Revitalizing TQM efforts: a self-reflective diagnosis based on the theory of constraints

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Product quality is merely a necessary condition for a firm to stay in the market. Yet most managers have not accepted this perceived reality. Highlights a self-reflective diagnosis used to uncover the real contribution of TQM in achieving the firm's global goal. Also introduces the theory of constraints as a powerful tool to guide decision processes that could bring the firm closer to its goal.

The authors wish to thank the anonymous referee and Dr John Peters for their valuable suggestions.

Management Decision
35/10 [1997] 746–752

[ISSN 0025-1747]

Introduction

Competition is fiercer than ever before. To stay in the market, managers constantly redefine their firm's competitive edge to be different from competitors in satisfying the customers' needs and expectations. TQM is one type of competitive edge that has been believed to be a powerful weapon to beat the competition. Therefore, most firms eagerly seek the potentials of TQM by investing considerable amounts of money and other resources. However, the reality suggests that TQM is just a necessary condition to survive.

Profound efforts, sacrificed by firms for the sake of TQM, have not reaped any real benefits (Brown *et al.*, 1994). Even all the efforts seem to cause the firm to move away from achieving its goal. This devastating issue must be highlighted before it penetrates deeper to destroy all the functions of the firm and finally causes its competitiveness to deteriorate.

The main objective of this paper is to demonstrate that TQM could significantly impact on the firm's ability to compete. A self-reflective diagnosis based on the theory of constraints (TOC) is discussed in the next section to assist managers to contemplate their firms' practices. The decision procedure captured in TOC is introduced to facilitate managers' view of the wider spectrum of TOC applications. A section entitled "The essence of TQM practice" shows a way to revitalize TQM efforts in sustaining the firm's existence. Finally, conclusions present the important points derived from the prior descriptions.

Goldratt method for self-reflective diagnosis

Managers often deal with tough issues that diminish the capability of the firm to attain higher performance and also distort the way managers take actions. This condition stimulates many scholars, consultants, and practitioners to invent new managerial philosophies to address these tough issues. Adopting a managerial philosophy will drastically affect the behaviour of the people in the firm and its performance. However, with the passage of time and environmental change, the logic of developing yesterday's solution is no longer relevant to the new reality. This phenomenon can be seen from numerous disparities between actual performance and potential performance. Even when more efforts based on the principles of solution are taken to improve performance, apparently the actual performance stagnates. To be able to diagnose and replace the obsolescence of yesterday's solution, managers must adopt new ways of thinking about new reality in business.

Diagnosis should help managers to perceive the obsolete solution. According to the *Oxford English Dictionary* (1989), diagnosis is a critical and careful study of [managerial] practice especially to determine its nature or importance. The acceptance of a diagnostic method is subject to the ability of self-reflection, that is to allow managers to ponder on the relationship between the new reality faced by the firm and the dominance of different solutions. Thus the result of diagnosis relates to the understanding and knowledge about how the new reality works and why it works that way. Managers must explore their own understanding before communicating the findings to others and gaining their support. Like Socrates (470-399 BC), Goldratt (1990) argues that a solid foundation for knowledge is relying on human reason. Only people that are close to the system concerned possess the intimate knowledge necessary to uncover the true insights. The Goldratt method for self-reflective diagnosis provides basic principles to describe the circular processes of perceiving, judging and acting.

To achieve true insights, managers must learn to unleash intuition. Intuition consists of an immediate understanding about managerial reality as well as managerial problems. Very often, intuition tells managers what things are required to understand the subtle managerial issues. However, their actions are not directed by their own intuition. In other words, managers usually ignore their intuition. As a result, many actions taken by managers do not make sense to themselves; thereby many conflicts arise. One way to escape from this circular difficulty is to locate managers in a realistic environment through challenging their assumptions about the real world through constructive criticism. Asking the tough questions that arise from the data and ideas that have been

assembled can form constructive criticism. This criticism can lead to highlighting key assumptions. If these key assumptions are found not valid any more in the new reality they should be dispensed with. Thus invalidating outdated assumptions will affect the future of the firm. However, finding the outdated assumptions is not a trivial undertaking. The right questions should be posed to lead to the right answers. Hence, verbalizing what type of possible questions (what if) the managers might face in the future is the first step in perceiving reality.

