can be no empathy from the machine. And if the customer made a mistake and pressed the wrong button, there can be no service recovery, and the only option is to pay a second time for what one meant to order. Therefore, it is impossible to specify a caring, empathizing automated process in advance, except in a general and meaningless way, and one cannot hold employees to precise empathy parameters. But as other work has shown, empathy is a critical dimension of service quality (Parasuraman *et al.*, 1985).

It is not easy to find a balance between process measures that drive quality and efficiency and the human touch quality dimension of service that comes from empathy and deep down customer care. For many service managers, the only practical option is to make the exercise of discretion an integral part of the art of service delivery. The whole idea of 'moments of truth' hinges on the empowerment of service delivery people to use discretion in dealing with ticklish service situations on the spot (Albrecht and Zemke, 1986; Carlzon, 1987; Zemke, 1998; Zemke and Anderson, 1998; Barlow and Matter, 1996; Berry, 1999). But, you cannot tell employees to use their discretion and turn around and say that service time is too variable because although discretion means variability, which is the archenemy of six-sigma, such discretion is critical to service quality in many service processes. Those service managers who believe in the value of discretion will insist, and sometimes validly so, that you cannot measure the number of sigmas of empathy and care, and their service management reflex is to dismiss six-sigma as inapplicable to service operations.

Non-evidentiality and Perishability: A manufacturing process, because it produces physical transformation of the input, leaves an indelible physical mark or impact that persists and often cannot be erased, except at high cost. That physical mark is an inescapable result of the interaction of the process and the nature of the input. Moreover, information about the quality of the product (output) is contained in the physical impact or mark that has been left by the process. Thus, if you punch a piece of metal with a die, you will get a shape whose width, depth and contours are the direct and irreversible result of the shape of the die (process), the power of the press (process), how much wear and tear the die has already been subjected to (quality control process), and the hardness of the metal (input). The mark left by the process is not perishable and cannot change except by the application of another process, and the evidence remains to be measured and evaluated as long as the part remains and has not been transformed. In most cases, even further transformation does not erase the first impacts, which means that one can do after-the-fact defect analysis to ascertain the cause of bad quality. Therefore, manufactured goods have innate evidentiality and non-perishability.

In contrast, the service core of the offering, the generic service, is characterized by dual non-evidentiality. The first, and most devastating to any six-sigma effort, is primary non-evidentiality, where some elements of the service offering, whether programmed or discretionary, fail to register with the customer and simply pass by his or her sensory perceptions. For a variety of reasons such as momentary inattention or diversion of interest towards other aspects of the service, the customer simply does not notice the service act or appreciate it at a deep enough level. Of course, high primary non-evidentiality is likely to occur at periods of high demand when their impact on the perceived quality of the service is most detrimental. The second type of non-evidentiality, secondary non-evidentiality, has received much attention, and it derives from one of the fundamental characteristics of a

service, perishability. The latter concept means that the impact of service acts disappears quickly into the memory of the customer and comes out of the psyche modified and sometimes distorted. At other times, the customer simply forgets and cannot bring out vital aspects of the service experience out of memory. Secondary non-evidentiality means that the part of the intangible elements of the offering that service managers generally view as having a decisive impact on the fundamental character of the service situation and which determine the crucial operating problems and challenges of the service delivery process, is afflicted by 'loss of the evidence.' As the term implies, loss of the evidence refers to the observable fact that, at least for the intangible elements of the service offering, failure to perform and high performance leave no physical trail but disappear with the service act. The service trail exists only in the memory of the customer, which means that improving the service process requires the firm to tap into the customer's psyche after-the-fact, to gain insight into the cause of quality problems or high performance opportunities. Such probing is very tricky business and usually generate data that are too ambiguous to support rigorous six-sigma analysis.

