

**Resource Allocation for Strategic Quality Management:
A Goal Programming Approach**

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Declaration

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself

Hisham Mostafa Alidrisi

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Abstract

The main aim of this thesis is to assist organizations in understanding the nature of quality management from a resource-based perspective by investigating the relationship between strategies needed to drive quality enhancement, and resources being allocated to support effective strategy implementation. To achieve this research aim, the thesis employs both quantitative and qualitative analysis techniques to give insight into how quality management strategies and resources interact.

The thesis argues that organizations may veer away from their quality management implementation plans because of an inherent mismatch between the *needed* and *allocated* resources to support strategy implementation. Therefore, a secondary aim of this thesis is to develop a methodology whereby an organization can: 1) determine how their resources are being allocated to support different quality enhancement strategies, and 2) identify any resource discrepancy between what is needed by a certain strategy, and what is being allocated to it.

For any organization, whether small or large, manufacturing or service, Total Quality Management (TQM) is a recognized source of competitive advantage to sustain the organization's position against its competitors. Benefits of applying TQM have been reported by various industries; in particular, the food-processing industry where quality is a major strategic issue. Food-processing organizations recognize that higher quality leads to better product reputation, increased market share and higher profits. They also operate under strict regulatory requirements, and therefore, adopt formal and disciplined approaches to quality management. Consequently, and keeping the above research aims in mind, this thesis adopts an organizational case study approach to explore quality management resource-strategy interactions, and related resource distribution challenges confronting Quality Departments in two of the largest food-processing organizations in Saudi Arabia.

Two broad sets of elements are fundamental to the success of TQM: soft elements (e.g. management commitment, employment empowerment, etc.) and hard elements (e.g. control processes, technology utilization, etc.). Although the literature does not clearly demonstrate which set of elements is more significantly related to business and organizational performance, all TQM elements can be viewed as human, organizational, and technological resources. It is this resource-based view of TQM elements that led this thesis to deal with quality management from a strategic viewpoint, or what is known as Strategic Quality Management (SQM).

Critical review of the SQM literature identified eight strategies as drivers of quality enhancement. These strategies include the continuous: 1) use of human knowledge, 2) control of quality costs, 3) check of failures, 4) transfer of customer feedback, 5) approach towards targets, 6) management of quality information, 7) management of the quality system itself, and 8) the periodical quality appraisal (i.e. auditing). The review also highlighted a lack of theoretical framework or empirical model to examine the various levels of contribution of each strategy towards quality

enhancement, or to guide the process of resource allocation among those eight strategies.

To bridge these identified research gaps, the thesis adopts a two-phase research methodology. In the first phase, the thesis handles the issue of resource allocation from the perspective of Multi-Criteria Decision Making (MCDM) as two MCDM techniques, namely Analytic Network Process (ANP) and Goal Programming (GP), are employed. In the first step of the first phase, a conceptual framework comprising three clusters (resources, strategies, and ability to enhance quality) has been developed in the form of a multi-criteria decision problem where the ANP was employed to model resource-dependence and resource-strategy interactions. This phase required the development and distribution of a questionnaire targeting managers who worked in the Quality Departments for the two selected organizations. The managers were asked to compare a pair of elements (e.g. resources or strategies) at a time with respect to a control criterion (e.g. supporting a certain strategy or enhancing overall quality).

Evaluating the dependence and feedback, among and within the framework clusters, provided a systematic and objective way of deriving the weights to be used for prioritizing strategies (in terms of their individual contribution towards quality enhancement), and determining the relative levels of resource influence on each other, and on strategy implementation. Moreover, this phase identified resource-allocation discrepancies between what each strategy needs and what it actually receives from available resources.

The second step of the first phase of the research utilized the output of the ANP analysis as input for a Goal Programming (GP) model to identify to what extent each strategy is under- or over-resourced. The model results indicated that both organizations, despite having different strategy priorities, need to re-allocate their resources to better support their quality enhancement strategies. The model results revealed interesting observations. For instance, one company ranked the strategy of controlling quality costs as having the least ability to enhance overall quality; however, this particular strategy was then found to be over-resourced by as much as 70%. Similarly, in the second company, the strategy of check of failures is the most over-resourced (16.8%), even though it is priority 6 in terms of resources that should be allocated for the eight strategies.

In the second phase of the research, a series of semi-structured interviews were conducted with 12 managers working for the two organizations. For each organization, the interviews ascertained how individual quality, supply chain or information technology managers manage, evaluate, and report the progress of strategy implementation. The interviews' findings not only shed some light on quality management practices, and resource availability and allocation, but were also used to see if the quantitative output resulting from the developed hybrid ANP-GP methodology would be corroborated.

There are two main contributions made by this thesis: 1) contribution to the existing body of knowledge on quality management through the development of a

conceptual framework that explicitly captures the interactions among, and within, quality management resources and strategies, and 2) contribution to current industry practice through the provision of a methodology whereby organizations would identify resource-strategy allocation discrepancies, and hence be able to convey a message to senior management of what resource is needed, and to which strategy the identified resource should be allocated, thus improving the overall level of resource utilization.

The proposed methodology relies heavily on the expertise, knowledge and experience of managers. As such, it involves subjective assessment of both qualitative and quantitative factors at a particular organization, as well as pertinent industry or country level variables. Consequently, the findings reported herein can only be analytically generalized in the context of large organizations operating in the Saudi food-processing industry. Nevertheless, the proposed methodology is generic in nature and could be replicated to provide a deliberate and structured approach to resource utilization in the context of implementing quality enhancement strategies.

List of Peer-Reviewed Publications

The following papers were produced to disseminate some results from the work undertaken by the author during the course of this PhD research.

Journal Paper

1. Alidrisi, H. and Mohamed, S (--). "Resource Allocation for Strategic Quality Management: A Goal Programming Approach." *International Journal of Quality & Reliability Management* (under review).

Conference Paper

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Acronym

Quality Management:

QM	Quality Management
TQM	Total Quality Management
SQM	Strategic Quality Management
MQS	Continuous Management of Quality System
CHF	Continuous Checking of Failures
ATT	Continuous Approach Towards Target
PQA	Periodical Quality Audit (for customer and manufacturers)
TCF	Continuous Transfer of Customers' Feedback
UHK	Continuous Use of Human Knowledge
QIM	Continuous Quality Information Management
CQC	Continuous Control of Quality Costs
SASO	Saudi Arabian Standards Organization
ISO	International Organization for Standardization
OHSAS	Occupational Health and Safety Standards
HACCP	Hazard Analysis and Critical Control Point
BRC	British Retail Consortium
BSI	British Standards Institution
SPS	Statistical Process Control
QFD	Quality Function Deployment
QC	Quality Control
QCS	Quality Control Systems
QA	Quality Assurance
TQC	Total Quality Control
PTR	Product Technical Requirements
HOQ	House of Quality
TQHRM	Total Quality-Oriented Human Resources Management
SQMI	Strategic Quality Management Index

Strategic Management:

SM	Strategic Management
HR	Human Resources
OR	Organizational Resources
TR	Technological Resources
SWOT	Strengths, Weaknesses, Opportunities, and Threats
RBV	Resource-Based View

General:

IT	Information Technology
HRM	Human Resource Management
WTO	World Trade Organization

OECD	Organization for Economic Co-operation and Development
ERP	Enterprise Resources Planning
SCM	Supply Chain Management
CSR	Corporate Social Responsibility
JUSE	Japanese Scientists and Engineers

Decision Making:

MCDM	Multi Criteria Decision Making
AHP	Analytic Hierarchy Process
ANP	Analytic Network Process
LP	Linear Programming
GP	Goal Programming
CR	Consistency Ratio
AIJ	Aggregating Individual Judgments
AIP	Aggregating Individual Priorities
ISM	Interpretive Structural Model
HSIM	Hybrid Structural Interaction Matrix

Research Questions:

RQ1	1 st Research Question
RQ2	2 nd Research Question
RQ3	3 rd Research Question
RQ4	4 th Research Question
RQ5	5 th Research Question
RQ6	6 th Research Question

Participation Experts (Data Collection)

QM1-A	Quality and Safety Manager (Company A)
QM2-A	Quality Assurance Manager (Company A)
QM3-A	Quality Control Manager (Company A)
HRM-A	Human Resource Manager (Company A)
ITM-A	Information Technology Manager (Company A)
SCM-A	Finished Goods and Supply Chain Manager (Company A)
QM1-B	Head of Quality Department (Company B)
QM2-B	Quality Control and Product Development Manager (Company B)
QM3-B	Supervisor, Quality Assurance and Product Development (Company B)
HRM-B	Department Manager, Human Development and Training (Company B)
ITM-B	Information Technology Manager (Company B)
SCM-B	Demand and Logistic Manager (Supply Chain - Company B)

Chapter 1

Introduction

1.1 Background

During the last century, the world has been strongly affected by the industrial evolution, during which a huge number of organizations were established. Moreover, the competition between these organizations has grown rapidly. Organizations have worked towards perfection, which has resulted in the appearance of many industrial and managerial concepts. One of these concepts is *quality management*. Indeed, the importance of quality management comes from its direct effect on products and services. Sales, market share, customer loyalty and other elements are also affected directly or indirectly by quality. Different concepts have appeared since the evolution of quality, including Quality Control (QC), Quality Assurance (QA), Total Quality Control (TQC), and Total Quality Management (TQM). TQM appeared in 1949 when the Union of Japanese Scientists and Engineers (JUSE) decided to concentrate on “improving Japanese productivity” (Powell, 1995). Since that time, the contributions of TQM in different organizations has been confirmed by various studies that link organizational performance to TQM (Douglas and Judge, 2001).

According to the literature on TQM, its critical elements can be separated into two main categories: soft elements and hard elements (Wilkinson et

al., 1998). These two categories are also known as the philosophical side (soft) and technical side (hard) of TQM (Vouzas and Psychogios, 2007). These two sides of TQM are included in all TQM definitions. Indeed, Rahman (2004) reported that the TQM literature views TQM as a managerial methodology that aims to develop the performance of organizations through mixing “technical and behavioural” themes. Soft elements are “the behavioral aspects of management” (Rahman, 2004) that can be represented by “management concepts and principles” (Vouzas and Psychogios, 2007), such as leadership, human resource management (Rahman, 2004), employee empowerment (Powell, 1995; Rahman, 2004), executive commitment, open organization (Powell, 1995), employee involvement, creating a shared vision, and customer focus (Dow et al., 1999). In contrast, hard elements of TQM refer to “management tools and techniques” (Vouzas and Psychogios, 2007), such as process management tools and methods, JIT (Just-in-time) practices (Rahman, 2004), benchmarking (Powell, 1995; Dow et al., 1999a; Rahman, 2004), manufacturing technologies (Powell, 1995; Dow et al., 1999), process improvement and improved measurement (Powell, 1995).