Dialogue on questions and answers is useful to analyse arguments, to bring assumptions to the surface, and finally to reveal inconsistencies. This dialogue also encourages managers to correct their insights. A number of vague questions may arise owing to lack of clarity, thereby leading to unsatisfactory answers. Poor verbalization usually causes the managers to behave contrary to what they believe in (Goldratt, 1990). A much better verbalization of intuitive questions is needed to justify the assurance of intuition as well as to convince others. Thus to clarify questions stemming from intuition is important in the quest for the truth.

Sometimes managers can use their common sense to answer the questions. Common sense is an intuitive answer that has the ability to produce an opinion. To verify an intuitive answer, managers need data. Goldratt (1990) defines data as any string or indication that gives meaning about reality. Good data can work interactively with managers. Therefore, the required data can be drawn easily from the data ocean as indicated by the questions. To arrive at the true answers to the questions, managers need to formalize their common sense into a decision process that enables them to deduce the needed information from the required data. Information can be deduced only as a result of using a decision process. Hence there are two necessary conditions to obtain information, namely the required data and the required decision process. In conclusion, information itself is the answer to the question asked, not the required data to answer the question (Goldratt, 1990).

Managers often have different levels of a question. On one level, information may be regarded as data. On another level, data can be considered as information depending on the question asked. Hence information can be arranged in a hierarchical way to form an information system. Every level consists of the required data as an input to the decision process, information as an output, whereby the decision process itself is implanted in the information system. On each level, information can be deduced from the required data or from the lower level using the decision process.

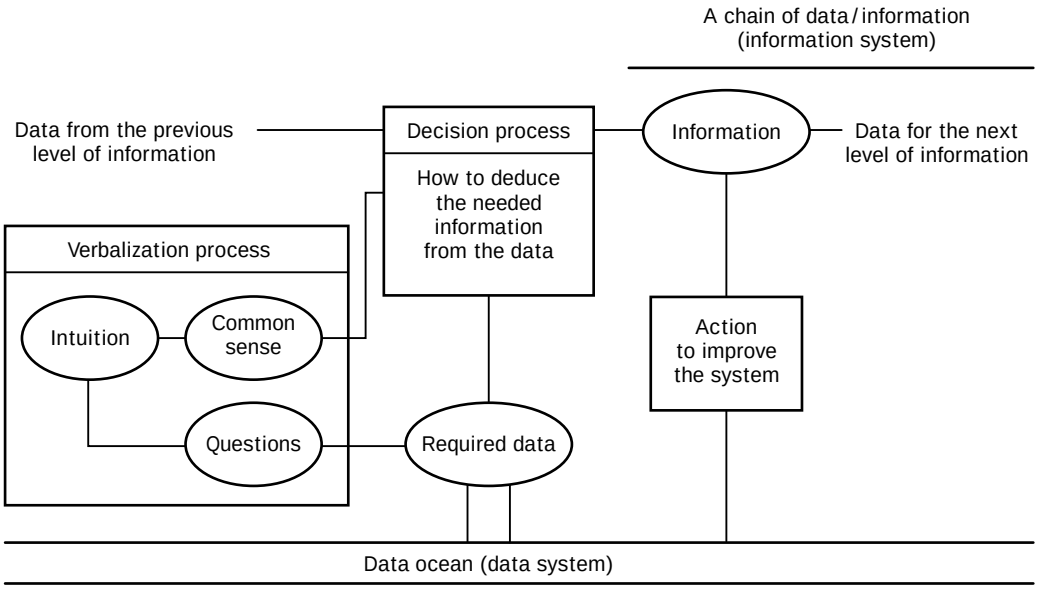
Managers take actions based on information. Both the availability and non-availability of information will impact on the managers' actions. Therefore a good information system is characterized by its ability to capture a broad range of "what if" questions and also to resolve conflicts on a timely basis. Access to information on a timely basis enables managers to make on-time decisions.

Figure 1 displays the Goldratt method for self-reflective diagnosis that consists of: verbalization process, required data, decision process, and information. The timing of events underlying the Goldratt method to be summarized here is as follows. A chain of the diagnosis forms an information system that is aimed at answering questions through its decision procedure. Once managers verbalize their intuition into a tough question, the required data are acquired to answer the question. Verbalization of intuition is also important to derive common sense. This common sense is needed to formulate the decision procedure that enables managers to deduce information from the required data. The data system that can answer most trivial questions feeds the decision procedure with the required data. The decision procedure usually comprises a series of effective formal routines derived from common sense in order to deduce information from the data.

