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MEETING THE CHALLENGE OF SUPPLY CHAIN INTEGRATION: USING SIX SIGMA FOR PROCESS IMPROVEMENT

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ABSTRACT

Increased performance expectations, a more complex operating environment, rising costs, and declining operating margins have become every day challenges for carrier management. In order to meet these challenges, business-as-usual is not an adequate response. The time has come to take a new look at the way things are being done and the results that are being achieved. One method of making such an examination, Six Sigma, has produced extraordinary results for many of the manufacturing and service companies, large and small, that have implemented it. The introduction of Six Sigma as a means of examining and improving carrier service delivery processes is discussed and illustrated.

INTRODUCTION

Looking back to the passing of the Motor Carrier Act of 1980 and similar acts affecting the other modes of freight carriage, one can only marvel at the changes that have taken place. The 1980's were characterized by free entry into the industry (especially motor carriage), industry over-capacity, fierce competition for a share of the existing shipper business (fought mainly on price), and the struggle to understand and implement marketing and differentiation strategies to create a competitive advantage. At the same time shippers were discovering the possibilities of developing cost saving distribu-

tion strategies based on the ability of carriers to be more responsive to their needs and the ability to negotiate rates (Rakowski, Southern and Jarrell 1993).

In the 1990's, carriers were developing strategies to operate as both common and contract carriers in an effort to better serve shipper needs and to make more efficient use of assets. This involved the use of marketing strategies such as shipper segmentation based on the identification of shipper segments with similar needs, the implementation of technology to track and trace shipments, and the initial efforts to use the Internet (Cottrill 2003). During this same period,

shippers were engaged in a reexamination of their business processes in an effort to identify and reduce waste in areas such as efficiency of manufacturing operations, the inability to match supply and demand leading to improper inventory levels and poor customer service (Drickhamer, 2003; Vollum, 2004). In an effort to be more competitive, companies sought to identify core competencies and investigated the efficacy of outsourcing these functions that did not contribute to their core competencies (Ewaldz, 2004). The view of logistics changed from a cost center to a source of profit and a vital link in the delivery of customer service.

By the turn of the century, the focus in the competitive arena had moved from the individual firm to the supply chain. The emphasis on process improvement within the firm has been expanded to embrace the design and implementation of processes connecting members of the supply chain. The Internet has become a communication tool used to create a user-friendly electronic environment to provide information, conduct transactions, and build better customer relationships. Intranets allow the members of the supply chain to engage in joint research, product development, and process improvement projects. In the effort to meet their customer demands and stay competitive in an increasingly globally based competitive environment, shippers continue to demand more from carriers. They expect individualized services that improve operations and meet stringent time requirements, and, at the same time, hold actual transportation costs to a minimum (Kent, Parker and Luke, 2001).

Each firm has a different vision for supply chain integration and strategies for implementation. However, regardless of the shipper's vision and resulting strategies, carriers must be prepared to become an integral part of supply chain operations, an equal partner in the smooth delivery of product and service from raw materials to final customer and back to final disposal (Premeaux, 2002). The challenge of meeting this requirement is in developing a proactive strategy and mind set that facilitates the ability of the carrier to

provide flawless service and the flexibility to respond to changes in customer requirements today and in the future.

THE CARRIER'S DILEMMA

Actually, carrier management finds itself on the horns of a dilemma. Shippers are demanding more services which will contribute to their own ability to maintain a competitive advantage and provide better execution of transportation services that facilitate the time-sensitive, inter-organizational flow of products throughout the supply chain. At the same time, carriers must achieve a level of process excellence that allows them to meet the additional demands made by shippers while maintaining operating margins that provide sufficient funds to invest in state-of-the-art technology, equipment, and infrastructure, and provide the trained personnel at all levels needed to execute strategic customer service initiatives.

To further complicate the situation, a series of new laws targeting safety, security, and environmental concerns, rising fuel prices, and an ever increasing level of global operations have placed even greater demands on supply chain operational performance in general and, more specifically, on the ability of transportation to meet the demands of customers throughout the supply chain. The net result of these changes in the operating environment has been to add costs in the form of additional time requirements, personnel, IT infrastructure, and equipment assets, plus the more publicized cost increases for fuel and insurance.

Carrier management no longer has the luxury of reacting to changes regardless of whether the changes are legal or technological, local or industry-wide, customer specific or supply chain wide, national or global in scope. Reactive strategies tend to be problem or situation specific. When the issue under consideration is considered to have been solved, business-as-usual prevails. After the fact response mechanisms are not adequate for providing the capacity, agility, and cost effective strategies needed to be an active participant in an integrated supply chain

network. What is needed is a continuous, systematic approach to process improvement that is used throughout the organization to specifically identify and eliminate obstacles to the provision of error-free service that is responsive to changes in the operating environment and shippers' needs.

