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**Published**

2009

**Conference Title**

Proceedings of the Fifth International Conference on Construction in the 21st Century - Collaboration and Integration in Engineering, Management and Technology

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## **Resource Allocation for Strategic Quality Management: An Analytic Network Process (ANP) Model**

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### **Abstract**

Recent research attempts emphasize that Total Quality Management (TQM) is a combination of two broad categories of elements: hard elements and soft elements. Many academicians believe that there is no commonly accepted framework for TQM. This is due to the complexity of identifying the base from which the soft and hard elements of TQM are defined. This paper views Quality Management (QM) itself from a perspective that allows for resources to be the base by which QM operates. Thus, it deals with QM from a strategic point of view, or what is known as Strategic Quality Management (SQM). The Analytic Network Process (ANP) is, used herein, to model the interactions between eight SQM strategies (identified in the literature as critical), and their resources. The case of two different companies is investigated to show how the interaction between strategies and their allocated resources differs due to the nature of business, product and history.

### **Keywords**

Strategic quality management, Total quality management, Resources, Analytic network process

## **1. Introduction**

### **1.1 Background**

Critical elements of TQM can be categorized into soft elements and hard elements (Vouzas and Psychogios, 2007). The former refer to "the behavioral aspects of management" (Rahman, 2004) whereas, the latter refer to "management tools and techniques" (Vouzas and Psychogios, 2007). Over the years, many empirical research studies have shown that the soft elements of TQM significantly affect organizational performance. However, if TQM is largely influenced by the soft elements, then the logical question is: what do the hard elements of TQM really do? (Rahman, 2004). The answer could be as Tari (2005) stated, that "TQM is much more than a number of critical factors; it also includes other components, such as tools and techniques for quality improvement which are a must for effective TQM implementation". TQM is, therefore, a mixture of technical systems as well as social systems (Vouzas and Psychogios, 2007).

### **1.2 Research Rationale**

The above brief background highlights that "there is no agreement as to which elements are actually implemented in the organization when a TQM system is set up" (Montes *et al.*, 2003). Thus, there is a lack of a commonly accepted framework for TQM (Vouzas and Psychogios, 2007). Additionally, Tari (2005) stated that "there is no unique model for a good TQM programme; and TQM itself is a network of interdependent components, namely critical factors, practices, techniques and tools". In fact, this appears

to be because “one of the main difficulties in the identification of critical elements is the basis of defining these elements before they become critical” (Rahman, 2004). Hence, Rahman concluded that future research should “rediscover the link between the soft and hard TQM elements”.

From this perspective, this paper proposes that a better understanding of the nature of TQM elements can be obtained through focusing on the roots from which these elements come. The TQM literature supports this perspective, that is, all TQM elements can be viewed as resources, namely, technological, organizational and human. Therefore, this paper views QM from a perspective that allows for resources to be the base by which QM operates. Thus, it is reasonable to deal with QM from a strategic point of view, or what is known as a Strategic Quality Management (SQM), rather than TQM. Aravindan *et al.* (1996) defined SQM as:

‘The process by which quality management activities focus towards the long range direction and progress of quality enhancement strategies by ensuring the careful formulation through strategic quality planning, proper implementation through vital quality strategies, and continuous evaluation through quality improvement and control’.

They also stressed that strategies are essential for quality to be improved. Thus, they identified eight critical strategies (listed in Figure 1) by which quality enhancement approaches should be driven. Although strategic management provides a resource-based view of QM, SQM’s studies have not adequately exposed the role of such resources. In other words, how resources interact with quality strategies warrants further research.

### **1.3 Research Questions**

This paper focuses on the three different resources (i.e. technological, organizational and human) which are collectively viewed as the roots of all TQM elements, and investigates the identified SQM critical strategies with respect to these resources. Thus, the research questions are:

- RQ1: For an organization, what is the relative ranking of the three different resources in the context of how they affect each other?
- RQ2: For an organization, what is the ranking of the three different resources in the context of their individual contribution to each critical strategy supporting SQM?
- RQ3: In light of their ability to enhance quality, what is the relative ranking of the critical strategies, considering their resource-dependency?