A self-reflective diagnosis requires two conditions to be able to check whether intuition will lead to the satisfactory information system. First, managers have to realize that every system was built for a goal. The *Oxford English Dictionary* (1989) defines goal as "the result to which effort is directed". For profit-oriented firms, the goal is to make more profit now and in the future. However, the behaviour of a system is also subject to the necessary conditions that are important in order to attain the goal. The goal must be a primary criterion to judge the impact of every action taken by any subsystem. Any progress that has been made towards goal achievement is termed productivity. Managers can use performance measuremlocal ent to judge the impact of any sub-system and any decision on the global goal (Goldratt, 1990).

Any actions and decisions that impact on the system moving it closer to its goal is called improvement. The principle is global optima, which is not the same as the sum of local optima, because any actions and decisions that attempt to improve local performance will detract from the system achieving its goal. Lockamy and Cox (1994) contend that the group's intuition can be tapped to re-engineer outdated performance criteria. Any function in a firm necessitates its having objectives, information requirements, performance measurement systems, and a required linkage. The question asked is generated in the critical

Figure 1
The Goldratt method for self-reflective diagnosis



linkage between functions, for instance between production and marketing. Then an information system is developed to synchronize actions and to align performance measures to the global goal.

The second requirement involves devising all the required decision procedures. However, in today's high paced environment, the decision procedures can change. This indicates a need for the appropriate decision procedure that allows managers to critique that existing organizational practices are distorted. This decision procedure must provide a way of finding flawed assumptions, which underlay organizational practices. The next section describes the theory of constraints (TOC) as a robust decision tool for managers in conducting the improvement process.

The theory of constraints

TOC comprises a set of enquiry tools that can raise critical questions about systems of concern and focus on the system's constraints to help managers gain understanding and knowledge. Any organized enquiry consists of ideas and frameworks (tenet), methodology, and area of application (Checkland, 1985). The basic tenet of TOC is that any system comprises a series of interdependent elements joined together like a chain for a common purpose. The weakest link serves as a constraint that prevents the system from attaining its goal. Because of the constraint, the first assumption of TOC is that every system has a few constraints. Constraints may be a physical constraint (e.g. resource constraint, market constraint), behaviour constraint (e.g. knowledge, technology, resistance to change), and policy constraint (e.g. regulation, guideline).

The idea of viewing a system as a chain of elements and the weakest link as a constraint enables the managers to distinguish constraint elements from non-constraint elements. The constraint element dictates the system's ability to achieve its global goal, whereas the non-constraint elements have an indirect impact on the firm's performance. Hence a different set of performance measurements is needed to monitor the activities and decisions of the constraint element and non-constraint elements. If the elements are resources in a firm, managers have to link the performance measurements in a firm's levels across functions to its global goal in order to ensure the resources have been used effectively. Managers can tap the performance measurements to monitor the firm's success on its competitive edge, monitor sources' activities, and provide information for proactive decision making.

The logic of reality can be perceived through employing an effect-cause-effect explanation. This leads to the second assumption of TOC in which common sense can be derived using an effect-cause-effect explanation. Effect-cause-effect explanation is experimenting with an observed effect through postulating its hypothesized cause. If another secondary effect can be found and there is evidence that the cause explains the secondary effect, then the relationship between the first effect-cause can be accepted as true common sense. By using the rules of effect-cause-effect explanation, managers can develop an effect-cause-effect diagram

to find the core problems. Thus managers are able to discover a true cause of problems rather than dealing with the undesirable symptoms.

An example of an effect-cause-effect explanation is in determining the performance measurements of the bottom line of a for-profit company. If the global goal of a for-profit company is to make more profit now and in the future, an effect-cause-effect explanation can be used to answer the question "How would the managers know that the operational actions and decisions impact on the global goal?" By assuming three operating measurements, throughput (T), inventory (I), and operating expense (OE), managers will know that their actions on the bottom line really affect the achievement of the firm's global goal (Goldratt and Cox, 1992). Throughput is the rate at which the firm generates money through sales. Inventory is all the money that the firm invests in purchasing things that it intends to sell valued at raw material cost. Operating expense is all the money the firm spends in turning inventory into throughput. Managers can deduce a basic principle for improvement that is to focus on the locations of higher-impact actions on the shopfloor. There are three ways to improve the shopfloor: increase throughput, decrease inventory, and decrease operating expense. The first line of action should be to increase throughput.