Generally, most empirical studies have shown that the soft elements of TQM affect organizational performance more significantly than the hard elements of TQM. For example, Hart and Schlesinger (1991) believe that human resource (HR) activities should lead quality efforts and reported that the Malcolm Baldrige National Quality Awards framework supports this perception and helps HR experts to allocate corporate resources towards quality objectives. Similarly, Bowen and Lawler (1992) emphasized that HR and TQM should not act separately and proposed the so-called total quality-oriented human resources management (TQHRM). Powell (1995) identified that, even though quality tools and techniques are a must for TQM to succeed, these techniques cannot provide the desired results

without the existence of soft elements such as “executive commitment ... and employee empowerment”. Further, he added that soft elements can “produce success with or without formal TQM adaptation”. He argued that this is similar to the resource-based theory suggestion that organizations should focus on the culture in which the quality tools and techniques can succeed. Also, Dow et al. (1999) discovered that soft elements, such as employee commitment, shared vision, and customer focus, are positively related to better-quality results. Ahire et al. (1996) postulated that human resources are the main drivers for TQM strategies to be implemented. More specifically, they identified that aspects of HRM, such as employee empowerment, employee participation, and technical training, are important in forming an ideal environment for QM. Samson and Terziovski’s (1999) findings were consistent with the overall TQM perception that the soft side of TQM has a greater influence on performance than the hard side. In particular, they found that leadership, management of people, and customer focus are specifically related to the performance. Recently, Soltani et al. (2004) reported that the success of TQM in achieving better customer satisfaction is linked to HR performance because the hard side of TQM cannot lead to the success of TQM alone. Bou and Beltrın (2005) concluded that theories, as well as practice, support the importance of the social side of the TQM (i.e. the organizational) and the HR activities as being vital for TQM to be implemented and performed successfully.

However, if TQM is only influenced by soft elements, the logical question is: what do the hard elements of TQM 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”. According to Tari, although TQM tools and techniques are derived from the critical elements of TQM, these

tools and techniques are a must for TQM to be implemented. In fact, Rahman (2004) supported this point when he argued that Statistical Process Control (SPC) and other quality techniques have been blended together to form what is now known as TQM. He also emphasized that, according to the TQM's literature, TQM can be viewed as a "management approach" that includes a range of "technical and behavioral" themes that aim for better performance for the organization. Indeed, latter definitions of TQM reveal that it is much more than a set of tools and techniques; it is a mixture of technical systems as well as social systems (Vouzas and Psychogios, 2007).

The significance of the soft TQM elements does not mean that the hard elements are not essential. From the literature, it can also be noted that many quality tools represent the roots of TQM. Powell (1995) reported that TQM studies concentrated generally on TQM methods rather than the organizational/workplace environment surrounding these methods. Rahman and Bullock (2005) also stated that the literature on TQM emphasized that the hard side of TQM also has a significant influence on a firm's performance. In particular, Rahman and Bullock (2005) recently identified positive relationships between Just-In-Time (JIT) principles and four TQM measures. They also found that three TQM measures are significantly correlated with two hard elements: technology utilization, and continuous improvement enablers. Therefore, they concluded that:

... certain hard TQM elements have a significant effect on performance and ... for hard TQM to impact performance, it is essential that such hard elements are supported by the elements of soft TQM.

Most recently, Lewis et al. (2006) developed an Analytic Hierarchy Process (AHP) model for TQM elements in small and medium-sized enterprises (SME). They found that 65 per cent of the implemented elements were hard, while 35 per cent were soft. These results conflict with those of Powell (1995), Ahire et al. (1996), Dow et al. (1999), and Samson and Terziovski (1999) which show that the hard elements of TQM do not significantly affect organizational performance.

In practice, it is also difficult to ignore the success of hard elements in several well-known companies. This is because these successful practices provide realistic evidence for the importance of such elements. For instance, Honda faced a technical problem in their painting department in the United States of America (USA) when one painting line consumed significant amount of pigmentation compared to the other painting line (Maul and Gillard, 1994). Maul and Gillard (1994) reported that significant expenses were reduced by solving the problem through the use of basic quality tools and techniques that eliminated various causes of the problem. Moreover, in 1987, Motorola reduced variation by introducing Six Sigma as an effective quality tool (Smith et al., 1993). Additionally, to attain the main strategic objective of Six Sigma, Motorola also applied Statistical Process Control (SPC) as a technique to formulate their strategy, looking for zero defects (Kumar and Gupta, 1993). In fact, in a theoretical and mathematical sense, the SPC permits a better understanding of systems' variations (Rahman, 2004). There are many other respected companies such as General Electric, AlliedSignal (Honeywell), ABB, Lockheed Martin, Polaroid, Sony, Honda, American Express, Ford, Lear Corporation and Solectron, who are employing Six Sigma to minimize the variation in their different processes (Klefsjo et al., 2001).

Another example, reported by Taguchi and Clausing (1990), related to Ford asking Mazda to produce additional transmissions. They noticed that although Ford applied the principles of zero defects, Ford's transmissions generated more customer complaints and costs than Mazda's transmissions, which were near to the target. From this observation, Taguchi has formulated his loss function. Benton (1991) noted that "this loss reduces to zero, when the production process manufactures at exactly the target value".

Quality Function Development (QFD), as a quality tool, also has a similar importance level. QFD initially appeared in Japan's heavy industries when Mitsubishi implemented the technique in 1972 (Clausing and Hauser, 1988). It was reported that Toyota applied QFD and 60% of its production costs were subsequently reduced during 1977-1984. Additionally, many well-known companies use QFD as part of their quality program, including Digital Equipment, Hewlett-Packard, AT&T, ITT, Ford, General Motors (Clausing and Hauser, 1988; Prasad, 1998) "Procter and Gamble" and Baxter Healthcare (Prasad, 1998).

Therefore, it seems that the hard side and the soft side of TQM shares almost the same importance level. Although several research outcomes found that the hard elements of TQM are not strongly related to organizational performance (Powell, 1995; Ahire et al., 1996; Dow et al., 1999; Samson and Terziovski, 1999), the hard techniques of TQM, such as SPC, Six Sigma, seven simple tools, QFD, and the Taguchi function, also have a significant impact on organizational performance (Rahman, 2004). The hard elements have also succeeded in practice. Thus, regardless of which side of the TQM is more critical, the quality literature shows that both the hard side and the soft side of TQM need each other to achieve effective TQM. To illustrate this point, although Ahire et al. (1996)

concluded that the effects of the hard side of TQM are not strongly related to the quality of the product, the indirect effect of such hard elements need qualified employees (soft elements) to use and activate these tools (hard elements). Additionally, unlike Powell (1995), Ahire et al. (1996), and Samson and Terziovski (1999), Rahman (2004) recently proposed a model that grouped all the TQM elements into two categories (soft and hard), rather than investigating the effect of each element independently. This attempt is similar to that undertaken by Dow et al. (1999) and Rahman and Bullock (2005). Rahman (2004) attempted to explain the relationship between soft TQM, hard TQM and performance. He proposed that soft elements have two functions. Firstly, soft elements affect have an indirect effect on performance through their responsibility to build a suitable environment for the hard TQM that consequently has a direct effect on performance. Secondly, soft elements directly affect performance in a similar way to the traditional role HR plays in organizations. Thus, even though the soft side or the hard side is found to be more critical than the other, the interaction between them implies that the success of one side of TQM is as a result of (or results in) the success of the other. This attests to the way the soft elements and the hard elements need each other.

1.2 Research Rationale

The previous discussion highlights how experts in quality research disagree about which TQM elements are more critical for organizational performance. Indeed, “there is no agreement between researchers and practitioners as to which elements are actually implemented in the organization when a TQM system is set up” (Montes et al., 2003). Even within these elements, the soft side itself is not accurately defined. To illustrate this point, Vouzas and Psychogios (2007) noted that:

There is a general disagreement of what exactly composes the “soft” side of TQM ... while it is feasible to measure people’s awareness of the “hard” aspects of TQM, it is quite problematic to assess their actual understanding of its “soft” principles.

They added that this leads to the lack of a commonly accepted framework for TQM. Further, as stated by Tari (2005), “there is no unique model for a good TQM programme; and TQM is a network of interdependent components, namely critical factors, practices, techniques and tools”. 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, due to the lack of appropriate attempts that show the relations between soft and hard elements of TQM, Rahman (2004) suggested future research should “rediscover the link between soft TQM and hard TQM”.

With this in mind, this research endeavours to gain a better understanding of the nature of TQM elements by focusing on the roots from which these elements come. Once these roots are defined, the resulting definitions are considered as the best representative of the TQM elements. Fortunately, the TQM literature supports the perspective that all TQM elements can be viewed as resources; namely, technological, organizational and human resources (not listed here in specific order). Technological resources (TR) can be said to stand for hard elements, while soft elements can be represented by both organizational resources (OR) and human resources (HR). To illustrate, TR can be defined as “information, equipment, techniques and processes required to transform inputs into outputs in an organization” (Robbins and Barnwell, 2002). From this definition, it is clear that the hard elements of TQM are, in reality, TR. Indeed, Zbaracki (1998)

labels this category as technical TQM. On the other hand, OR are defined as organizational aspects including history, culture, management systems, policies, and formal and informal relationships (Barney, 1991; Barney, 1995). Many soft elements of TQM fit with this definition, including leadership, supplier relations and customer relations. HR as a organizational manpower (Daft, 2003) or as organizational functions that deal with people (Tracey, 2003), can also be considered as soft elements of TQM and include human resource management, training and empowerment. The aforementioned definitions of TR, OR, and HR clearly highlight the significant role of such resources in quality management (QM).

In addition, a better knowledge of resources reveals that their strategic importance, or what is referred to here as the role of resources in strategic management (SM), is a reasonable issue to be considered. In other words, the acceptance of the role of resources in QM implies that their strategic importance cannot be ignored. Obviously, resources have been referred to in SM definitions (Schendel and Hofer; 1978, Newman et al., 1985; Chandler, 1990). Additionally, the strategic importance of resources ensured their consideration as an internal organizational power (Barney, 1986; Grant, 1991; Lo´pez, 2005), through which the concept of the Resource-Based View (RBV) obtained its recognition (Fahy, 2000; Montealegre, 2002; Coates and McDermott, 2002; Finney et al., 2005). Thus, resources can be considered as a source of competitive advantage (Grant, 1991; Barney, 1991; Barney, 1995; Hill and Jones, 2004; Collis and Montgomery, 2005).