ADOPTING A PROACTIVE APPROACH TO CHANGE THROUGH PROCESS IMPROVEMENT

The objective of process improvement is to reduce waste and the costs associated with inefficient process design and execution (Hoerl and Snee, 2002). Initially, process improvement efforts were associated with the production function of the firm. The ultimate goal was to reduce costs and improve customer satisfaction with improved product quality. This same objective applies to the delivery of quality service. Most importantly, incidences of poor process design and execution lead to service delivery errors and ultimately to lost customers and missed opportunities.

The importance of service quality efforts is reflected in improved firm productivity and reduced organizational costs leading to increased profits (Kandampully and Duddy, 1999). Service providers have found that, like their manufacturing counterparts, providing service quality is critical to maintaining comparative advantage in a competitive global marketplace (Kandampully and Duddy, 1999; Sharma and Gadenne, 2002). Customer perceptions of overall service quality are influenced by the interaction between the customer and the company's representatives as much as the functional and technological quality of the service experience (Kang and James, 2004). The overall results of service quality research highlight the importance of meeting customer requirements in order to ensure service quality (Wycoff, 1984).

There are numerous quality improvement programs available which may be used for service process improvement. Some have been developed to target a specific problem or situation. Other

such programs are more general in nature. Two of the more commonly applied programs are Total Quality Management and Six Sigma. Total Quality Management (TQM) has been shown to lead to improvements in teamwork, feelings of process ownership, organizational efficiency, and customer orientation (Sharma and Gadenne, 2002). TQM projects can have a managerial or process control orientation and emphasize continuous, incremental change.

The Deming management philosophy which incorporates statistical thinking and statistical process control (SPC), total quality management (TQM) and continuous quality improvement provides the foundation for Six Sigma programs (Benedetto, 2002). Six Sigma is customer focused, using data and facts to drive better solutions. Unlike TQM, Six Sigma emphasizes the achievement of breakthroughs in every function and process of the firm. The benefits to be gained through the adoption of a Six Sigma management orientation have been publically reported by diverse companies such as Honeywell, General Electric, Sears Roebuck and Co., Ford Motor Company, Johnson & Johnson, American Express, and Starwood Hotels.

Six Sigma quality initiatives specifically target process improvement for the purpose of reducing errors and cycle time, and increasing customer satisfaction. The company benefits by achieving cost savings as well as providing opportunities to retain existing customers and gain new ones due to the ability to deliver extraordinary service. The customer benefits by receiving the service elements desired every time, thus reducing their own costs and improving their ability to provide the same levels of service to their customers.

SIX SIGMA FOR CARRIER PROCESS IMPROVEMENT

Carriers are faced with the need to meet shippers' demands for improved services. They expect carriers to contribute to their ability to maintain a competitive advantage, better execute transportation services that facilitate the time-sensitive, inter-organizational flow of products throughout

the supply chain, and to make changes in service mix and delivery when needed. At the same time, carriers must achieve a level of process excellence that allows them to meet the additional demands made by shippers while maintaining operating margins that provide sufficient funds to invest in state-of-the-art technology, equipment, and infrastructure, and provide the trained personnel at all levels needed to execute strategic customer service initiatives, all in a rapidly changing operating environment. Considering the task before them, the adoption of a Six Sigma management philosophy by carriers is especially appropriate due to its customer orientation, opportunities for major returns on investment, and new approaches to thinking, planning and executing business processes throughout the firm (Tagha-boni-Dutta and Moreland, 2004).

Six Sigma is more than a buzzword. It is a multidimensional approach to eliminating waste. Waste resulting from the poor execution of any process in the organization, whether it be order processing, routing, accounting, or any other process, leads to costs associated with the inefficient use of resources, the need to correct errors and essentially repeat what was done incorrectly, lost opportunities for revenue due to overpricing or under-pricing, or any number of other examples (Ramakumar and Cooper, 2004). Process measurement, goal setting, and management involvement are all essential to successful change through the use of Six Sigma (Harry and Schroeder, 2000; Beditto, 2002; Hoerl and Snee, 2002).