This potentially creates a very serious barrier to the implementation of six-sigma. First, non-evidentiality and loss of the evidence further complicate the development of factual quality measures to drive the service system improvement process. Performance of the intangible elements of the service can only be measured by probing the customer through feedback instruments like questionnaires based on some type of rating scale. Measuring quality on a rating scale has a very strong subjective component, and while the resultant data are good enough to steer general, soft improvement initiatives, they lack the concreteness (hard quality) and precision that six-sigma actions demand. For example, suppose a restaurant company wants to measure performance of the delivery process on the quality dimension 'Service Courtesy'. The feedback question and an associated rating scale are shown in Figure 4. There would be broad consensus as to what constitutes bad quality in this case, but what is good quality? Is it 'average' or better or 'very good' or better or only 'excellent'? When one sets the range of acceptable variation on a part in the form of a tolerance, the latter is chosen based on scientific analysis that demonstrates that the product in which the part goes will not function properly if the quality characteristic is not within the tolerance (Taguchi, 1986; Shingo, 1986; Ealy, 1988; Taguchi and Clausing, 1990; Evans and Lindsay, 2005). Measuring quality using attribute data requires a subjective decision as to what constitutes good quality, and this subjectivity is contrary to six-sigma thinking. The theoretical validity of the very sigma measure that comes from attribute data is questionable, even when these are measured as error rates, because individual errors in a sample occur discretely, whereas six-sigma is based on measures of the individual units in a sample that are continuous. Although the literature on service quality management has not recognized that there are major challenges in the development and use of SPC charts based on attribute data. These charts are based on some critical assumptions that, if violated, render them useless and misleading as instruments for the control and improvement of process quality (Alwan, 2000; Davis and Heinke, 2003).

Figure 4
Partial Quality Feedback Questionnaire for a Restaurant Operation

How would you rate the quality of our service?
 Courtesy: Very poor Poor Average Very good Excellent
 1 2 3 4 5

As discussed previously, a manufacturing process leaves an indelible, persistent, physical mark in the product, and the output characteristics directly measure the process. Consequently, one can directly measure the natural process variation with a limited

number of small samples. By superimposing the tolerances on the normal process variation, one can measure, a priori, both process capability and the expected level of defects. With attribute data, one does not have a direct measure of process variability, and both the idea of a tolerance and the concept of process capability, crucial to six-sigma, are meaningless. Questionnaires are a favorite instrument for generating the data to perform quality performance analysis in service businesses, but these produce questionable results when used for six-sigma analysis. A six-sigma process manufacturing generates a defect rate of 3.4/million opportunities, and we can compute this on an a priori basis using limited process sample information. But because we cannot measure a service process directly and do not have valid measures of process capability and tolerances, the service process must produce defects before we can compute its sigma performance using attribute data, since questionnaires are feedback instruments. Hence, to ascertain whether a service process is performing at the 6σ level, one needs to sample at least 294,117 units ($1,000,000/3.4$) and find no more than one error/defect before one can confidently say that 6σ has been achieved. For most service processes, the time it takes to achieve that level of output will be much too long to allow management to use the results to drive improvement. The quality control instruments used in service businesses are based on defect and error reporting and, as such, are feedback systems, whereas six-sigma is rigorously a feedforward, defect prediction and prevention system.

In addition, six-sigma also uses after-the-fact analysis of causes of defects and the factors driving them so that the underlying causes can be isolated and removed, thereby improving process capability. Six-sigma is a breakthrough in quality performance only if it is achieved through underlying process capability improvement. But non-evidentiality in a service delivery system means that such after-the-fact analysis is very difficult and pregnant with pitfalls.

Service Goods versus Manufacturing Goods: A manufacturing process is designed to deliver a physical good, while the reason-to-be of a SDS is delivery of a service. Most service offerings also include a physical good such as the meal in a restaurant, and the notes that come with a training program delivered by a Management Training company. However, the impact of the 'good' portion of the service offering is usually marginalized by service people and they like to refer to it as the facilitating good. They insist that the fundamental texture of a service delivery process is determined by the core service and not by the good portion. The basic difference between SDSs and manufacturing systems, service people argue, lies in the fact that the former are characterized by high contact between the customer and the service delivery process.