As a consequence, in this research, accepting the important role of resources in both QM and SM results in the perception that it is more reasonable to deal with QM from a strategic point of view, or what is

known as a Strategic Quality Management (SQM), rather than TQM. Not only does the role of resources in QM and SM justify this perception, its emphasis within the SM literature reveals that resources are vital for any strategy, and especially in generating a firm's competitive advantages. This means that any strategy cannot be formulated without the existence of resources. Hill and Jones (2004) reported that:

Distinctive competencies shape the strategies that the company pursues, which lead to comparative advantage and superior profitability. However, it is also very important to realize that the strategies a company adopts can build new resources and capabilities or strengthen the existing resources and capabilities of the company, thereby enhancing the distinctive competencies of the enterprise. Thus, the relationship between distinctive competencies and strategies is not a linear one; rather, it is a reciprocal one in which distinctive competencies shape strategies, and strategies help to build and create distinctive competency

As a result, soft elements and hard elements under the umbrella of TQM are not appropriate to show an interaction between resources and strategies. This is not to say that TQM is unsuccessful, expressly, but that SQM provides a more appropriate explanation or description of how such resources can interact with quality strategies. Moreover, the SQM literature stresses the notion that quality should be linked to strategy. Thus, Aravindan et al. (1996) advocated that strategies are essential for quality to be improved. They identified eight critical strategies for quality enhancement. However, although SQM is not a new concept, much attention has been given to TQM. Focusing on TQM rather than SQM may provide a reasonable explanation as to why quality gurus do not agree on

which side of TQM (hard or soft) is more significant for organizational performance.

In fact, Aravindan et al. (1996) identified eight critical strategies for quality enhancement by which SQM can be defined (Their detailed definition of SQM is provided in Chapter 2.). They reported that quality gurus always link traditional approaches, such as “company-wide quality control”, TQM, and so on, in their attempt to define SQM. Thus, they stated that:

The fundamental weakness behind these traditional approaches is that they are not supported by clear definitions. Also, critical studies made on these approaches by the authors and other researchers indicated that none of these approaches is found to be complete and focused in attaining vital quality strategies.

Regarding these critical strategies, Senthil et al. (2001) reported that Aravindan et al.’s theoretical model of SQM is “most exhaustive”. From this point of view, the strategies shown in Table (1.1) will be selected for the purpose of this research. These strategies are also briefly described in Table (1.2) within the context of their connection to this research.

Figure 1.1 shows that resources can be seen as an umbrella under which QM and SM are overlapped. QM’s critical elements can be grouped into human, organizational, and technological resources. From the perspective of SM, these resources are vital in defining any strategy. They are considered as an internal power and as source of competitive advantage for any firm. Figure (1.1) summarizes the rationale of this research and the next chapter covers the issues presented in Figure (1.1) in further details.

The eight strategies and the three types of resources represent the base from which the proposed research questions are developed.

Table (1.1): Critical Strategies to Enhance Strategic Quality Management
(source: Aravindan *et al.* (1996))

<u>Critical Strategy</u>	<u>Acronym</u>
Continuous management of quality system	MQS
Continuous checking of failures	CHF
Continuous approach towards target	ATT
Periodical quality audit (for customers and manufacturers)	PQA
Continuous transfer of customers' feedback	TCF
Continuous use of human knowledge	UHK
Continuous quality information management	QIM
Continuous control of quality costs	CQC

This research suggests investigating the interaction between the three types of resources (HR, OR, and TR) and the eight critical strategies of SQM enhancement in Table (1.1) to obtain a deeper understanding of how SQM is practically implemented. Consequently, it is proposed that the needed resources for each strategy should be identified first. This is important to identify the overall available resources HR, OR, and TR in a certain company.

To illustrate, the interaction between resources and strategies reveals that each strategy will have its own need for HR, OR, and TR in the company; regardless of the needs of the remaining seven strategies. For example, it might be found in a certain company that the strategy of QIM may need TR more than HR and OR resources. On the other hand, another strategy

such as UHK, for example, may see HR as the most important type of resources for success, followed by OR and TR. With this in mind, there are eight strategies under investigation, which confirms the complexity of the issue. This situation also reveals that identifying the relative significance of the overall available HR, OR, and TR by prioritizing the critical type of resources with respect to the need of each single strategy is a multi-criteria decision making (MCDM) issue. This will be addressed in this research.

Moreover, there is another factor that supports the MCDM nature of this issue. Regardless of the needed amount of HR, OR, and TR for each strategy, the actual support in practice from each type of resources toward each strategy may not be an exact reflection of what is needed by each strategy. The support of human resources toward the strategy of QIM in practice, for example, might be different (more or less) to what is needed by QIM as a human resource. All remaining strategies are in the same situation, which may also exist in utilizing OR and TR. This confirms that this is a MCDM issue, which this research will therefore handle from the perspective of solving a MCDM problem.

Exploring the differences between the needed resources and the support from resources for each strategy, as described above, is part of the issue that is going to be handled in this research. To be more specific, the differences between the needed resources and the support from resources for each strategy raise the issue of resource allocation for SQM. Hence, this research will identify to what extent each strategy is far from its strategic objective whether due to over-resourcing or under-resourcing (shortage of resources). In fact, such an attempt can be considered as a further practical explanation to what has always been stated by Juran and

Table (1.2): Brief Description of Aravindan et al.'s (1996) SQM Strategies

Strategy	Description
UHK	The use of human knowledge in a continual manner is a strategy for SQM due to the significance of 'knowledge' inside the organization. Without doubt, 'knowledge' itself is an organizational asset. In this sense, effective management of human knowledge facilitates executing this strategy towards achieving organizational objectives. Accordingly, such a strategy may require different forms of resources such as adopting quality circle programs (Aravindan et al., 1996).
QIM	Managing 'information' is a must for any organization. Therefore, continuous quality information management should guarantee accurate flow of information within the organization. For this strategy (QIM) to be effective, it needs specific forms of resources such as advanced technologies, software, methods for information security, training for staff, communication channels ...etc.
TCF	All philosophies related to the concept of 'quality' has achieving customer satisfaction as a common objective. Consequently, a strategy that handles customers' responses must be considered by the organization. Transferring customers' feedback certainly requires well implemented communication channels (with customers), techniques for gathering as well as analyzing feedback, trained staff...etc. All these requirements are critical resources for the implementation of this strategy.
ATT	In any manufacturing organization, producing with respect to the accurate specifications of the products is compulsory during the journey of 'achieving customer satisfaction'. From this perspective, target specifications must be maintained continually if the organization wants to create competitive products. Tools, such as 'six sigma', might be seen as one of the appropriate tools in this regard.
PQA	Without doubt, the efforts of executing 'auditing' requires resources. Human resources are must and, on top of that, they have to be capable to perform auditing works. Auditing also needs a commitment from Top management as well as Quality Department. Auditing is critical because, according to Aravindan et al. (1996), manufacturer as well as customer should be covered in auditing. Hence, formulating a strategy for 'Periodical Auditing' is vital for manufacturing organizations.
CHF	The appearance of 'quality failure' is common in any manufacturing organization. However, as long as the organization is capable to keep failures within acceptable range, the organization then be able to maintain its relationship with customers. Absence of 'failures' is a sign for a well implemented strategy for continuous checking of failures. Such a strategy cannot be successfully executed without the needed resources including technicians, techniques, and cooperation among employees.
CQC	Within the context of 'quality', 'costs' is a broad term as any activity within the organization can be categorized into the three common types of cost of quality (COQ) namely: prevention, appraisal, and failure. So, whether the activity is an enabler for quality or resulted from quality failures, the term 'costs' appears. With this in mind, any organization has a different of business units and, in regard to 'quality'; they differently produce different type of costs. Thus, the issue of 'controlling costs' should be handled continually in a strategic manner. Such a manner, off course, requires different types of resources.
MQS	Managing the quality system becomes a necessity for any organization seeking perfection. This is one of the reasons behind the attitude of many organizations to hold different ISO certifications. The significance of managing quality system is to have guidelines for documenting and implementing quality system; and this in turn requires technological and methodological progress, enhancement and modifying mind-set of customers as well as employees abide (Aravindan et al. (1996). From this point of view, the Management of Quality System (MQS) has to be considered.

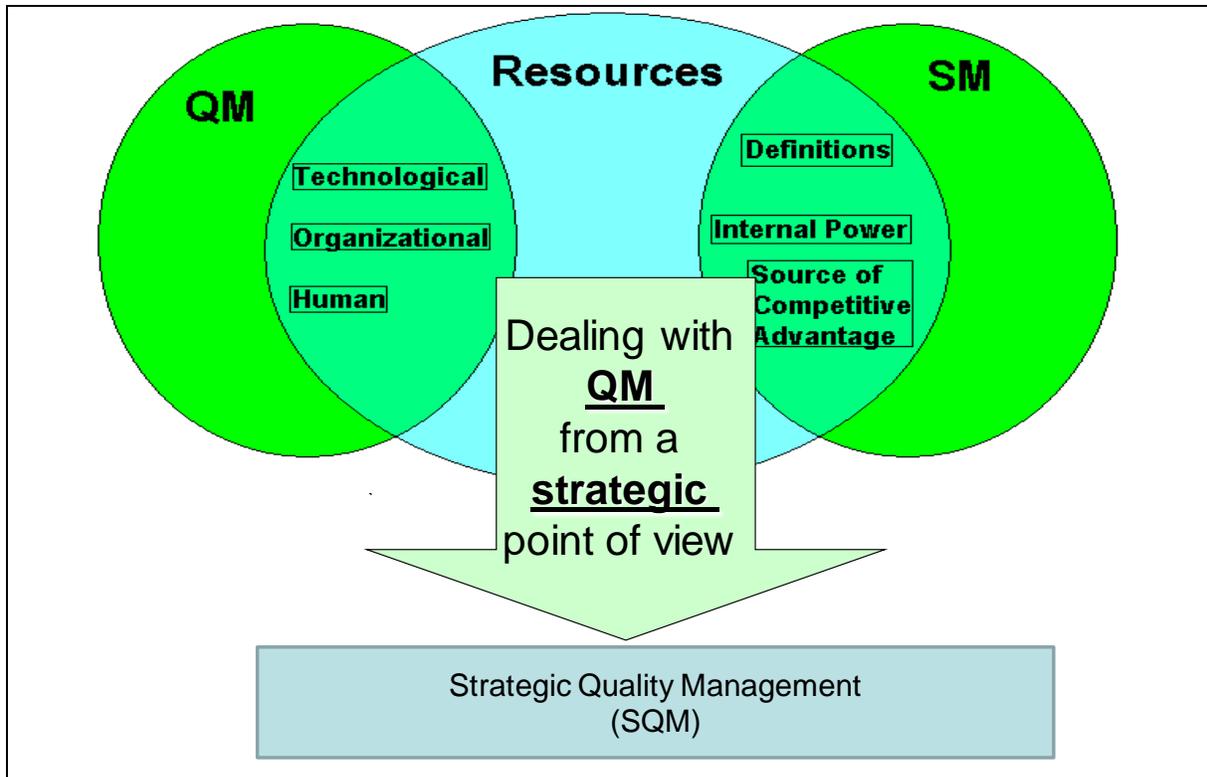


Figure (1.1): Illustration of how research rationale is developed from the Literature.

Gryna (1993), British Standards Institution (BSI) (1992), and Tummala and Tang (1996) in their definition of SQM that, generally, SQM is linked with the identified objectives (targets/goals) of the organization. In particular, Tummala and Tang (1996) connected “quality improvement efforts” within the context of SQM with resource allocation. This PhD therefore aims to contribute to the field of SQM by providing a rational understanding of the issue of resource allocation through investigating the interaction between resources and strategies.