The third assumption of TOC is that the people surrounding the system have the intimate intuition that is necessary to define problems as well as solutions. This emancipatory property enables managers to formulate new substantive knowledge about the system of concern, without being under oppressive power or domination from the top level (Minger, 1992). The emancipation motivates the participants to own the process of changes.

TOC is a complete theory that consists of both substantive theories about managerial matters such as scheduling and methodological theory concerning how to investigate the managerial matter. TOC helps managers to define problems both in the real world and within the discipline. Managers apply TOC in real world applications using TOC methodology. According to Checkland (1985), methodology is a set of principles of inquiry to guide how the ideas and frameworks applied to solve the problems in the real world. The findings would recommend actions in the real world whether through intervention, influence, or observation.

TOC has two focusing processes aimed at realizing ongoing improvement. From the perspective of the system to be improved, the methodology is the five-step focusing process (Goldratt, 1990) and from the perspective of ongoing improvement, the methodology is the thinking process (Goldratt, 1994). The five-step focusing process is a methodology used as decision procedures to:

1 identify the system's constraints;
2 decide how to exploit the system's constraints;
3 subordinate everything else to the decision in step 2;
4 elevate the system's constraints; and
5 if in the previous steps, a constraint has been broken, go to step 1, but do not allow inertia to cause a system constraint.

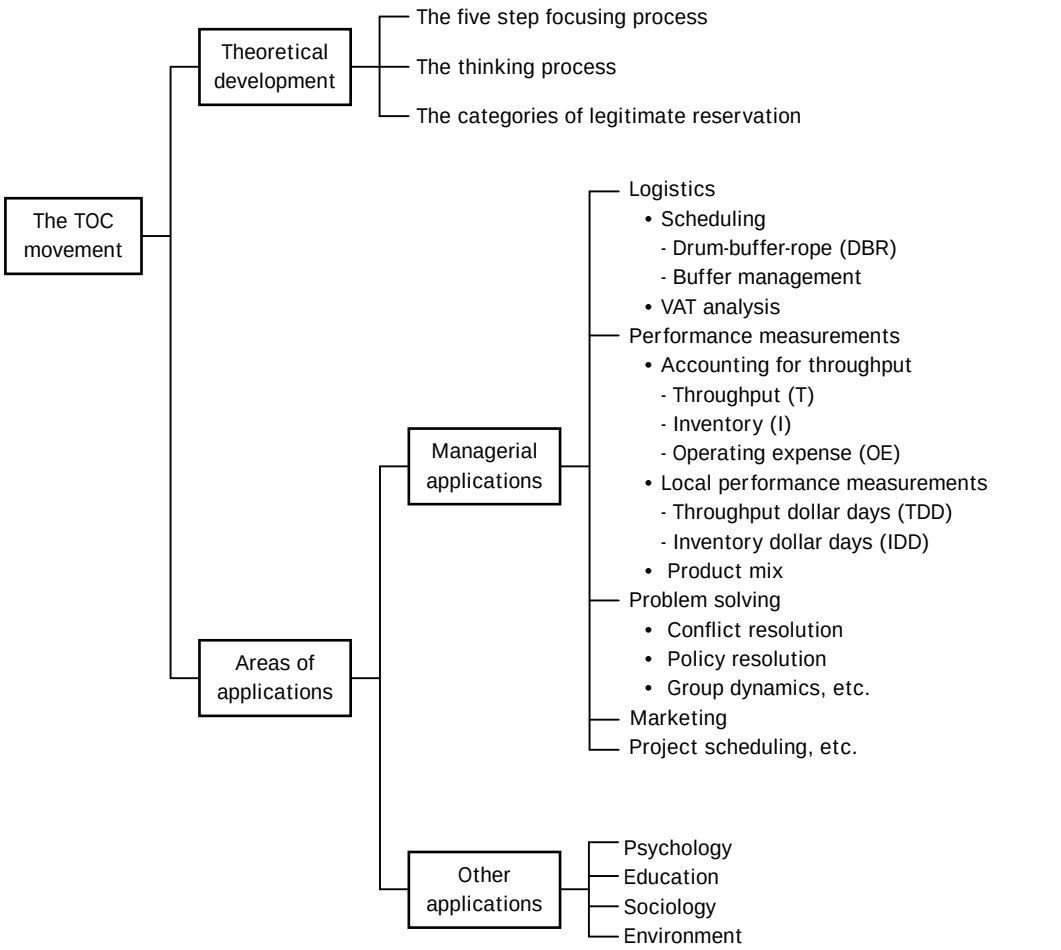
The thinking process is a methodology for identifying the underlying causes for undesirable effects and to enable the managers to explore the impact of local actions and decisions on the global system performance. This methodology includes current reality tree, evaporating cloud diagram, future reality tree, pre-requisite tree, and transition tree (Goldratt, 1994; Noreen *et al.*, 1995). The last methodology of TOC is a methodology of the categories of legitimate reservation that comprises the rules of logic to verify effect-cause-effect explanation (Noreen *et al.*, 1995).