There are two important ramifications of this insistence that the fundamental nature of the service delivery process is largely determined by the core service, the auxiliary good being of secondary import. First, service managers project the features of the service part of the service offering unto the goods part. Instead of recognizing two subsystems in the service delivery process, back office and front office, many do as if the fundamental character of the goods part is determined by the service part. Such projection is quite normal. There is a cultural mindset that says that because a company is in service, the goods that it produces are service goods and are not like manufacturing goods. The idea of a service factory has not even begun to penetrate the cultural make-up of most service managers. Thus, a manufacturing company manufactures cars but a company in the restaurant or hotel business prepares meals. On the other hand, a computer manufacturing company manufactures computers but services (note the distinction very carefully) the computers that it sells to customers. IBM, for example, manufactures computers but also services them, and has created a world-class service organization that strategically exploits that reality to the hilt. Manufacturing managers have no hang-ups about leveraging their service subsystems for competitive advantage, but service managers simply cannot bring themselves to admit that they manufacture service goods, much less services, and thus

are slow to develop the cultural inclination to strategically manage the service factory for competitive advantage. The resistance to ideas and tools originating in the manufacturing industries seems to flow out of that mindset.

Second, service managers argue that consumption of service goods has a strong psychological component, and satisfaction with the service offering is strongly influenced by psychological service. Also, 'service goods' are different from manufacturing goods because the service characteristics such psychological content, emotional dimension, nature of the interaction, that is whether the customer is passive or active in the service delivery process, knowledge intensity and the delivery environment all interact with the service good to influence the reaction of the customer to the entire package. The service makes the 'service good' good or bad, so to speak. That is why it is more accurate to refer to the set of requirements delivered to the customer as the service packaged, because both the physical (tangible) and intangible dimensions interact in a holistic, synergistic fashion to determine the value delivered to and perceived by the customer. In the vast majority of cases, one cannot cut the service offering up into distinct, stand-alone elements and place a value on each one of them independently of all others, even with the sharpest tools of value-cost leveraging analysis. In a Japanese steak house, service managers will argue, you cannot dissociate the quality of the food from the quality of the show that makes the food taste good or bad and the dining experience great or poor. They will contend that customers do not go to a Benihana of Tokyo mainly because of steak but because of the unique dining experience that results from the dexterity and showmanship of the chef. Benihana of Tokyo sells theatre and the food, and the quality of the steak is an enhancement of the service offering and not the core of it. In a medical service delivery process you cannot dissociate the quality of the physical facilities and drug therapy from the quality of the care and human relationships that interact with the medication to enhance the healing process. At least, not since medical science discovered the placebo effect and demonstrated that laughter rooms, petting therapy, nature (gardening) therapy have positive impact on the healing process. Because of the indisputable impact of psychological service, managers in service companies have the tendency to trivialize the impact of the good. One consequence is that because they see it as being difficult to precisely measure psychological service and to exactly specify the parameters of the psychological service delivery process, they conclude that it is a waste of time to develop and deploy rigorous measures for the goods and goods producing part of the process. The way they define and conceive of the service delivery task leads service managers to conclude that quality is substantially driven by perception and the management of it than by any hard, tangible measurable elements. Consequently, they conclude that their businesses have many less opportunities for using hard measures to drive the improvement process.

TQM Legacy and Strength of Foundational TQM Values, Principles, Tools and Feedforward SPC: The implementation of strategic quality concepts is progressive, and prior quality improvement initiatives leave a legacy that can either facilitate or hinder subsequent efforts to drive quality levels higher. For example, there is clear evidence that the companies that were quickest in implementing Total Quality Control (TQC) inspired by the work of Feigenbaum were also those who had mastered SQC. The companies that were quickest in implementing TQM were also those who had already mastered TQC, while companies that are quickest at successfully implementing Six-Sigma are those that had successfully implemented TQM. A well functioning TQM system is the best base from which to build Six-Sigma. Services have always lagged behind manufacturing when it comes to adopting and implementing quality management innovations. For example, Feigenbaum's Total Quality Control appeared in 1958 and was being used for at least twenty years by manufacturing companies before a major book on Quality Control in Services appeared (Feigenbaum, 1958; Rosander, 1985).