## **2. The Role of Resources in Quality Management**

Technological resources stand for hard elements, while soft elements can be represented by both organizational, as well as human resources. To illustrate, technological resources can be defined as “information, equipment, techniques and processes required to transform inputs into outputs in an organization” (Robbins and Barnwell, 2002). On the other hand, organizational resources are defined as organizational aspects, such as, an organization’s history, culture, trust, management system, policies, and formal and informal relationships (Barney, 1995). Many soft elements of TQM fit within this definition, including leadership, supplier relations and customer relations. Finally, human resources, as an organizational manpower (Sampson and Daft, 2003) or as an “organizational function that deals with the people” (Tracey, 2003), can also be considered as soft elements of TQM such as human resource management, training and empowerment.

### 3. Research Design

#### 3.1 The Case Study

In order to develop a comparative study, two different large companies were selected, both hold ISO accreditation, but have different types of products and customers. Company A was founded in 1979 whereas Company B was founded in 1997. The reason of selecting these two different companies is to show how the interaction between the strategies and their allocated resources differs according to the nature of business and product. The Analytic Network Process (ANP) was used herein to model such interaction, as described below.

#### 3.2 The Analytic Network Process (ANP)

The ANP uses a network approach to structure a decision problem in order to allow for capturing the inner-dependence among the alternatives. ANP provides a way to input judgments and measurements to derive ratio scale priorities for the distribution of influence among the factors, and groups of factors in the decision. Because the process is based on deriving ratio scale measurements, it can be used to allocate resources according to their ratio-scale priorities. Hence, ANP was deemed suitable to model the interactions and feedback within SQM resources and between strategies. The ratio scale was presented in the form of questionnaires, completed by six participants (3 from each company) selected via judgment sampling. Cavana, Delahaye, and Sekeran (2001) defined judgment sampling as a sampling technique that “involves the choice of subjects (members) who are in the best position to provide the information required”. Thus, the sample frame of this study was restricted to quality/senior managers. This approach guarantees the reliability of the data collected. Super Decisions® software was used to build the ANP model (Creative Decision Foundation, 2003).

#### 3.3 The ANP Model

To provides answers to the research questions, participants’ input was used by ANP to qualify (in terms of rank) and quantify (in terms of weight), the contribution made by each type of resource to each and every strategy. As shown in Figure 1 (RQ1), the inner-dependence among the three resources (represented by the arrow exiting the cluster of resources and entering itself in Figure 1) was captured as each type of resource was ranked and weighted with respect to the other two remaining types. Moreover, the three resources were weighted and ranked with respect to each individual strategy as shown in Figure 1(RQ2). Figure 1 also shows that strategies were ranked with respect to their ability to enhance quality considering their dependence on each type of resource (RQ3).