1.3 Research Objectives

In contrast to all recent attempts that have focused on hard and soft elements, this research firstly will focus on resources, the root of hard and soft elements of TQM. The purpose of this research is to develop a comparative study by investigating two different cases (i.e. two case studies). As Cavana et al. (2001) state, “the case study, which is an examination of studies done in other similar organizational situations, is also a method of solving problems, or of understanding phenomena of interest and generating additional knowledge in that area”. Therefore, two cases from the Saudi Arabian food industry are investigated to show how the interaction between SQM’s strategies and their allocated resources can differ according to the strategic nature (environment) of each company.

Without doubt, for any organization, TQM is a source of competitive advantage to sustain a position against competitors. This is due to the fact that practicing QM has the potential to generate sustainable and competitive advantages through the interaction between different resources. This is because that the competitive advantage itself is a result of practicing QM in parallel with the involvement of the interaction between the organization’s vision, strategies and environment. From this point of view, understanding how resources are allocated to support different strategies is a mandatory requirement for quality improvement. Yet, within such a context, there are no existing models to assist Quality Department managers to see how resources are being allocated, how resources can be re-allocated for better utilization, or even how to convince senior management about certain patterns of resource allocation. Consequently, the main aim of this PhD research is to develop a methodological manner through which a certain company can assess its level of resource utilization for SQM by explaining how resources interact

with strategies. By understanding this interaction and the re-allocation of resources based on strategy prioritization, organizations will ultimately realize a better utilization of their resources.

Although SM provides a resource-based view of QM, QM studies have not significantly focused on how resources interact with quality strategies. Neither TQM nor SQM studies have highlighted this gap. Handling such an issue through investigating soft elements and hard elements under the umbrella of TQM, is not adequate to demonstrate such an interaction. That is not to say that TQM is unsuccessful; but rather that SQM is more appropriate to provide an explanation or description of how such resources can interact with quality strategies. In this PhD research, the attempt is to fill such a gap by demonstrating the interaction between resources and the organization's strategies within the context of quality enhancement.

So in the context of SQM implementation in an organization, this thesis raises the following four research questions:

RQ1:

Given that the three types of resources depend on, and influence, each other; what is the relative contribution made by any two types of resources to enable the third type to play its role effectively?

RQ2:

Given that each strategy depends on contributions by the three resources, what is the relative contribution made by each type of resource to ensure successful implementation of each critical strategy?

RQ3:

How is each available resource allocated for the eight strategies to ensure successful implementation?

RQ4:

In light of their ability to enhance quality, what is the relative contribution being made by each of the eight critical strategies?

Answers to RQ1 and RQ2 would give rise to the relative contributions made by each resource as well as the actual needs of each single strategy from HR, OR and TR. Moreover, the third and fourth research questions provide the overall amount (expressed in percentages) of resources decided to be assigned or allocated for each single strategy, regardless of its actual need. Naturally, discrepancies between what is needed and what is being allocated may occur in an organization. In light of this, this thesis proposes and develops a model that has two parts. The first part utilizes the Analytic Network Process (ANP) to differentiate quantitatively between the needed resources for each strategy and the 'resource support' it actually receives. The second part formulates a Goal Programming (GP) scenario in order to answer the following fifth research question:

RQ5:

How can resources be allocated for each strategy to satisfy its exact need, or at least, to minimize the extent to which each single strategy is *under-resourced* or *over-resourced*?

Answering the fifth research question reasonably leads to the sixth and final research question:

RQ6:

Why does each single strategy receive resources, whether more (overloaded) or less (shortage), than what should be allocated for it?

1.4 Research Design and Methodology

This case study research is conducted in two phases: quantitative and qualitative. The sample frame of this research is restricted to experts in quality management and top level managers. This approach ensures the reliability of the data collected. The quantitative phase of this case study research can be considered as a kind of operations research, as two operational research techniques, namely ANP and GP, are employed. In the first step of the quantitative phase, the ANP model is developed to address the first four research questions. Within the implementation of ANP, six quality experts (three from each company) are involved in comparison judgments among SQM's strategies and their required resources. Super Decisions® software, developed for AHP and ANP by Thomas L. Saaty for structuring decision making models, will be used to build the ANP model (Creative Decision Foundation, 2003).

In relation to the RQ5, the GP model is developed as a second step of the quantitative phase. In this regard, QM for Windows software (Render et al., 2006) is used to formulate and solve the GP model. Regarding the qualitative phase, twelve semi-structured interviews (six with each company) were conducted with 'Quality' managers and other managers from related areas such as human resource, supply chain, and information technology (IT). The qualitative phase is conducted to address RQ6. Answering these six research questions is the primary objective of this research.

In fact, one of the vital aims of this case study research is to develop a methodological manner through which a certain company can assess its level of resource utilization for SQM. This is mainly achieved by employing ANP and GP in the quantitative phase. Specifically, the issue (problem) of resource allocation that should be handled from the strategic perspective of a certain company, as argued above, is explored and illustrated through ANP. As a consequence of an allocation problem caused by conflict among quality strategies in terms of their strategic objective, GP then plays its strategic role allowing a company to utilize its resources with respect to its strategic objectives. Accordingly, a Strategic Quality Management Index (SQMI) is generated and developed from the GP model as a tool for companies to assess their SQM, or even through benchmarking with other companies if applicable. The qualitative phase, in turn, validates the SQM's situation in the investigated cases (companies) and draws a road map for the investigated companies to improve their SQM implementation.

1.5 Thesis Organization

This thesis consists of eight chapters. This chapter (**Chapter 1**) introduces the thesis through providing background, research rationale, and research objective. A comprehensive literature review is provided in **Chapter 2** covering the role of resources in strategic management, the role of resources in quality management, SQM, applications of ANP, as well as GP in quality management and resource allocation. **Chapter 3** introduces the three methodologies (ANP, GP, and semi-structured interviews) that are used to discuss why and how they are employed. **Chapter 4** shows how this research is conducted within the context of the case study covering the issue of validity and reliability. Chapter 4 also illustrates how the three

methodologies are mixed into two phases namely: quantitative phase followed by the qualitative phase. **Chapter 5** covers the aspects of data collection for the quantitative and the qualitative phases. Justification is provided for selecting the two cases (companies) as well as the participants (experts). The quantitative results and analysis are presented in **Chapter 6** by addressing the first five research questions, covering all aspects related to the application of the ANP analysis and the GP model. The sixth (final) research question is addressed within a full qualitative analysis in **Chapter 7** by utilizing semi-structured interviews. **Chapter 8** concludes the thesis by providing an overall discussion that merges the quantitative and the qualitative findings. The main contributions, implications, limitations, and directions for future research are also provided in Chapter 8. Figure (1.2) summarizes how research questions and methodologies are handled within the eight chapters.

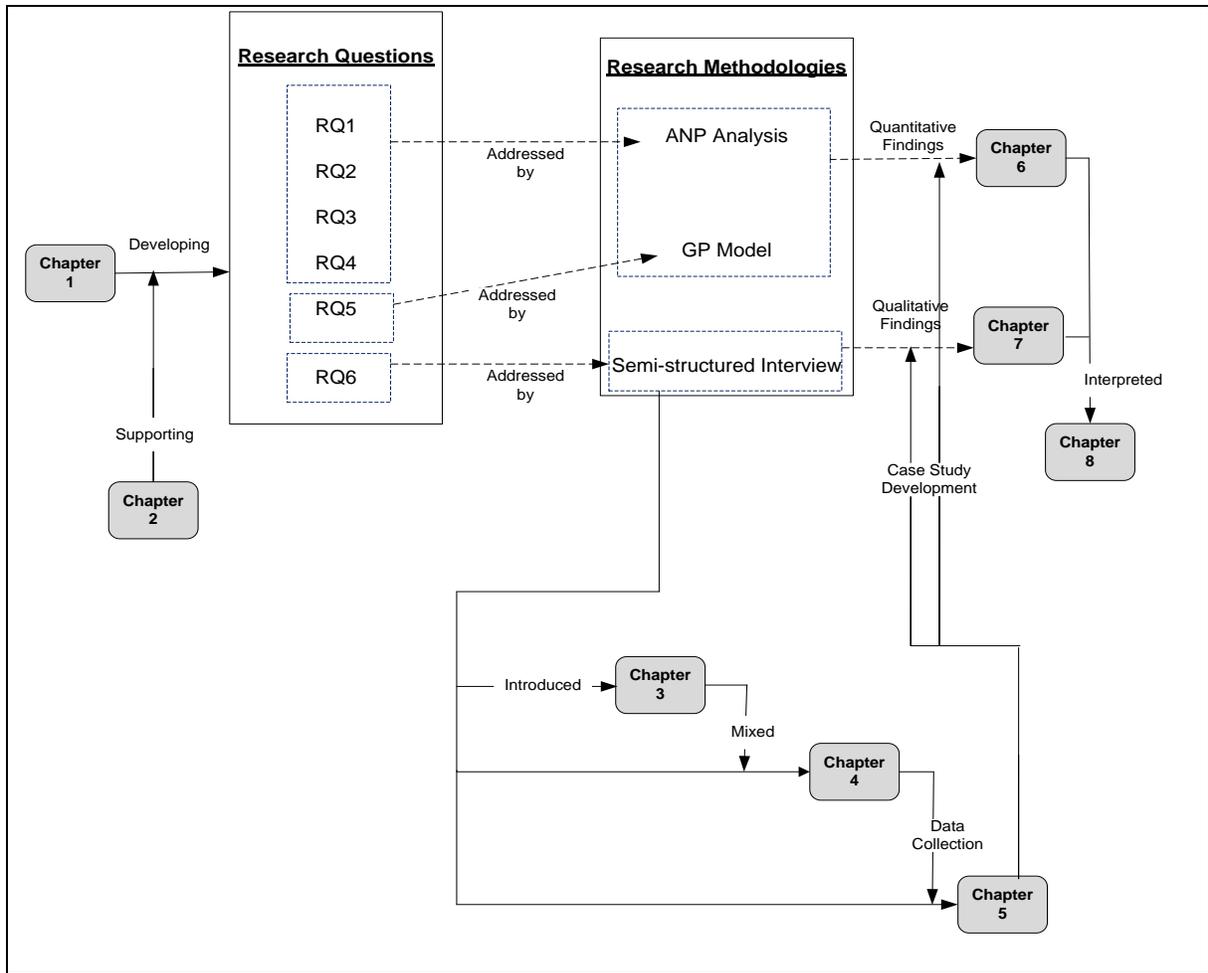


Figure (1.2): Thesis Layout and Chapters

Chapter 2

Literature Review

2.1 Introduction

This chapter reviews the literature that supports the arguments presented in Chapter 1 [See Figure (1.1)] and specifically the relative fields of knowledge that belong to the rationale of this research. Firstly, this chapter shows that TQM elements can be categorized into three types of resources: human, organizational, and technological. Then, the role of resources in Strategic Management (SM) and Quality Management (QM) are critically reviewed. Accordingly, the concept of Strategic Quality Management (SQM) is then introduced. The final part of this chapter highlights the applicability of ANP as well as GP to be implemented in the field of quality and resources allocation as they are selected as tools to carry out the quantitative phase of this research.