The Baldrige started by focusing on manufacturing and added services eight years later. ISO for services appeared no less than forty years after the first attempts to normalize manufacturing quality standards. JIT systems were invented by Japanese manufacturers in the early 1970's but credible efforts to introduce JIT to services started to emerge in the early 1990's, although given the nature of services, one could argue that JIT is more natural and necessary to their success in their markets than in any other sector of the economy. This means that currently many service companies have not mastered TQM to a degree that provides the foundational footings for successfully implementing Six-Sigma. And, not coincidentally, many of the six-sigma implementation successes that have been broadcast by six-sigma consultants highlight elements of the six-sigma strategy that we have categorized as culture and values, management process and improvement tools which are germane to the TQM have broad applicability and were imported into six-sigma. By contrast, the much promoted six-sigma successes in service businesses de-emphasize the hard-core statistical analyses and tools that are generically part of the six-sigma strategy. In particular, the successful implementation of SPC, especially feedforward SPC, as distinguished from SPC defect reporting systems, provides a rich quality improvement legacy that a company can build on to implement six-sigma and drive delivery processes to near zero error and defect rates. But, even feedback SPC is being successfully used by few service companies and, predictably, feedforward SPC as a rigorous error and defect prevention mechanisms, is practically unheard of. If the foundational elements of TQM are not thoroughly embedded in a service company through a strong TQM legacy, then the introduction of Six-Sigma must start from scratch to nurture these, and this makes the task doubly difficult.

Service Business Opportunities For Six-Sigma Implementation

While there are still too few true six-sigma service companies, the evidence from a company like GE Financial tells us that astute service managers can exploit the characteristics of their businesses to leverage six-sigma implementation. We now consider some of these characteristics and how they can be leveraged to successfully implement six-sigma.

Strong Organic and Strategic Links with Six-sigma Manufacturing Organization: GE Capital was at least a full decade ahead of other service companies in embracing and successfully mastering six-sigma and its success has still not been replicated by any other service business that we know of. While the visionary leadership of Jack Welch was obviously the overwhelming reason why GE adopted the six-sigma strategy, it is our view that the depth and breadth of six-sigma deployment, the speed of implementation and the magnitude of the measurable improvement in quality and overall performance achieved by GE Financial has much more to do with the organic, strategic links between GE and its financial subsidiary than has been recognized in the literature. We propose that these links created in GE Financial a wide range of values, skills and competencies that it leveraged to rapidly deploy six-sigma thinking and technologies. These links also allowed GE Financial to avoid the negative values and attitudes that are an integral part of the quality management legacy of service companies that were discussed earlier, and which have hamstrung most service companies from implementing cutting-edge improvement approaches that originated in manufacturing industries.

As part of the GE organization, GE Financial shares all the core values and culture of GE. These include strong customer-centeredness, a broad range of human resource policies that place a very high value on people and foster and reward individual excellence, extraordinary emphasis on training and human resource development as a means of forging human resource excellence, an unswerving commitment to competitive excellence,