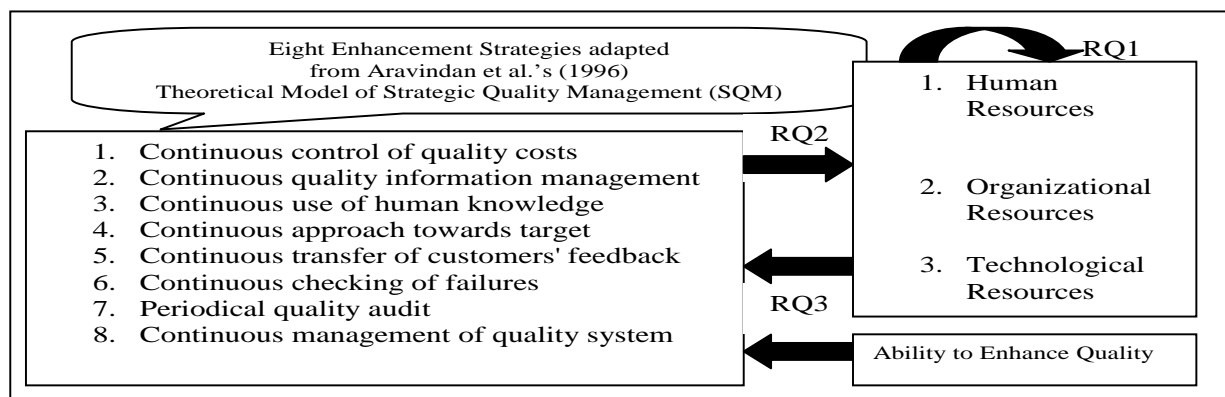
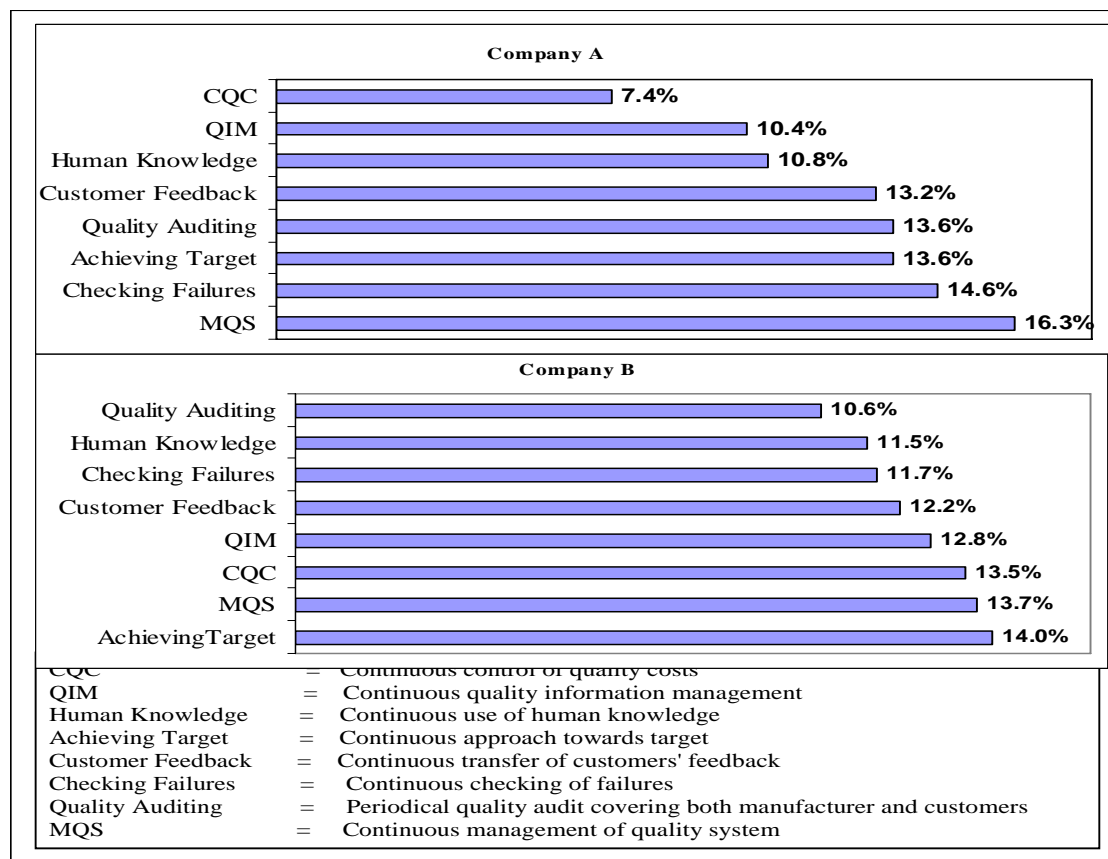