2.2 Categorization of Resources

Hill and Jones (2004) classified a firm's resources into two broad categories: tangible resources and intangible resources. Tangible resources are those which are regularly shown in the balance sheet of the firm (Collis and Montgomery, 2004), and include: physical resources (Hill and Jones, 2004; Penrose, 1995) such as land, buildings, plant, equipment, inventory

(Collis and Montgomery, 2004; Hill and Jones, 2004; Hofer and Schendel, 1978; Chandler, 1995); natural resources, raw materials, semi-finished goods, waste products, by-products, and stored finished goods (Penrose, 1995); services and distribution facilities (Hofer and Schendel, 1978); and money (Hill and Jones, 2004). Intangible resources are those that usually form critical functions for competitive advantage or disadvantage (Collis and Montgomery, 2004). They are not physical and instead relate to things that are created by a firm's employees (Hill and Jones, 2004), such as brand names, reputation, and human knowledge (Collis and Montgomery, 2004; Hill and Jones, 2004); experiences, patents, copyright, and trademarks (Hill and Jones, 2004); and technological knowledge (Collis and Montgomery, 2004).

In addition to tangible and intangible resources, Collis and Montgomery (2004) added a third category known as organizational capabilities, which they defined as a mixed grouping of "assets, people and procedures" by which firms convert their inputs to outputs. Thus, lean manufacturing and product development, as applied in Japanese automobile firms, can be considered amazing organizational capabilities.

Resource types have been classified into physical (or tangible) resources and human resources, such as secretarial, executive, marketing, technical, and financial staff (Penrose, 1995; Chandler, 1995; Hofer and Schendel, 1978), and inexpert and expert workers (Penrose, 1995). Steiner et al. (1986) and Chandler (1995) added financial resources to the physical and human resources, while Barney (1991) categorized resources into physical, human and organizational. Later, he added financial resources to his categorization (Barney, 1995). However, a more comprehensive classification of a firm's resources is presented by Schendel and Hofer (1978), who stated that there are five kinds of resources that enable

any organization to attain their goals. These resources are: financial resources, physical resources, human resources, organizational resources and technological capabilities.

Financial resources include debt, equity (Barney, 1995; Hofer and Schendel, 1978), cash flow (Hofer and Schendel, 1978), and earning (Barney, 1995). Examples for organizational resources include “the history, relationships, trust, and organizational culture that are attributes of groups of individuals associated with a firm, along with a firm's formal reporting structure, explicit management control systems, and compensation policies” (Barney, 1995). In relation to technological capabilities, Schendel and Hofer (1978) reported that “the term technology is used in the broad sense; that is, as a description of the way that each of a business’s various functional area activities are carried out ... such as ... high-quality products, low-cost plants, and high brand loyalty”.

All the classifications of resources presented above reveal that Hofer and Schendel’s (1978) five categories of resources can be considered as the most suitable classification of resources. There are two reasons for this consideration. Firstly, some classifications are too broad and place all resources in just two or three general categories; for example, tangible or intangible resources (Hill and Jones, 2004). Organizational capabilities only is added by Collis and Montgomery (2004). Similarly, resources can be seen only as physical resources and human resources (Penrose, 1995). Steiner et al. (1986) and Chandler (1995) have only added financial resources. Including further categories will allow the types of resources to be identified more accurately. Secondly, some categories are hidden or mentioned only indirectly by the authors. For instance, although Hill and Jones (2004) classified resources into tangible and intangible resources, their definition of resources highlighted the significance of the five

categories of Hofer and Schendel. To illustrate, Hill and Jones (2004) defined resources as the “capital or financial, physical, social or human, technological, and organizational factor endowments that allow a company to create value for its customers”. Moreover, they classified money (financial resources) under tangible resources. Additionally, although Barney reported that resources can be classified into physical, human, organizational (Barney, 1991) and financial resources (Barney, 1995), technological resources are also mentioned indirectly in his description of physical resources. Specifically, he stated that “physical resources include the machines, manufacturing facilities, and buildings firms use in their operations” (Barney, 1995). It appears that Barney has combined physical and technological resources under one category. To be specific, according to the meaning of technology, as defined by Hofer and Schendel, it is clear that technological resources can be represented by the “machines” and the “manufacturing facilities” in Barney’s description of physical resources. Indeed, Amit and Schoemaker (1993) also highlight the significance of the technological factor, noting that technological resources are one of the main resources for the company to produce products or services.

In support of Hofer and Schendel’s (1978) classification of resources, Wolf and Reed (2000) contend that a general look at the resource-based literature shows a slight agreement about the way resources should be classified. They added that the broad classification of resources as tangible and intangible resources can be considered as evidence that categorization of resources should be more specific. Thus, they have selected the classification of Schendel and Hofer (physical, financial, organizational, human, and technological resources) in their work. The justification of the selection of these five categories can be observed through the fact that “there are no individual resources that do not fit this schema” (Wolf and Reed, 2000).

2.3 The Role of Resources in Strategic Management

This section discusses the strategic importance of resources. This discussion is divided into four dimensions. First, a number of definitions of strategy, corporate strategy and resources are presented to show the link between resources and strategy. Second, an understanding of the role of resources as an internal and strategic power of an organization is provided. Third, the significance of resources as a source of competitive advantage is illustrated. Finally, the classification of different types of resources according to the literature of strategic management (SM) is presented. The aim of this part of the chapter is to show the significance of resources in forming a firm's strategy.

2.3.1 Definitions of Strategy and Resources

The role of resources in strategy can be seen in the definition of strategy. Originally, the word strategy was derived from the Greek word *strategos*, meaning *general*; therefore, it can be described as an “art of the general” (Steiner et al., 1986). Schendel and Hofer (1978) defined strategy as a “fundamental pattern of present and planned resource deployments and environmental interactions that indicates how the organization will achieve its objectives”. Correspondingly, the determination of the main long-term aims and targets of the firm, with implementation of methods of activities and assigning of the critical resources to execute these aims, can be also considered as a definition of strategy (Chandler, 1995).

Katz (1970) stated that there are two features of strategy: strategic position and structure plan. According to Katz, the strategic position is the real association or the real connection between the organization and its

environment at an exact moment of time. Newman et al. (1981) added that obtaining resources earlier, specifically “tangible or intangible” assets that will situate the organization in a beneficial position in the future, is considered as a “strategic position”. On the other hand, the structure plan is the proposed relation in the future, which includes a number of corporate goals as well as activities that are necessary to achieve these goals (Katz, 1970). Katz expressed the notion that the group of people, at an exact moment of time, who enforce a collection of resources inside a competitive environment, can be called an “enterprise’s strategic posture”. From this point of view, he defined corporate strategy as a “relationship between an enterprise and its environment”.

Andrews (1980) differentiates between business strategy and corporate strategy. Business strategy identifies the preference of the “product or service and market” of the business inside the organization. In contrast, corporate strategy regularly impacts comprehensively on the organization. It identifies the business in which the firm fights through focusing on the resources that will assist to translate the “distinctive competence” to “competitive advantage”. Further, Andrews emphasized that the valuable strategic decision is the decision that focuses on a significant portion of the firm’s resources. Hence, corporate strategy is forming an efficient group of business-units through an accurate “investment (allocation) of resources” and adding value to businesses through these resources (Newman et al., 1981).

Understanding resources by definition will provide a better perception of their role in strategy. Resources can be defined as “stocks of available factors that are owned or controlled by the firm” (Amit and Schoemaker, 1993). Specifically, Collis and Montgomery (2004) defined resources as “the assets, skills, and capabilities of the firm”, stating that resources are

essential elements because decisions about what a firm can do depend on the resources. Similarly, resources can be defined as the “capital or financial, physical, social or human, technological, and organizational factor endowments that allow a company to create value for its customers” (Hill and Jones, 2004). Steiner et al. (1986) defined resources as those tangible and intangible capitals by which the firm can improve its capacity for success. Montealegre (2002) has clearly shown the relationship between resources and strategy in his definition of resources. According to Montealegre, resources are “firm specific assets and competencies controlled and used by firms to develop and implement their strategies”. These opinions and views about resources appeared to be reasonable and are supported in so far as “the firm is more than an administrative unit; it is also a collection of productive resources” and the employment of these resources represents the best way to measure the firm’s size (Penrose, 1995).

In summary, the strategic importance of resources is identified through a number of definitions of strategy, corporate strategy, and resources. First, it can be said that resources are significant in forming the current position of the firm, as well as the future position. Second, resources enable the organization to create its competitive advantage. These two points have been reported on directly and indirectly in the various definitions of strategy and corporate strategy described above. Additionally, these definitions support the idea that resources represent a base for strategy. Indeed, the power of resources in a firm is reflected in the firm’s ability to perform activities within its strategic boundaries.

2.3.2 Resources as an Internal Power of Organization

Considerable research in the field of strategic management has concentrated on strengthening product market positions as a foundation for competitive advantage and superior profits (Dierickx and Cool, 1989). However, the significance of organized resources as a tool to reach or protect superior product market positions is frequently ignored. Furthermore, Grant (1991) identified the lack of attention being given to the relationship between strategy and resources, possibly due to the limited awareness of most of the researchers in this area. Nevertheless, limited attention was focused on a firm's resources as a base for strategy. For example, Barney (1986) launched the notion of a "strategic factor market", which is the market that obtains and relies on resources essential for strategy implementation.

In fact, a variety of suitable market opportunities can be identified by resources; this relationship represents the main influence of resources on "corporate strategy" (Collis and Montgomery, 2004). A SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis is helpful in explaining this relationship. To illustrate, the link between the external opportunities and the firm's threats on one side, and their internal strengths and weaknesses on the other side, can be considered as a definition for a SWOT analysis (Barney, 1995a). Barney added that even though the concept of SWOT analysis was introduced nearly forty years ago by Learned, Christiansen, Andrews, and Guth, the current existence of this concept as a strategic principle is evidence for its success. A SWOT analysis employs the internal strength of the firm in exploring external opportunities on the one hand, while reducing the effect of threats and overlooking the weaknesses.

Many researchers have highlighted the importance of focusing on internal strengths and weaknesses as a source of competitive advantage, resulting in a better and more favourable situation. For instance, Barney (1986) reported that strategic alternatives must be driven from an analysis of the exclusive skills and capabilities of the firm rather than the firm's external environment; further "analysing a firm's skills and capabilities can be a source of more accurate expectations". Grant (1991) identified how changes in the external environment can justify the resources and capabilities required as the steady base from which the firm can determine its identity. Grant also emphasized that a business should be described based on its capabilities to provide stronger strategy, rather being described according to the requirements it aims to satisfy. Therefore, it is important for strategists and executives to understand that investigating a firm's internal assets provides a more reasonable analysis for formulating strategies than concentrating on what the firm should do to meet demand (Lopez, 2005).