total dedication to unsurpassed quality and its persistent, overall improvement, management by fact, that is, decision analysis and search for causes that are based on solid data/information and the use of hard measures to drive performance, a strong drive for results that is sustained by the formulation and deployment of stretch goals, an absolute belief in the value of technology as a driver of corporate performance, promotion of forward-looking, long term and clear vision of the market and a strong desire to be the leading company in its chosen markets (Slater, 1995; Bossidy and Charan, 2002; Welch, 2001; GE, 2001). These core values, culture and beliefs of GE came to permeate GE Financial because of GE's highly developed and articulated "Social Software of Execution", that is, the values, beliefs and norms of behavior, along with everything else that is not hardware. Bossidy and Charan identified GE's "Social operating Mechanisms", a key component of the Software of Execution, as the key driver of GE culture and values deep and broad across the highly differentiated divisions of GE, and elaborate on these social operating mechanisms in the following terms; "These are formal meetings, presentations, even memos or e-mail exchanges-anywhere that dialogue takes place. Two things make them operating mechanisms, not just meetings. First, they're integrative, cutting across the organization and breaking barriers among units, functions, disciplines, work processes and hierarchies and between the organization and the external environment as well. Social Operating Mechanisms create new information flows and new working relationships. They let people who normally don't have much contact with one another exchange views, share information and ideas, and learn to understand their company as a whole. They achieve transparency and simultaneous action. Second, Social Operating Mechanisms are where the beliefs and behaviors of the social software are practiced consistently and relentlessly. They spread the leader's beliefs, behaviors, and mode of dialogue throughout the organization. Other leaders learn to bring these beliefs and behaviors to the lower-level formal and informal meetings and interactions they conduct, including coaching and feedback...GE's highly developed Social Operating Mechanism is central to the company's success....This system of linked Social Operating Mechanisms is how GE's leaders unite a company of businesses so diverse that people have sometimes called it a conglomerate." All these fundamental elements of corporate culture and values are, in part or in whole, paramount drivers of six-sigma implementation success and operating performance, and their transmission across the entire GE organization gave GE Financial an overpowering advantage in the adoption of the six-sigma. The strong, organic link with GE liberated GE Financial from the paralyzing influences of traditional service business culture and values.

Additionally, the strong organic links with GE allowed GE Financial to tap into the core managerial and operating competencies of a set of solid manufacturing organizations that have all achieved world class manufacturing performance. Among these core manufacturing and operating competencies that have been adopted by six-sigma thinking are a solid TQM legacy that derives from years of successfully implementing, exploiting and refining TQM systems and tools such as QFD, SPC, quality improvement teams, and design for manufacturing, the precursor to design for six-sigma, across all manufacturing divisions of the parent, technical orientation and technology driven operations, process orientation and management, emphasis on direct process measures, Zero-Defects, zero-inspection, rigorous defect prevention and poka-yoke systems, and insistence on the development, refinement and deployment of hard measures of process and product quality. The central point is that successful six-sigma implementation requires a solid foundation of quality culture and values that make an organization open to adopting some aspects of manufacturing thinking that are fundamental to six-sigma processes and practices. Organic links with a high quality manufacturing organization facilitate the embedment of these elements of culture and values within a service organization and make six-sigma implementation a normal process of quality improvement.

Service companies that do not have these privileged links with such a manufacturing organization must find ways to open up their organizations to aspects of manufacturing

thinking that are germane to six-sigma and that facilitate its successful adoption. The creation of partnerships with their manufacturing suppliers, the building of strategic alliances with suppliers, customers or other manufacturing companies with which they have strategic synergies or becoming members of benchmarking groups that include significant benchmark manufacturing companies are some of the obvious ways that service companies can make their culture and value system permeable with regards to TQM and six-sigma thinking, technology and practices.