Process Measurement

Traditionally, measures of performance have been focused on the execution of processes internal to the firm. Six Sigma changes the focus to measures that are important to customers (Taghaboni-Dutta and Moreland, 2004). This provides the ability to compare the performance of different processes as they contribute to the goal of meeting customer requirements. In the transportation industry, the ultimate goal might be the on-time delivery of goods to the customer

without damage in transit. This entails the coordination and execution of a number of different processes such as scheduling, routing, driver and equipment availability, loading methods that minimize the probability of damage, etc. Each of these in turn is dependent upon the execution of other processes. For instance, equipment availability is dependent upon the absolute number of units, location, repair status etc. Repair status is dependent upon training, parts availability, routine maintenance and repair schedules, etc. It becomes obvious that each of the supporting processes contribute to the ability of the carrier to meet customer service requirements. Poor performance at any level will effectively prevent the carrier from meeting service goals and contribute to higher costs and missed market and revenue producing opportunities.

Goal Setting

The setting of performance goals has often been a rather haphazard affair. Goals of 90%, 95%, or even 99% on time delivery sound admirable. But changing the perspective to one of how many unhappy customers or how many missed delivery times will be tolerated provides a different picture. The use of percentages hides the impact of even a 4 sigma (99.38%) rate of on time delivery. At the 4 sigma level, assuming a volume of 250,000 deliveries, 1,550 deliveries do not meet the service delivery time specification! Remember, on time delivery also assumes that the product is undamaged. Now, for each of these missed delivery opportunities, how many lead to financial penalties, lost customers, or the loss of opportunities to gain additional business due to lack of shipper confidence in the carrier's ability to meet performance requirements? Complaints about the inability of railroads to meet service requirements have affected both rail specific traffic and the willingness of shippers to use intermodal shipping options. This provides a vivid example of the ramifications of missed delivery commitments. Using the goal of Six Sigma, one would only expect 3.4 missed delivery commitments per 1,000,000 attempts. Using the previous example of 250,000 deliveries, there

would be .85 missed delivery times. This would mean only one incident of failure to deliver according to customer specifications. This is definitely a goal worth working for.

Management Involvement

Six Sigma managerial involvement takes place at all levels of the organization. Given the opportunity and responsibility, personnel who are in direct contact with shippers generate ideas, create solutions for problems as they arise, identify changes in existing processes that will lead to better performance and eliminate wasted steps. Operators, customer service personnel, and sales personnel are positioned to make tremendous contributions in this way. Middle managers and supervisory personnel are responsible for identifying the need for Six Sigma teams to address problem areas due to recurring service failures, customer complaints, or declines in process performance measures. In this way, a proactive, customer-directed approach to strategic management becomes an integral part of the management focus (Thompson, DeSouza, and Gale, 1985). This may occur at the individual facility and/or regional level as the design, execution and integration of processes to provide customer service is measured and improved using input from the customer contact personnel. The upper levels of management are responsible for ensuring that the Six Sigma philosophy of customer focus and error-free process performance for service delivery is part of the vision and strategic planning for the carrier's future goals and objectives.

ADOPTING SIX SIGMA

An initial issue that must be addressed when considering the adoption of Six Sigma or any other quality improvement initiative is the definition of the expected outcome. This is doubly important when considering the use of Six Sigma, which necessitates the involvement of every individual in the carrier's organization. It has been shown that successful implementation of a Six Sigma program provides the ability to track quality improvement progress leading to more

consistent process performance and service delivery. The net result of the efforts to improve process performance at all levels is to increase the focus on the customer, reduce waste and increase profitability (Harry and Schroeder, 2000; Bane, 2002; De Feo and Bar-El, 2002).

The second consideration is to determine the best approach for incorporating Six Sigma into the individual organization's operations. Six Sigma can be incorporated using anything from the toe-in-the-water approach, which entails focusing on persistent problem areas using a team trained in the use of six sigma tools, to the big-plunge approach that is needed to break old habits and transform a business that has lost its customer focus and instead is dealing with the consequences of continual service failures (Pande and Holpp, 2002).

The most comprehensive approach to Six Sigma is used to effect a business transformation. There is an urgent need to change the way business is conducted in order to meet competitive and customer pressure to improve performance. Time, effort and financial resources are not being used in a productive manner as reflected in shrinking profit margins, service failures, and customer defections. Taking this approach requires the commitment of the entire organization. It entails training, active participation on project teams, and a willingness to approach the improvement of each critical business process (such as delivery, sales, creation of innovative service packages, customer complaint response, and information systems) in an open and creative manner. There will be changes in performance measures for people and processes, customer interaction, and the integration of all internal processes to meet the ultimate goal of exceptional service delivery.