This point leads naturally into a discussion of the concept of *economic rent*. The notion of the economic rent appeared in the nineteenth century with a disagreement on the exact meaning of this concept. Generally speaking, there are three common types of rents: Ricardian rent, Quasi rent, and Monopoly rent. Ricardian rents involve significant returns obtained from fixed resources, or resources that are in restricted supply and can be attained by possessing a precious and rare resource (Mahoney and Pandian, 1992). According to Grant (1991), Ricardian rents are "the returns to the resources which confer competitive advantage over and above the real costs of these resources". Quasi rents involve the difference in payments to a resource between the first-best use of the resource and its second-best use (Mahoney and Pandian, 1992; Amit and Schoemaker, 1993). The "returns to the market power" (Grant, 1991) or the rents that

are obtained through the protection of the government, are called Monopoly rents (Amit and Schoemaker, 1993).

For clarity, it is important to explain the link between the resources and the economic rents in the context of strategy. The concept of the Resource-Based View (RBV) of a firm illustrates this relationship. Simply, RBV considers a firm as a collection of resources and capabilities (Montealegre, 2002; Coates and McDermott, 2002). To be more specific, RBV is the process of maximizing the income through highlighting strategic alternatives and assigning the critical task of defining, improving, and implementing the main organizational resources to management or the decision makers (Fahy, 2003). Finney et al. (2005) reported that RBV implies that resources are the base of success for organizations. Similarly, for Coates and McDermott (2002), RBV reveals that the success of a company's strategy depends on its collection of resources. Indeed, RBV assumes that a sustainable competitive advantage results from the required outputs of the management activities of the organization (Fahy, 2003). This way of obtaining a sustainable competitive advantage enables the organization to acquire economic rents (Coates and McDermott, 2002; Fahy, 2003). While Grant (1991) has also mentioned that the aim of RBV, in the context of strategy, is to take full advantage of rents over time, he emphasized that strategy must be built on the bases of Ricardian rents rather than Quasi rents.

Resources thus represent an internal power for the organization. A SWOT analysis and RBV are good examples of how an organization can be driven successfully through its resources. As a SOWT analysis concentrates on both internal and external environments, an analysis of the internal factors, specifically resources, cannot be ignored. However, the significance of resources is more important in RBV, which is an internally focused tool

specifically for building strategy. It focuses on the firm's resources generating the firm's internal power. Thus, the role of resources in strategy can be expressed through a description of resources as the internal power of a firm.

2.3.3 Resources as a Creator of Competitive Advantage

The relationship between profitability and competitive advantage can provide a good understanding of the role of resources in strategy. To illustrate, although a positive relationship exists between profitability and the market share, the main objective of "competitive position analysis" is to provide a measurement method for continuing growth and profit instead of analyzing the market share (Hofer and Schendel, 1978). Consequently, a firm's profitability may be affected negatively if its competitive advantage is lost. This is the reason that a failing firm can be defined as a one whose profitability is considerably lower than its rivals' average profitability when an ability to produce and manage the resources is absent (Hill and Jones, 2004). Further, Reed and Defillippi (1990) have declared that competency consists of a collection of resources and the methods by which these resources cooperate to provide outputs. Amit and Schoemaker (1993) believe that the real challenge for executives is to make profits through a sustainable competitive advantage by defining, improving, defending, and implementing the required resources. Thus, according to Hill and Jones (2004), the main goal of strategy (collection of resources) is to develop a competitive advantage that obtains better profitability. From this point of view, strategy can be seen as "the driver of competitive advantage and profitability".

Strategic executives and academic authors have always explored sources of competitive advantage (Barney, 1991, Barney, 1995). A company is considered to have a competitive advantage if it employs a “value creating strategy” which is not available to its rivals; it is considered to have a sustained competitive advantage if it has a competitive advantage and its competitors are unable to duplicate the value creating strategy (Barney, 1991). Hill and Jones (2004) reported that, within the same industry, if the firm’s profitability exceeds the average profitability of its competitors, it is considered to have competitive advantage. They added that the ability to protect “above-average profitability” for years is equivalent to sustained competitive advantage.

However, strategy cannot attain competitive advantage unless the firm forms its distinctive competencies (Hill and Jones, 2004). Indeed, Schendel and Hofer (1978) reported that a significant amount of research has proposed that distinctive competency is the main base of strategy. To be specific, they identified the importance of resources through their definition of the firm’s distinctive competency as “its unique resources and resources deployment pattern”. In addition, Hill and Jones (2004) defined distinctive competencies as particular powers of the organization to differentiate its outputs and/or produce with a cost considerably lower than its competitors. Similarly, Collis and Montgomery (2004) declared that resources differentiate between firms and represent a durable supply by which competitive advantage is revealed. These definitions imply that resources represent organizational powers, by which strategy can be successful.

As a result, resources and capabilities represent the two corresponding sources for distinctive competencies (Hill and Jones, 2004). Indeed, Grant (1991) has offered two reasonable points that place resources and

capabilities at the base of a firm's durable strategy: 1) they form the main "direction" for the strategy, and 2) they represent a major source of profits. However, understanding the difference between resources and capabilities is important. Hence, Grant (1991) has specified that, "while resources are the source of firm's capabilities, capabilities are the main source of its competitive advantage". Specifically, he considered the resources as a main element of the analysis that represents the "inputs into production processes", while capability is the ability for a group of resources to execute or carry out actions. For Hill and Jones (2004), capabilities are the skills required to organize a firm's resources. These skills are inherent in a firm's systems and procedures to attain the organizational goals through controlling the internal processes. In summary, recognizing, forming, and implementing vital resources is a significant contributor to corporate strategy as well as competitive strategy (Collis and Montgomery, 2004). Additionally, according to Hill and Jones (2004), the minimum requirements for a firm to have distinctive competency are:

1. Special and valuable resources and capabilities to obtain the benefit of the resources; or
2. Special capability to direct and control resources.

They added that having both, special-valuable resources and special capability, will result in the strongest distinctive competency for a firm.

2.3.4 The Strategic Role of the European Foundation for Quality Management (EFQM)

In the USA, and specifically in the early 1980's, there was a need for national awards in quality (Olve et al., 1999). The need for such awards

has also been a concern in Europe and, in 1988, 14 famous European companies formed what is known now as the European Foundation for Quality Management (EFQM), and in 1992, The first EFQM or what is known as the European Quality Award (EQA) was then founded (Wongrassamee et al., 2003). Such awards are provided to companies that achieve excellence in QM as a part of their continuous improvement process (Shergold and Reed, 1996). In regard to the strategic role that these frameworks, such as Balanced Scorecard and EFQM, play, Wongrassamee et al. (2003) stated that:

A common theme in the newer integrated performance models or frameworks has been a determined attempt to tie performance metrics more closely to a firm's strategy and long-term vision...EFQM Excellence Model ...received wide publicity and ...recently ... adopted by many organizations worldwide, particularly in Europe and the USA.

As for the components of the EFQM, Shahroudi (2010) stated that:

The EFQM Excellence Model comprises nine criteria grouped under five "enablers" criteria that include: leadership, policy and strategy, people, partnerships, and resources and process and also, four "results" criteria that includes: customer results, people results, society results, and key performance results. The enablers stand for how the organization operates, and the results focus on the achievements towards organizational stakeholders, those who have an interest in the organization, and how they can be measured and targeted.

Nowadays, many companies in Saudi Arabia, including the selected cases of this research, seriously attempt to implement the EFQM in order to guide their quality practices.

2.4 The Role of Resources in Quality Management

In this part of the chapter, the role of resources in the context of quality is highlighted. TQM literature reveals that any TQM factor or element can be considered as one of three types of resources, i.e. technological, organizational and human resources (Saraph et al., 1989, Flynn, 1994, Anderson et al., 1995, Badri et al., 1995, Powell, 1995, Ahire et al., 1996, Black and Porter, 1996, Grandzol and Gershon, 1998, Quazi et al., 1998, Rungtusanatham et al., 1998, Tamimi, 1998, Dow et al., 1999, Joseph et al., 1999, Hua et al., 2000, Zhang et al., 2000, Tari, 2006, Perdomo-Ortiz et al., 2006, Antony et al., 2002) [See Appendix A]. This part provides clear definitions and descriptions of these resources to demonstrate the links between TQM and each type of resource. The aim is to use TQM literature to show how relevant human, organizational, and technological resources are to the field of quality. The efforts of eighteen TQM philosophers are summarized in Appendix A to show how TQM critical elements (or factors) can be viewed as one of these types of resources.

2.4.1 Technological Resources and Quality Management

Simply put, technology is the process of occupying the knowledge in order to carry out the required job (Rousseau, 1979). It can also be defined as “information, equipment, techniques and processes required to transform inputs into outputs in an organization” (Robbins and Barnwell, 2002). A

similar definition has been given by Perrow (1967), who considered technology as an action “that an individual performs upon an object, with or without the aid of tools or mechanical devices, in order to make some change in that object.” It can also be defined as a collection of capabilities (knowledge and skills) that are supposed to be applied theoretically and practically to provide and improve the products and services (Burgelman et al., 2008). Tompkins (2004) provided a broad definition of technology; that is, coordination of a firm’s “tools and techniques” to generate its activities. All these definitions can be integrated into one definition (White and Bruton (2007):

The practical implementation of learning and knowledge by individuals and organizations to aid human endeavour. Technology is the knowledge, products, processes, tools, and systems used in the creation of goods or in the provision of services.

In addition, technology has developed and modernized a firm’s way of managing services by updating the manners, methods, or techniques by which employees are operating within the firm (Sivabrovnvatana et al., 2005). Moreover, Sivabrovnvatana et al have emphasized that the implemented technologies should be well-known and controlled by the organization to generate the maximum advantage from these technologies. They declared and summarized their view stating that “technology has been used as a productive, tactical, and strategic resource, as a tool and as a change agent.”

Previous definitions of technology highlight its role in quality management. Consequently, Prajogo and Sohal (2006) stated that quality techniques, such as Statistical Process Control (SPC) and Quality Function

Deployment (QFD), have always been considered in the TQM literature as a technology. In fact, according to the definition of technology, the term can include traditional forms, such as advanced tools and equipment, as well as methods and techniques. Hence, Waldman and Gopalakrishnan (1996) present techniques as “operational factors” that have an ability to reduce the variations of the services. This helps to achieve customer satisfaction, which is quality as it is defined by Juran (1988), Feigenbaum (1991), and Oakland (1993).

Thus, due to the significance of technology as a main factor in forming future contact between sellers and their customers, the influence of technology on the “quality-value-loyalty chain” must be investigated (Parasuraman and Grewal, 2000). Consequently, it is important to understand that a superior innovation level is the result of combining TQM and technology management (Prajogo and Sohal, 2006). This thinking draws attention to the importance of integrating technology into a firm’s products or services to obtain customer loyalty (Kandampully and Duddy, 1999; Sivabrovnvatana et al., 2005). Logically, customer loyalty is driven by customer satisfaction (i.e. “quality” as mentioned earlier). Therefore, investing in research and development to improve the products or to produce them more quickly implies considering quality itself (Ettlie, 1997).