The Six-sigma Opportunity of Direct Customer Contact: Where service managers see problem, they should be seeing opportunity. Direct customer contact means that the company can observe the synergistic interaction of the process and the customer in the quality creation, have quick customer-generated information on the level of subjective customer satisfaction on all dimensions of the service, and relate these to hard, process characteristics wherever possible. Contact is a continuous, reality driven market research opportunity that can be used to generate information on real, directly observable customer requirements that can be used to drive a QFD and design for six-sigma process. Using direct contact to generate customer satisfaction data is a potent signal to customers that the company is concerned about improving quality. Attribute data may not pinpoint the exact cause of quality problems as six-sigma demands, but they are clear, direct signals that there is a problem. More importantly, attribute data can be used to establish the relationship between the physical dimensions of the service and customer satisfaction, and six-sigma can focus on these parameters to improve and control them to six-sigma limits. Some companies take direct contact to mean that 'you have the customer in your hands', literally in some cases, and to shape their perceptions of the service delivery process. But, there is another dimension to the marketing opportunity of contact that is ignored by most companies, and it is that the customer is the one who really has the company in his/her hands, to influence the service delivery process and to critically judge it. Contact is a marketing opportunity to receive reaction from customers and to let them influence the company's understanding of their needs and how well or poorly they are being satisfied. Very few companies exploit that aspect of customer contact as a sound basis for isolating customer requirements unambiguously and for relating customer reactions to elements of the service offering to directly observable process measures.

Service Non-inventoriability, Process Experimentation/Improvement: Six-sigma tells us that the areas where the process impacts on CTQ characteristics are those where improvement must be quick and visible. In SDS, the impact of the process on customers and on the characteristics that influence satisfaction is visible. A manager needs no complex marketing or Taguchi experiments to know the CTQ characteristics, because once one makes even a modest improvement in the delivery process or service offering, one can directly observe the impact on customers. While non-inventoriability means that one cannot hold the service captive long enough to directly observe and measure it, it also means that the impact of the service process is immediate and direct, and the time frame for observing the results of experimentation or an improvement initiative is short. One can go through a cycle of experimentation, observation of results, analysis and refinement of the new initiative very quickly, in a short Deming Plan-Do-Check-Act cycle and squeeze more experiments into a given time period. If the process or service improvement happens to be irrelevant, management will also know it very quickly, change course and move on to the next improvement. In that sense, a service delivery system can be converted into a site of on-going experimentation, learning and continuous improvement.

Back-office, Front Office- The Service Goods Factory: The service goods factory is well-suited to the six-sigma improvement process. One can specify precise quality characteristics for the service good and parameters for the process. Back-office operations usually have processes and output parameters that are of the variable, continuous type that can be subjected to six-sigma thinking, methods and analysis. One can measure the

output to evaluate whether it meets the quality criteria and off-specification products can be unambiguously identified. Moreover, in many cases, operating management can devise direct process measures that can be used to design and deploy direct, feedforward process control. For example, one knows that the customer will react negatively to the size of a doughnut, and that characteristic is directly influenced by the both the ingredients that go into it and the process that cuts the dough. Therefore, rather than weight to get negative reactions to the size of the doughnut, one can directly control the processes that mix the ingredients and cut the dough and avoid making undersized doughnuts altogether. This is the essence of six-sigma process thinking. In the vast majority of cases, the individual back office (service goods factory) is of much smaller scale than the typical manufacturing system, has fewer processes and is easier to measure, improve and change. A company whose management is committed to pursuing breakthrough quality levels can push the typical service goods factory to six-sigma capability levels very fast. There is no reason why a company like McDonald's with significant service goods factories cannot achieve six-sigma capability in its 20,000 or so service units by integrating fool proofing (bake yoke/poke yoke) devices into the design and operation of its processes. A favorable service task structures makes the potential greater.

Consider, for example, the case of a highly popular sandwich restaurant franchise operator in the Toronto area that we know of. The franchisee has approximately fifteen outlets with total sales of about \$ 20 Million, but all baking for the fifteen units is done at a central facility located within minutes of the restaurants that doubles as a service outlet. The bakery (service goods factory) occupies about one thousand square feet of space, has a total of ten pieces of equipment and employs four workers. The quality and freshness of baked goods is obviously a CTQ characteristic, so the potential impact that a six-sigma program would have on customer satisfaction and retention is very high. According to our estimate, \$ 20 Million sales translates into 8 million pieces of baked goods per year which means that wastage rate of 2.0% causes a loss of 160,000 pieces of baked goods at a total cost of \$ 160,000. This is equivalent to the net profit generated by four service delivery units, without counting the marketing impact of failure to achieved six-sigma quality. Showing the profit impact of high defect rates in the service goods factory will motivate management to push for near-zero defects at least in that segment of the SDS. This could condition management to start thinking in terms of zero defects as a quality target and facilitate the introduction of six-sigma thinking.