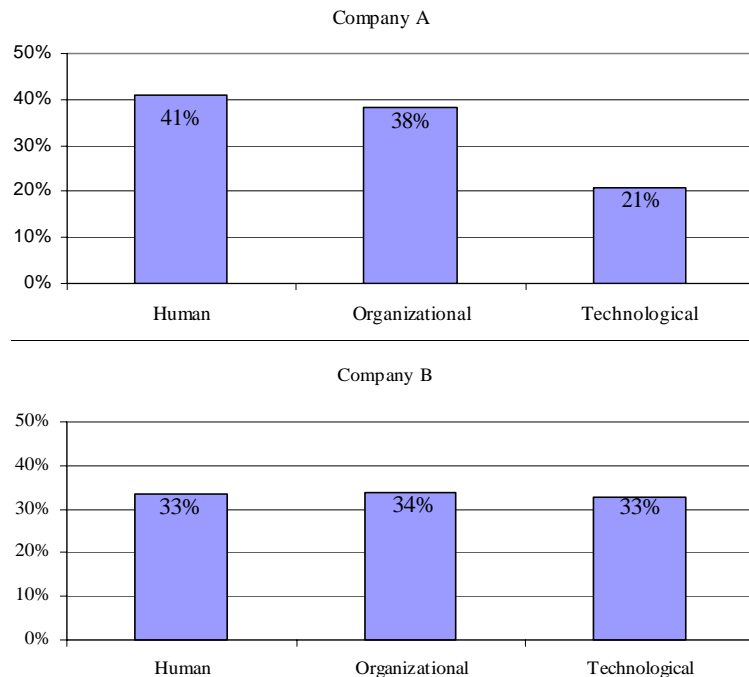
Figure 1: The ANP Model

### 4. Results and Discussion

The main objective of employing ANP was to obtain weighting and ranking for the identified strategies with respect to the three resources and vice versa. To illustrate, all eight strategies were firstly weighted and ranked with respect to human resources. The ranking was in terms of the level of support received from human resources. The same procedure was repeated with respect to organizational resources, technological resources, and the ability to enhance quality. The overall results, as computed for each company, are shown in Figure 2, and are listed in Table 1. The three resources were also weighted and ranked in two ways. Firstly, they were weighted and ranked with respect to each other (RQ1). As such, organizational and technological resources were compared to each other in terms of the level of influence; each has on the contribution made by human resources on the implementation of the eight strategies. The same procedure was repeated with respect to the contributions made by organizational and technological resources. Secondly, resources were also weighted and ranked with respect to each type of strategy (RQ2). That means they were ranked in terms of their relative importance to the successful implementation of a particular strategy. The same procedure was continually repeated to cater for the remaining strategies. The overall results, as computed for each company, are shown in Figure 3 and are listed in Table 1. Figure 3 indicates that in Company A, quality is strategically driven more by human and organizational, rather than technological, resources. This is not the case in Company B where the three types of resources appear to have the same level of influence/ contribution on quality implementation. It is worth noting that, as shown in Table 1, although each single strategy has its own needs (i.e. ranking) for resources, the ANP model generated an overall ranking of resources that respects the need of all strategies collectively. Similarly, although each type of resource supports each strategy differently, the ANP model ranked all strategies with respect to the received support from all resources collectively with the consideration of the ability of each strategy to enhance quality.



**Figure 2: Prioritization of Strategies**



**Figure 3: Prioritization of Resources**

The dissimilarity between the two cases implies that resources might be utilized differently according to the need or the strategic objectives of the firm reinforcing the argument made by Perdomo-Ortiz *et al.* (2008) that TQM cannot be dismissed as just an administrative trend, because it provides a typical organizational resource on which firms may build a durable competitive advantage. Consequently, executives must balance the soft and hard sides of QM if the aim is to formulate an effective quality strategy (Bou-Llusar *et al.*, 2009). In other words, it is up to the organizations to have its own ‘unique way’ of resource utilization. That is Perdomo-Ortiz *et al.* (2008) believes that better understanding of the linkage between the soft and the hard sides of TQM is possibly to be obtained from a strategic management point of view.