In the context of quality, it is reasonable to highlight the importance of information technology (IT) as the main form of technology. Indeed, IT has always contributed and supported TQM factors (Dewhurst et al., 2003). Therefore, firms must ensure that their TQM process recognizes the significance of implementing new technologies to obtain competitive advantage (McAdam and Henderson, 2004). Specifically, McAdam and Henderson summarized that the future of TQM appeared to rely on new forms of technology, such as e-commerce and IT.

2.4.2 Organizational Resources and Quality Management

Organizational resources can be defined simply as “relationships among individuals” (Tomer, 1998). They can also be defined by organizational characteristics, such as an organization’s history, culture, trust, management system, policies, formal and informal relationships (Barney, 1995), and long or short financial management systems (Hofer and Schendel, 1978). Leana and Buren (1999) defined the concept of organizational social capital as a resource that represents the nature of the social relationships within organizations and that enables employees to share trust, objectives, and activities to create a significant value for the organization.

It might seem somewhat confusing to differentiate between organizational and human resources. However, Tomer (1987) has clearly distinguished between *Pure Human Capital* and *Pure Organizational Capital* through some examples. He considered that training programs, as an ideal example of pure human capital, can be viewed as values that are invested in employees to increase their productivity. Where the employee does not respond positively, the firm is supposed to fire him or her and hire a new employee to protect its productivity. He justified this by saying: “This is pure human capital because this attribute does not contribute to the functioning of the organization ... It is specific to the firm’s technology but not to the firm’s organization”. On the other hand, Tomer also stated that pure organizational capital can be explained by “a change in the formal organizational structure in which the channels of communication and formal relationships between several work groups are altered”. This is pure organizational capital because it is a collective of organizational attributes that form the required activities of the employee.

Thus, Barney's (1991) definition of organizational resources seems to be appropriate in the context of quality. To illustrate, he stated that:

Organizational capital resources include a firm's formal reporting structure, its formal and informal planning, controlling, and coordinating systems, as well as informal relations among groups within a firm and between a firm and those in its environment

From a quality perspective, the best representative of "... formal reporting structure ... formal and informal planning, controlling, and coordinating systems..." in Barney's (1991) definition is the role of leaders (senior management) in the TQM process. To exemplify this point, leadership is one of the common TQM categories that always covers issues such as "top management leadership and quality policy", 'top management commitment', 'top management implication', 'visionary leadership', 'leadership and policy', 'managerial support', 'quality leadership', 'visible support for the change', 'quality management system' and 'company orientation toward quality'" (Sila and Ebrahimpour, 2003). Indeed, organizational factors such as senior management commitment, the quality policy, quality culture and the Quality Department's responsibilities are important in obtaining better quality results and achieving customer satisfaction (Waldman and Gopalakrishnan, 1996). Hence, due to the fact that top management is responsible for improving and protecting the organizational culture, executives should employ TQM as a tool for organizational success (Gore, 1999). Furthermore, many studies have shown the significance of the role of top management commitment in TQM. The importance and the contribution of such a role is clearly illustrated by Ahire and O'Shaughnessy (1998), who reported that all TQM constructs can be employed and executed successfully once

the top management is committed to TQM. Sila and Ebrahimpour (2005) saw it as a requirement for firms to employ managers who are capable of leading TQM matters, especially those related to people (HRM), strategic plans, and customer relations.

In addition, from a TQM point of view, the statement of "... informal relations among groups within a firm and between a firm and those in its environment ..." in Barney's definition of organizational resources reveals that internal relationships (employees) and external relationships (customers and suppliers) can also be considered as organizational resources. Indeed, these relationships have always been given attention by quality gurus. For example, to obtain customer satisfaction, it is important to consider real feedback from customers and ensure it is reflected in the firm's products and services (Antony et al., 2002). This can be achieved through communication between employees, customers, and suppliers. Thus, if TQM is implemented with respect to customer requirements, a firm can maintain a durable source of innovative ideas that conform to the real demand (Perdomo-Ortiz et al., 2006; Zhang et al., 2000). Additionally, success in TQM also relies on strong relationships with suppliers. Badri et al. (1995) stated that durable and strong contracts with suppliers are vital for TQM success. This fact is justified by Zhang et al. (2000) who stressed that "supplier quality management" is a critical component of TQM because the primary cause of quality troubles comes from goods obtained from suppliers. Therefore, Appendix A illustrates how key TQM elements can be considered as organizational resources.

2.4.3 Human Resources and Quality Management

The concept of human resources refers to the firm's employees (Daft, 2003), such as managers, researchers, technicians, engineers, sales people and financial staff (Hofer and Schendel, 1978; Penrose, 1995). Indeed, Chandler (1995) considered "technical, marketing, and administrative skills" as one of the most significant types of resources. However, the definition of human resources can be expressed broadly to include some organizational activities. To illustrate this point, both "human resource management (HRM)" and "human resources (HR)" have always been used to describe the functions of managing employees (Armstrong, 2006). Indeed, according to Akdere (2006), if firms are seen as "human systems", then HR is defined as:

The development and management of people in an organization through a framework of activities and practices that design, develop, organize, support, and execute employees' work—while ensuring compliance with legislation and regulations governing the employer/employee relationship.

Thus, it seems that Tracey's (2003) definition of HR in his book, *The Human Resources Glossary : The Complete Desk Reference for HR Executives*, represents the ideal description of what HR means. According to Tracey, the two definitions of HR are:

1. The people that staff and operate an organization — the executives, managers, supervisors, scientists and engineers, technicians, marketing and sales personnel, administrative and clerical personnel, and hourly workers

— *as contrasted with the financial and material resources of an organization.*

2. *The organizational function that deals with the people who manage, produce, market, and sell the products and services of an organization.*

Regardless of the definition of HR, it has received significant attention in the literature of quality management. It is a requirement for any effective quality development process and top management should give it a high level of attention and priority in their programs (Kufidu and Vouzas, 1998). In relation to Tracey's second definition, the organizational functions can be classified into four main HR processes: selection, appraisal, rewards, and development (Armstrong, 2006). All these functions relate to Tracey's first definition about organization's people. In addition, all these functions are always mentioned as part of TQM's elements. For example, selection is a process of assigning obtainable human resources to the required work (Armstrong, 2006), which can be viewed as a critical task in the TQM process. Ahmed and Schroeder (2002) stated that selecting employees is a significant process for both service and manufacturing industries and emphasized the need to study the importance of selection in the context of quality. They added that TQM elements, such as training and empowerment cannot be successful unless the appropriate person is selected. Indeed, the existence of people who are committed and involved in the quality process is important, as is the existence of a suitable recruitment and selection system and training program (Calvo-mora et al., 2005). In the selection process, Tari et al. (2006) reported that "employees should possess skills for continuous improvement in a TQM context, such as working in teams, problem solving and improving process aptitudes". Ahmed and Schroeder (2002) concluded that the importance of the

selection process is that it emphasizes a common quality principle that “prevention is better than cure”.

Moreover, development as a HR function means “developing high quality employees” (Armstrong, 2006). Therefore, training programs are considered as a good way to demonstrate the importance of “developing employees” in organizations that seek success in their TQM system. Yang’s (2006) study of HRM practices concluded that providing “training and education” and “employee development” has a positive impact on TQM. Similar results have shown that quality management, as one of the integrated manufacturing practices, is supported by training (Snell and Dean, 1992). Thus, the role of human resources in TQM reveals that training must be a consideration in enabling employees to utilize their capabilities (Bou et al., 2005).

TQM is also influenced by appraisal and rewarding. Appraisal, which means “performance management” (Armstrong, 2006), has been mentioned frequently as one of the critical elements of TQM. Soltani et al. (2004) stressed that “TQM-driven HR performance evaluation must be an organizational imperative if TQM objectives and customers (i.e. internal and external) are to be met”. In addition, recognizing employees’ efforts and rewarding them must be considered as part of the quality improvement process (Zhang et al., 2000; Baidoun, 2004). More specifically, Zhang et al. (2000) suggested that “salary promotions, position promotions, monetary or non-monetary rewards, (and) financial awards for excellent suggestions” are effective ways for rewarding. Appendix A shows how some of these TQM elements can be viewed as human resources.

2.4.4 TQM Elements as Resources

The definitions and descriptions discussed for technological, organizational, and human resources demonstrate the significance of these resources in TQM implementation. This, in turn, leads to the perspective that TQM elements can be considered as resources. This is not surprising and, in fact, is explained through the definitions of the resources. As shown in Appendix A, 18 TQM advocates and researchers have used different elements of TQM in their investigations of the critical factors of TQM. According to the definitions presented earlier, these elements can also be viewed as technological, organizational, or human resources.

2.5 Strategic Quality Management (SQM)

Human, organizational, and technological resources play a significant role in both SM and QM, so the focus of this section is on the concept of Strategic Quality Management (SQM). SQM is divided into three dimensions. First, quality is investigated from a strategic perspective to demonstrate how it can generate a competitive advantage. This dimension is an extension of the previous two sections, providing further explanation of the role of resources in SM and QM. The second dimension draws attention to the need to link quality to strategy as a requirement for TQM to succeed. In the third dimension, SQM is directly presented through its definitions and critical elements of SQM are presented. The collective discussion of SQM researchers who have directly used the terminology of SQM is then summarized.

2.5.1 Quality as a Competitive Advantage

As illustrated in the previous sections, the strategic importance of quality can be determined from the role of the resources in both QM and SM. Further clarification can be obtained from the strategic view of QM or what is known as SQM. In fact, a consideration of quality as a basis for building strategy permits firms to cover all organizational aspects such as culture, market position, identification of the strategic goals and identification of the required resources (Leonard and McAdam, 2002a). Moreover, to enable "quality strategy" to translate the mission and the vision of the firm into an understandable and practical formate (i.e. specific goals), the external environment (competitors) as well as internal capabilities (resources) must be considered (Beecroft, 1999). In addition, it is important to understand that resources cannot be utilized without a system that is capable of assembling them, because "how a firm mobilizes its resources determines what activities it becomes good at" (Pruett and Thomas, 1996). Pruett and Thomas (1996) added that:

The capacity to achieve high quality is difficult to develop, hard to buy, and provides a substantial benefit, which sounds much like the definition of a valuable resource. Clearly, a management system which manages for quality is an abstract form of a resource.

The significance of resources can also be investigated throughout the strategic role of the technological, human, and organizational resources in QM. For example, achieving a high level of quality and productivity requires good investment in "people, design of products and process improvements" (Calingo, 1996). Pruett and Thomas (1996) noted that "technological change drives and is driven by quality". Moreover, in

strategic TQM, the focus is on issues related to social responsibilities to attain high levels of competency (Madu and Kuei, 1993). From these examples, it is obvious that people, design of products and process improvement, and social responsibilities represent the human, technological, and organizational resources, respectively.