Or, take the case of the automated sushi. The production of sushi was traditionally a very labor intensive process, a culinary art that takes a Japanese chef years to master. Sushi production is now completely automated because management liberated itself from thinking of the production of service goods as an art and started thinking of it as a factory. In the modern sushi restaurant the automated process can be brought under the six-sigma discipline just like any factory, liberating resources that can be deployed to give even greater personalized service in the front office. In fact, automation of the sushi service goods factory makes six-sigma performance mandatory for the simple reason that it is producing such high volumes. Producing fast is very good but it also means that if your process is not near perfect, you are producing defects very fast. A chef making two hundred pieces of sushi a day with a defect rate of 2%, or 3.55σ , and a defect cost per unit of \$ 1.50, is costing the company \$ 6.00 a day. A sushi machine making the same product at the rate of 100,000 pieces a day and a 2% defect rate is making 2000 defective pieces of sushi a day, potentially negatively affecting up to 2000 customers, destroying the company's reputation as fast as 2000 customers per day can spread the bad news-and they do so very fast, since each dissatisfied customer passes the information to twenty others by word-of-mouth- and costing \$ 30,000 a day in direct, non-conformance costs. To hold the cost of defective product to \$ 6.00 a day with automation, you need a defect rate of no more than $4/100,000$ opportunities or at least 5.45σ quality performance. Hence,

automation which results in high productivity demands six-sigma performance to reap the benefits of the increased process speed.

Service Process/System visibility : Customer presence in and contact with the service delivery system has two implications. First, moderate to high contact service delivery systems are permeable in that the customer must do some on-the-spot specification of the service package, either by choosing specific items from a broader 'menu of services' or by completely specifying the service from a general offering. The latter case is characteristic of customized services such as barber shops or hairdressing salons where one cannot specify in advance the unique features of the service that will be demanded, and all the service company knows in advance is that the customer will require a haircut. There is a line of visibility and customers see and can evaluate the service delivery effort as it is unfolding, and must pass instantaneous judgment on the quality of the delivered service. Operations within the line of visibility are under the critical eye of the customer who, on the basis of what he/she sees and experiences, holds the power to decide if performance is acceptable, whether or not to pay for the current service and whether or not to compensate the company with repeat purchases. For some service companies, the visibility and permeability of the service process is a major headache.

We take the opposite view that service process visibility/permeability, far from being a problem, should be viewed by management as an opportunity to use the customer as a means of driving the six-sigma continuous improvement effort. The opportunity afforded by the customer's presence can be used to solicit direct feedback and, over a rather short space of time, isolate CTQ characteristics. One can use customers as direct drivers of quality improvement by encouraging them to pass active judgement on quality performance. Instead of using employees to do white glove inspections or pre-designating mystery shoppers, management can choose customers on a random basis to perform these activities and compensate them appropriately, thus involving customers directly not only in the service delivery system but also in the quality improvement effort as well. If a company is really serious about achieving six-sigma quality where mistakes and defects are barely measurable, then why not use the fact of the customer's presence and service process visibility to directly deploy customer feedback into the service delivery improvement system, in a kind of direct and continuous QFD process. Manufacturing companies go to great lengths to survey customers and ascertain their requirements as required by the front-end phase of the QFD process. Yet, service managers have not made use of the opportunity created by customer presence and service process visibility to systematically and vigorously solicit feedback from customers and integrate the results into a continuous QFD process. The typical customer feedback questionnaire used by a few service businesses is woefully inadequate for driving six-sigma quality. These questionnaires are usually filled by extremely dissatisfied customers, generate attribute data which are too general to support a pinpointed search for causes. It is now commonplace for customers of manufacturing companies to do source inspection of the production processes of their potential and actual suppliers before they will certify them as suppliers and buy from them. Some leading-edge service companies, MacDonal's being a good example, do the same with their own suppliers of the physical inputs that go into their service offerings, so what is good for them must be good for their customers. It would drive service quality improvement in a powerful way if a part of employee compensation was tied directly to defects discovered by customers. And it would have a revolutionary impact on customer satisfaction and retention if the customers who found defects were invited back to see and evaluate that the problem was fixed.