The above discussion also supports our argument that QM is supposed to be studied from a strategic point of view, by which quality strategies are driven by available resources. Although the weights of all eight strategies in the case of company (A) were close to those in company (B), strategies were ranked differently. More specifically, as shown in Figure 2, the weight calculated for the “Continuous control of quality costs” strategy is 13.5% for company (B) compared to only 7.4% for company (A). In both cases, the final ranking of strategies is a reflection of the manner by which the company utilizes its resources. Consequently, in order to implement QM, the company may prefer one strategy over other according to its own utilization of resources. This corroborates the perspective that, in some cases, TQM may be implemented partially and the organisation can gain some advantages without implementing all TQM elements (Taylor and Wright, 2006). This is because considering QM as an integrated model does not prevent it from adopting different configurations according to the prevailing environmental conditions and the organizational context in which the QM implementation takes place (Roca-Puig, Escrig-Tena, Bou-Llusar, and Beltrán-Martín, 2006). Prajogo (2006) found that, in 2001, Australian manufacturing companies were spending more in improving leadership practices to achieve best practice and less in training and developing their employees compared to the year of 1994. From this point of view, Prajogo disagreed with the claim that TQM is failing and he argued that “firms can selectively adapt in ways which are meaningful to their business operations and environmental situations rather than adopting such principles and practices as a “rigid package”.

**Table 1: Interaction between Resources and Strategies for Company A and Company B**

<b>Company A</b>				Needed resources (%)			Support of resources (%)			Overall ranking of strategies (in term of % of received resources)
Strategies	*HR	OR	TR	HR	OR	TR				
	MQS	33	35	32	<b>16</b>	<b>59</b>	<b>25</b>	<b>16%</b>		
Checking Failures	21	47	32	35	23	42	15%			
Achieving Target	44	15	41	38	24	38	14%			
Quality Auditing	30	45	25	40	39	21	14%			
Customer Feedback	39	44	17	38	25	37	13%			
Human Knowledge	25	27	48	49	19	32	11%			
QIM	26	30	44	25	31	44	10%			
CQC	36	31	33	37	34	29	7%			
<b>Overall ranking of resources</b>	<b>41%</b>	<b>38%</b>	<b>21%</b>							

<b>Company B</b>				Needed resources (%)			Support of resources (%)			Overall ranking of strategies (in term of % of received resources)
Strategies	HR	OR	TR	HR	OR	TR				
	Achieving Target	25	45	30	<b>32</b>	<b>34</b>	<b>34</b>	<b>14%</b>		
MQS	21	56	23	42	33	25	14%			
CQC	17	55	28	27	39	34	13%			
QIM	18	46	36	26	36	38	13%			
Customer Feedback	16	61	23	41	30	29	12%			
Checking Failures	27	40	33	33	32	35	12%			
Human Knowledge	18	51	31	27	29	44	12%			
Quality Auditing	16	57	27	38	31	31	11%			
<b>Overall ranking of resources</b>	<b>33%</b>	<b>34%</b>	<b>33%</b>							

\*HR: Human Resources, OR: Organizational Resources, TR: Technological Resources.

## 5. Concluding Remarks

This paper confirms the fact that there is no agreement among quality experts on whether the soft or hard elements of TQM are more supportive of better organizational performance. The paper proposes that the concept of strategic management can provide the basis from which QM can be better understood. The interaction between firm's quality strategies and its resources supports this perspective. This interaction provides a reasonable justification of why firms and quality gurus are responding differently to the soft and hard side of TQM. The main contribution of this paper is that ANP model quantitatively differentiates between the needed (critical or important) resources for each strategy and the actual amount of resources received by each single strategy as illustrated in Table 1 where 16% of the needed resources for the implementation of "Quality Auditing" strategy in company B were human resources while, in reality, human resources appear to be contribute 38% of the received 'allocated' resources for this strategy. Similarly, other strategies, in both companies, appear to have deviations between what is perceived to be needed and what actually has been allocated. In such a situation, the organization cannot exactly satisfy the need of each strategy because a single strategy may receive more or less than the needed resources.

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