Every effort to develop TOC and to apply TOC in the real world application provides a contribution to the TOC movement (see Figure 2). The TOC movement can be defined as the progress of TOC to enrich its internal logic as a consequence of various applications. TOC is developed based on its ideas and frameworks and while TOC is applied to the real world, the results in turn will enhance TOC ideas and frameworks. In this sense, there are two streams of TOC: the theoretical development and areas of applications. The theoretical development consists of ideas and frameworks of TOC (Spencer and Cox, 1995). This stream consists of three components, namely the five-step focusing process, the thinking process and the categories of legitimate reservations.

The TOC applications can be divided broadly into two sub-categories: managerial applications, and other applications. Managerial applications are well recorded in various references that comprise logistics, performance measurements, problem solving, marketing, and project scheduling (e.g. Goldratt, 1994, 1997; Umble and Srikanth, 1990). Other applications attempt to apply TOC in the area of psychology, economy, sociology, and environment (Noreen *et al.*, 1995). The next phase the managers have to attempt with TOC is to find the substantive solutions for their firms.

Managers use TOC especially to critique the foundation of other improvement approaches and to cascade them in a proper use to accelerate the improvement process. This complementary property enables managers to adopt TQM and JIT simultaneously to improve bottom line actions (Lockamy and

Figure 2
The theory of constraints movement



Cox, 1994). The next section demonstrates how TOC can direct TQM to get real results.

The essence of TQM practice

In today's competitive era, every manager must be faced with the question: "How better can TQM affect both the competitive edge and the firm's profit?" The first reality is that TQM as a means to attain the goal has to guarantee that the firm can provide a good deal for its customers. The second reality emphasizes the objective of TQM, which is to address the profitability issues (Dettmer, 1995).

Managers have to solve problems that relate directly to profitability and accelerate the rate at which the company succeeds. To assess the impact of competitive edge on profit, managers need performance measurements. Any attempt to improve the competitive edge of TQM based on customers' needs and expectations should be assessed in terms of the performance criteria. The customer function is responsible for defining the performance criteria that have a real impact on the profit, such as increased revenue or increased market share (Lockamy and Cox, 1994). The performance criteria must be translated into the bottom line results. As a consequence, managers can focus TQM efforts on the bottom line that support the firm's ability to improve current and future throughput.

On the shopfloor, managers are faced with identifying the true cost of the improvements. The process of improvement often absorbs investments in terms of resources and policy such as purchasing new machines, training, and adopting TQM technology. Any investment opportunity should be aimed at creating revenue. Of course the defined performance systems help managers to monitor the firm as it moves towards its goal as well as to provide information on a timely basis to make decisions regarding ongoing improvement.

From the above discussion, there are two contributions TOC makes to TQM, namely the

performance measurements and the focusing process. Another contribution of TOC to revitalize TQM is the use of the drum-buffer-rope (DBR) scheduling system. This creative scheduling system can be used to increase sales in terms of lead time reduction while decreasing work in progress (Gardiner *et al.*, 1994). In a low work in progress environment, the source of quality problems such as variations, disruptions, breakdowns and material shortcomings can be effectively identified. The five-step focusing process provides the decision procedures for DBR implementation to pinpoint the constraint and also the tactical efforts as to how to elevate the constraint in order to attain the firm's goal (Goldratt, 1990; Goldratt and Cox, 1992).

Considering the same principles, the other programmes such as total productive maintenance (TPM), just-in-time (JIT), and business process re-engineering (BPR) can be implanted on the bottom line improvement processes based on the decision procedures of TOC (e.g. Chakravorty and Atwater, 1994; Lockamy and Cox, 1994).