Conclusions And Implications For Management And For Future Research

We have argued that there are a number of significant barriers to the implementation of six-sigma by service companies and these partly explain why these companies substantially lag behind their manufacturing counterparts in the successful adoption of the six-sigma strategy. These barriers derive from three kinds. The first derives from the innate characteristics of services and service delivery systems that complicate the development of robust measures of both the quality of the service and direct measurement of the process, the latter precluding deployment of feedforward process quality which is germane to a defect prevention program that is paramount in six-sigma. The second relates to the manufacturing origins of six-sigma which has conditioned service managers to view it as tool that applies only to physical products that can be specified to within very close tolerances and the tight design and control of the manufacturing process to achieve these tolerances. Although the measurement problems associated with six-sigma implementation are acute for service companies, the existing literature almost completely ignores these. It is a reasonable postulate to be evaluated by future research that service companies that have not found ways of effectively dealing with these measurement challenges will be relatively unsuccessful at implementing the six-sigma strategy and at achieving defect rates that are 3.4 defects-per-million-opportunities or better. The third set of barriers has to do with the fact that successful six-sigma implementation exploits a core set of culture and values, competencies and technologies that are the legacy of TQM implementation and few service companies have a strong track record of mastery of a broad range of TQM practices. Six-sigma is a natural extension of TQM which lays the foundation for the mastery of more advanced quality management technologies and practices. The absence of a strong TQM legacy in service companies handicaps management attempts to drive six-sigma because the company must start almost from scratch to build the requisite foundation of culture, values and core competencies.

On the other hand, drawing from theory and some successful cases of six-sigma implementation in service businesses, we have argued that there are a number of factors that service companies can use to facilitate the six-sigma implementation effort. Chief among these factors are the nurturing and exploitation of close organic links with a quality-driven, TQM-based manufacturing organization that allows a company to build the measurement and process orientation culture that six-sigma calls for, direct customer contact and process visibility that facilitate the identification of critical-to-quality characteristics and rapid experimentation, the existence in most service companies of a service-goods factory where vigorous output and process quality measurement and orientation are feasible and advantageous. The arguments developed here suggest that, rather than be preoccupied with the attributes of their companies that are radically different from manufacturing and which may hamper the adoption of the six-sigma strategy, service managers should focus on the similarities with manufacturing and also on the distinctive characteristics of services that they can leverage to successfully implement six-sigma.

Moreover, future research can do three things. First, research can investigate whether speed of adoption of six-sigma and implementation success as observed in the case of GE Financial is replicated in other service companies that have strong organic links with a quality-driven, TQM-based manufacturing organization. Evidence for this conjecture would confirm that the absence of a TQM legacy may be more detrimental to the successful adoption and implementation of six-sigma than now recognized in the literature. Second, research can seek to ascertain whether the mastery of the core culture and values, practices, competencies and technology of TQM explain success in the adoption and deployment of the six-sigma strategy, even if a service company has weak or no organic

links with a quality-driven, TQM-based organization. Support for that conjecture would reveal that the critical barrier to six-sigma implementation is not the fact that services are unique and less amenable to quality and process measurement than manufacturing but rather the fact that service companies as a whole have a weak TQM legacy. Finally, by focusing on a few outstanding six-sigma service companies, research can seek to identify and explain the key success factors of six-sigma implementation in service businesses and whether these successful are systematically related to key characteristics of service companies themselves.

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