A less comprehensive and more flexible approach to Six Sigma is to focus on strategic improvement efforts. In this case, teams address issues such as determining the appropriate approach to taking advantage of opportunities that have arisen or addressing weaknesses that are hindering competitive positioning. This might

occur when one carrier is acquired by another or when customers indicate that they are not willing to utilize a carrier that does not offer them the opportunity to have one point of contact for all their shipping needs on a global basis. In other instances, efforts might be focused on a specific functional area that has been the source of customer complaints.

The least comprehensive use of Six Sigma focuses on the use of Six Sigma methods and problem analysis tools to gain a fact-based understanding of the causes of persistent problems. With this information, solutions to the problems can be identified and implemented. The benefit of this approach is that root causes to problems can be identified based on facts and data. This circumvents the use of trial and error problem solving that does not achieve lasting results. Another advantage is that this approach is less intimidating and can be effectively used with fewer people actively involved in the effort. The danger, of course, is that this approach focuses on obvious problem areas and does not attempt to change the underlying organizational issues that contribute to these problems.

IMPLEMENTATION

The choice of Six Sigma adoption approach is dependent upon carrier specific needs, resources and objectives. The most important consideration is that the project be conducted thoroughly, using fully trained personnel having the full support of all levels of management. The problem solving process hinges upon maintaining a customer focus because, no matter whether the objective is to improve an internal process or one that directly involves customer contact, the solution will impact the ability of the carrier to deliver the shipper specified services. For instance, improving the process used to resolve damage claims directly impacts the shipper, but improving processes to ensure that loads are properly secured to prevent damage in transit indirectly affects customers through the reduction in the incidence of damage and the resultant need to engage in the claims process. The steps

used in the Six Sigma process are Define, Measure, Analyze, Improve, and Control (DMAIC).

Definition of the Problem

It is common to focus on the symptoms of a problem and never actually address the problem. Using Six Sigma, the problem identification must be supported by facts. This requires a greater depth of understanding of processes and their contribution to the successful completion of tasks. Building on the previous example, a superficial definition of the problem may be that there is a high level of complaints regarding the handling of damage claims. Therefore, solutions might center around clerical improvements that speed up the process. Obviously, this solution will alleviate the complaints about the speed of processing, but the real issue is the occurrence of damage leading to the need for claims processing. Therefore, a renewed emphasis should be placed upon preventing damage from occurring.

Measuring the Problem

Once the problem has been defined, it is necessary to gather data to quantify what is taking place which contributes to the problem. The objective is to examine all aspects of the process to determine the root cause of process deficiencies. The process can be thought of as having three basic elements; inputs, process activities, and outputs or results. The first task is to develop measures of the output. This provides insight into what the problem might be. In our damage example, measures of the rate of damage broken down by shipper, route, and product would be appropriate measures. This would serve to narrow the focus from damage in general to specific problem areas.

A second point of measure involves the inputs. The inputs into the process have a major effect on the outputs. The process cannot produce excellent results if the inputs are faulty. Following the damage example, assume that the preponderance of damage claims are originating from a specific shipper or product category.

Packaging is an important element of damage prevention that is under the control of the shipper. Measures might include analysis of all elements of the package and packing materials to see if they are sufficient to protect the contents under reasonable handling conditions.

The third area of measurement is the process itself. Again assume that the packaging materials were sufficient to protect the contents under normal shipping conditions and that the products were not damaged when they were presented for shipment. At this point a careful examination of the loading, unloading, and movement elements of the carriers shipping process would be appropriate. The problem might originate with the loading process. Other activities, such as stacking, bracing, and handling, may also contribute to damage if not performed correctly. During the actual transport, goods may become damaged due to vibration, sway, or other transit conditions. If there are several deliveries prior to reaching the product's destination (common in LTL), is there sufficient bracing to prevent movement of the remaining goods during transit to the final destination? Are the products unloaded and reloaded so that the shipment to be unloaded first can be reached? An answer of no to either of these questions can indicate the potential source of the damage. Finally, during the unloading process, is appropriate care given to the handling of the items? Does the driver note any damage to the products when they are accepted by the customer? Is it possible that the damage is actually occurring after the shipment has been delivered?

Analyzing the Data

An analysis of the data that has been collected gives a picture of the complete process and hopefully identifies the root cause or source of the problem. From the example, the source of shipment damage could have originated at the input stage, during the shipment process, or at the point to delivery. If no historical data are available, it may be necessary to actually track

current shipments and document all of the events along the way. It may be possible, especially if the incidence of damage has risen fairly recently, to track any changes that have taken place in the intervening time between a period of few damages and the current period of rising damages.