Implications for managers and future research

This article has attempted to expose the importance of intuition as technical expertise and the methodology to create breakthrough thinking. The use of quality management as a competitive edge depends on a manager's ability to cultivate their intuition to explore and answer the basic questions that can lead to fundamental quantum leap solutions to real problems. Therefore, the self-reflective diagnosis and TOC have simultaneous implications for managers and academicians. These implications which are described below arise from three fundamental questions: how to translate a manager's intuition into mental models that can be used to disseminate shared understanding, how to achieve the collaboration of people in an ongoing improvement process and how to determine performance measures that report in a timely manner the impact of ongoing improvement efforts on global performance.

The role of intuition is necessary to derive effective mental models in revitalizing TQM efforts. The self-reflective diagnosis enables managers to invent, criticize, and challenge their intuition and to express it in new mental models. Using TOC, managers can trust the verified mental models and use them to identify outdated policies as well as novel approaches to improve operations. The relationship between shared mental models and competitive edge is one of the most important concerns of TQM. However, little has been done on the construct of how shared mental models shift. Further work is needed for a better understanding of the role of intuition in individual, group and organizational learning, the types of intuition that are appropriate for representing the complex reality, the procedures of TOC to capture the understanding of such reality, and the means through which new learning can be transferred to the whole organization. Moreover, the problem with quality policy to affect ongoing improvement should be a concern for both managers and researchers (Dettmer, 1995). Perhaps future research should develop the way managers can create updated quality policy that can have a direct impact on customers' satisfaction.

Managers should not just initiate ideas of ongoing improvements but also involve employees to cause the change. The focus of ongoing improvement is on improving current business operations and advancing the status quo. People need to realize that they have to change to create new competence. There are three features related to change: empowerment, teamwork, and communication skills. Empowerment is aimed at aligning the idea of individual responsibility and authority into organizational policies. Teamwork is important to build a commitment to solving real problems in the real world, whereas communication skills are needed to share mutual understanding and to resolve conflicts and fears. These three features should be directed to overcome resistance to change (Goldratt, 1996). To understand change, managers and researchers can explore how TOC can be used to produce actionable knowledge that causes lasting changes in the status quo. Future research on overcoming resistance to change can encourage managers and employees to drop stereotypes, prepare new mental models, reprogramme their mental maps, and be open and flexible in dealing with new environmental change.

The nature of the relationship between performance measurement and TQM efforts is an area in need of further research. Performance measures should focus on how to motivate the key players to make TQM implementation an important priority. TOC can provide both the focus and the concrete performance measures lacking in TQM. Future research should focus on the development of a synergistic relationship between TOC and TQM. Other improvement methods such as JIT, TPM and BPR could also benefit from being integrated with aspects of TOC.

TOC has limitations as well. First, the robustness of the self-reflective diagnosis

should be tested over a wider variety of industrial problems. Second, the use of self-reflective diagnosis to aggregate managers' judgements should be contrasted with other systems thinking approaches, such as system dynamics and soft systems methodology to ensure validity and complementarity. Third, the extent of bias introduced by a manager's extensive participation in the process should be explored.

Despite these limitations we believe that TOC provides a powerful framework for viewing the important problems of intuition and mental models in the TQM area. Both managers and academicians are likely to benefit from increased attention in this area. Finally, we encourage researchers and managers to consider the theory of constraints approach for self-reflective diagnosis, especially when standard approaches do not adequately capture the underlying complexities and assumptions.

Conclusions

A self-reflective diagnosis has been shown to assist managers to question underlying assumptions of their firm's management practices. By letting managers use their intuition in finding and fixing the flawed assumptions, they can remove counter-productive actions (or policies) and outdated measurement systems that have a detrimental impact on organizational performance. In so doing, managers will be able to find the answers to the questions of how to revitalize their TQM efforts in the most prudent way.

TQM efforts can only be justified if they really contribute to attaining the firm's goal and at the same time guarantee the achievement of customer satisfaction. In the case of a for-profit company, the goal is to make more money now and in the future. Managers can use TOC to define the performance measurements and to focus improvement efforts on the bottom line.

TOC is a complete theory for dealing with sophisticated problems and unpredictable human behaviour in a flexible and effective way to get the real benefit of TQM efforts. TOC also can be viewed as an umbrella for other improvement approaches, such as JIT, TPM, and BPR. Orchestrating the firm's improvement efforts under TOC will aid the firm in realizing a win-win-win situation for owners, employees, and customers.

Application questions

1 Does TQM work? How do we know? Can we measure?

2 In your experience, do quality improvement initiatives tend to improve overall decision making and enterprise in organizations? Why or why not?

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