Making Improvements

At this point, it is time to create problem solutions based upon improving the identified underlying cause. There is usually more than one possible solution, each of which will affect not only the immediate problem under consideration but will also impact other areas of carrier performance. If our damage problem originated with the packaging, some obvious approaches might be to require different packaging or the shipper may be asked to pay higher rates or carry his/her own insurance. If the damage occurred during the transportation process, do changes need to be made to the packing or bracing configurations or materials? Does the load need to be packed according to delivery order? If, for a shipment by truck, the damage is attributable to actual road conditions, should the routing be changed or should air shock equipped trailers be used? If there is a possibility that the damage is actually occurring after the load has been delivered, does there need to be an open package inspection made before the driver leaves the receiving dock? Understandably, this particular issue will be a touchy one.

Implementation Control

Once the proposed solution has been agreed upon, it must be put into place—and monitored to ensure that things do not revert back to the old, and familiar, way of doing things. Continuing to measure inputs, process performance, and outputs will serve to identify deviations from the expected performance before they become a source of customer service failures. It also serves to reinforce the importance of the “new way of doing things.”

DISCUSSION AND IMPLICATIONS

The publicity surrounding Six Sigma appears to be centered on applications by Fortune 1000 or other high profile corporations. However, the benefits to be gained from the use of a Six Sigma managerial orientation are not limited to the largest of companies. It is especially useful for service providers because service delivery depends upon the execution of processes that may not be well understood and controlled and are less likely to have quantitatively-based quality improvement processes. It is all too easy to focus on quick fixes without conducting a thorough examination of the factors which underlie and contribute to the problem.

Carriers must meet shippers' demands for different, and in many cases, more complex services which must be executed flawlessly in order to be the carrier of choice, maintaining close working relationships with shippers and making significant contributions to providing the uninterrupted flow of goods throughout the supply chain. To do this, carriers must achieve a level of process excellence that allows them to meet shippers service demands and maintain operating margins sufficient to provide funds to invest in state-of-the-art technology, equipment, infrastructure, and personnel training. A rapidly changing operating environment contributes to the complexity of the task. In view of the challenges facing carrier managers, the adoption of a Six Sigma management philosophy is an appropriate response. Six Sigma, with its customer orientation, opportunities for major returns on investment, and new approaches to thinking, planning and executing business processes throughout the firm can provide the framework to move forward.

The obvious benefits of Six Sigma adoption include gaining a better understanding of the customer's requirements and expectations. This provides an opportunity to assess the carrier's ability to meet an individual shippers service needs based upon resource availability and profit potential. It also requires carriers to objectively examine and assess the performance of the

processes at all levels which contribute to the flawless execution of service to the shipper and the efficient operations of the carrier. A clearer understanding of process capabilities, performance, and value-adding potential is a basic result of Six Sigma analysis projects. The development of meaningful performance measures that are shipper-focused enables the carrier to detect performance discrepancies before they become major impediments to service delivery. Six Sigma also contributes to the ability to identify the most critical projects. Team working to improve process performance must cross functional boundaries as they track the process from beginning to end. It allows everyone to see the inefficiencies that result in the absence of cross-boundary cooperation.

Some less obvious, but vitally important benefits center on the effects of Six Sigma management methods on the workforce. As a result of improved process performance and a carrier-wide commitment to quality, the work environment becomes less chaotic due to the occurrence of fewer preventable emergencies. Employees can work more effectively and find it to be more rewarding. They benefit from the training, additional responsibility and their contribution to making process improvements. They are more likely to take pride in their individual contribution to the effort. Drivers are an integral part of the effort to deliver flawless service to the shipper. The training, additional responsibility and ability to suggest and make process improvements provides an additional pride of ownership that serves as an incentive to be a long-term contributor to carrier success.

If present trends extend into the future, successful supply chain operations will hinge upon the ability of all members to contribute to the flawless execution of processes that transcend firm boundaries, promoting the seamless flow of product, service, information and financial resources to meet the needs of the final customer. As an integral part of the supply chain, carriers must differentiate themselves by their ability to provide exceptional service in order to participate as a full partner in the

strategic operations of the supply chain. The decision to use Six Sigma methods as a problem solving framework, to effect strategic improvement, and/or to serve as the vehicle for a transformation of the business and its operations

provides a sound, data-based approach to meeting the challenge to improve shipper-based service performance and maintain a sound level of financial performance.

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