Hence, it is not surprising that Juran and Gryna (1993) emphasized that quality should be viewed from a business rather than from a technical perspective. Similarly, Rapert and Babakus (1996) postulate that “quality should not be viewed merely as a problem to be solved; it should be viewed as a competitive opportunity”. Madu and Kuei (1993) introduced SQM through the philosophy of strategic TQM (STQM) and emphasized that attention should be concentrated on both the customer and the environment because they represent the driving force for any quality agenda. They stated that:

This approach views quality as the driving force to the survivability and competitiveness of a firm ... rather than viewing quality just from the standpoint of the direct products and services ... quality is seen as a reflection of the overall performance of a firm.

This reveals that the strategic force of resources can present quality as a tool for competitive advantage. In fact, the relationship between quality management and “competitive strategy” has not been examined in depth or given significant consideration in the literature (Chang et al., 2003). It is surprising that there is almost no theory that supports this relationship (Reed et al., 2000). However, respected quality gurus, such as Crosby (1979), Feigenbaum (1991), and Deming (2000), mention that quality is a significant source for sustainable competitive advantage. Moreover,

although quality literature has not clearly shown the relationship between competitive strategy and quality, there is significant evidence in the strategy literature regarding the importance of quality in competitive advantage (Morgan and Piercy, 1996). It is almost agreed that TQM is a source for sustainable competitive advantage (Reed et al., 2000), and that TQM is the only mechanism to sustain competitive advantage (Spitzer, 1993).

Indeed, Powell (1995) proposed that competitive advantage can be generated through TQM, while Douglas and Judge (2001) found a strong relationship between TQM and competitive advantage in their empirical study. Similarly, Morgan and Piercy (1996) reported that the development of product/service quality is discussed extensively as a suitable competitive strategy that leads to sustainable competitive advantage.

From the previous discussion, therefore, it can be derived that TQM has the potential to generate competitive advantage. Importantly this potential comes from the vital role of valuable resources. It is important to note that competitive advantage does not result from TQM alone, but is also the result of the interaction between “strategy, firm orientation, and the environment” (Reed et al., 2000). They show “how the process of TQM has the potential to create sustainability of advantage” through interaction between different resources.

2.5.2 Linking Quality to Strategy

Quality, as a business issue, should be managed from a strategic base (Beecroft, 1999). To illustrate this point, rather than seeking causes for quality, attention should be “on the strategic use of quality” (Leonard and McAdam, 2002). For many executives, the significance of quality is purely

centred on the operational issues of production or marketing (Pruett and Thomas, 1996). A lack of quality strategies that direct TQM activities (Leonard and McAdam, 2002) results in a failure of senior management to implement TQM successfully. For example, Srinidhi (1998) reported that practice experts in management are dissatisfied with the effects of implementing quality methods, such as re-engineering, process value analysis, activity based cost management, target analysis and cost of quality analysis.

However, Srinidhi (1998) noted that the failure of quality methods in many organizations occurs for two main reasons: the absence of assigning these methods to the overall strategy; and the absence of coordination between these methods. He added that quality management cannot be employed successfully without linking its activities to the strategic initiatives of the organization. To support this point of view, Preiss et al. (1996) stated that:

The reason there was little improvement in bottom line profit in many companies that tried re-engineering, total quality management, or many of the other recommended practices is that the tactical changes were not coordinated by an overall strategy.

Consequently, TQM cannot be performed successfully if it is separated from the overall strategy. Therefore, the success of an organization depends on quality issues being considered in all strategic actions of the organization; the “key to success” is to recognize the manners by which quality can be assimilated with the “corporate strategy” (Calingo, 1996). Calingo added that successful quality management implies that quality initiatives are employed in activities which are unified under a formulated strategy.

2.5.3 Definition of SQM

As organizational aspects, such as HRM and organizational procedures, are influenced by TQM, the concept of TQM can be developed to form what is known as SQM (Leonard and McAdam, 2002). Leonard and McAdam (2002) added that a better understanding of environmental issues results when the focus of TQM is on the strategic aspects of the firm and “this emphasizes the importance and impacts of SQM”. Indeed, from a strategic point of view, “TQM was found to be a means of achieving strategic level targets” (Leonard and McAdam, 2002). From these bases, many researchers have attempted to define SQM. Garvin (1988) stated that the absence of specific work (books or articles) that describes the evolution of SQM as a concept means the starting date cannot be identified. In fact, although SQM is introduced and described by Garvin through five elements, he did not provide a definition. Madu and Kuei (1993) see STQM is an extended form of TQM that is intended to set up organizations for the future. They introduce SQM through the following definition of STQM:

Perform a customer- and environment-driven analysis of the internal and external performance of a firm to drive defects to zero and maximize the satisfaction of customers with the products/services of the firm.

Put simply, SQM blends customers’ feedback into the firm’s strategies (Lo et al., 1998). Juran and Gryna (1993) also defined SQM as a process of setting long-term quality objectives and identifying the method of attaining these objectives. Additionally, the British Standards Institution (BSI) defined SQM as attaining a firm’s goals using its organizational practices and management attitude to utilize and bind all available resources effectively (BSI, 1992).

However, these definitions are either too short or too general (Tummala and Tang, 1996, Aravindan et al., 1996) and do not explain the critical factors (elements) that interact to achieve quality objectives (Tummala and Tang, 1996). Hence, Tummala and Tang have defined SQM as:

... a comprehensive and strategic framework linking profitability, business objectives, and competitiveness to quality improvement efforts with the aim of harnessing the human, material and information resources organization-wide in continuously improving products or services that will allow the delivery of customer satisfaction.

While Tummala and Tang's definition of SQM highlights the significance of utilizing resources, Srinidhi (1998) concentrates on linking quality techniques with corporate strategy. According to Srinidhi, SQM is:

... the formulation and deployment of quality management within the overall framework of strategic planning, in a way that is aligned with all the other initiatives such as process re-engineering, cost management, inventory control and target analysis.

However, although Tummala and Tang identified seven critical elements for SQM and highlighted the importance of these elements as the base of forming strategies for quality improvement, the strategies have not been included in their definition. In contrast, Aravindan et al. (1996) emphasized the significance of such strategies and stressed that "quality enhancement approaches" should be driven by specific strategies. Therefore, they 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.

Senthil et al. (2001) stated that Aravindan et al.'s (1996) theoretical model of SQM, which is based on Aravindan et al.'s definition of SQM, is comprehensive and provides a better explanation of SQM. Senthil et al.(2001) illustrated that this is because a number of essential strategies for quality enhancement have been considered in the model. Thus, Aravindan et al.'s definition seems to be the most suitable definition for SQM.

In practice, SQM unites the concept of corporate strategy with TQM where quality activities are substituted by initiatives “such as cycle-time reduction and business process re-engineering” (Pheng and Hong, 2005). Thus, as the linking process is not easy and needs a methodical frame, Srinidhi (1998) introduced a framework, named “congruence management business architecture” as a practical way of implementing SQM. He identified three fundamentals for implementing SQM: continuous improvement, facilitating instruments, and HR empowerment. Pruett and Thomas (1996) have identified four elements to incorporate the concept of quality management into strategic management: environment, leadership, method, and systems view. These elements and other elements identified by Garvin (1988), Juran and Gryna (1993), and Tummala and Tang (1996) are listed in Table 2.1.

Table (2.1): SQM Elements

Author	SQM elements
Garvin (1988)	<ul style="list-style-type: none"> • Performance; • Features; • Reliability; • Conformance; • Durability; • Serviceability; • Aesthetics; and • Perceived quality.
Juran and Gryna (1993)	<ul style="list-style-type: none"> • Define the mission of our organization; • Analyze the opportunities and threats; • Analyze strengths and weaknesses; • Identify and evaluate alternative strategies; • Select a strategy; • Develop goals; • Prepare detailed short range plans; • Translate plans into budgets; and • Monitor performance.
Tummala and Tang (1996)	<ul style="list-style-type: none"> • Customer focus; • Leadership; • Continuous improvement; • Strategic quality planning; • Design quality, speed and prevention; • People participation and partnership; and • Fact-based management.
Pruett and Thomas (1996)	<ul style="list-style-type: none"> • Environment; • Leadership; • Method; and • Systems view.
Srinidhi (1998)	<ul style="list-style-type: none"> • Notion of continuous improvement; • Information and measurement; and • Involvement and empowerment of all employees.

2.6 Goal Programming and Analytic Network Process in Resources and Quality Issues

This part of the chapter presents a number of applications for two decision-making methods that are employed in this research. The first method is the Analytic Network Process (ANP). This part of the chapter also describes the Analytic Hierarchy Process (AHP), which represents root of ANP and later AHP became known as a special form of ANP. The second method is one of the well-known *multi-criteria decision making* (MCDM) tools, Goal Programming (GP). The aim of this part of the chapter is to provide evidence that these methods can be applied successfully to allocate resources and improve quality. Some examples also show how these two methods can be integrated so that a decision making problem can be formulated in one (single) model. This section highlights these methods through examples, while more detailed explanations are discussed in the next chapter.

2.6.1 GP and ANP/AHP in Resource Allocation

A significant number of researchers have shown that linear programming (LP or the root of GP) has always been associated with the application of AHP (the special form of ANP). The allocation of energy resources, such as coal, natural gas, solar thermal and other such resources, are presented by Ramanathan and Ganesh (1995) as a MCDM problem They suggested that solving such a problem needs an incorporated methodology and therefore developed a model that integrates AHP and GP, where AHP is employed to rank and quantify the criteria as the first step. Then, GP uses these ranked quantities as coefficients for decision variables. Similarly, Lee

and Kwak (1999) have combined GP and AHP in one model to allocate information resources that are applicable to strategic planning in a health-care system. They added that this model:

(1) Utilizes a GP approach to reflect the multiple, conflicting goals of the health-care system; (2) employs a GP solution process to reflect multi-dimensional aspects of the resource allocation planning; and (3) allows for some degree of flexibility of decision-making with respect to resource allocation.

In fact, many studies have employed GP models to address various decision making issues, especially in the field of resource allocation. For example, Schroeder (1974) proposed a GP model that takes into account the long-term planning and allocation of financial resources and human resources (academic staff) in universities. The significance of the model came from its consideration of the fact that the process of planning is driven by financial resources. However, Diminnie and Kwak (1986) expressed their understanding of the educational process and reported that academic objectives could be negatively affected by a focus on financial resources. Thus, another GP model is designed by Diminnie and Kwak (1986) to reduce financial expenses with respect to academic objectives. They emphasized that department chairmen and deans are responsible for allocating and mobilizing resources. Another interesting application of goal programming in allocating resources is proposed by Mardle et al. (2000) and illustrates how fisheries' resources could be controlled through the power of GP as a MCDM tool. The reason for their selection of GP is that they have noticed that a fishery is a MCDM problem that deals with different economic, biological and social goals, "such as

improving the income of fishers, reducing the catch of depleted species and maintaining employment”. Strategic resources were also allocated by Blake and Carter (2002) when they applied two GP models in hospitals. According to them, these two models assisted the decision maker to “explore an institution’s production possibility frontier”. Therefore, GP is considered as a suitable tool for allocating resources.

2.6.2 GP and ANP/AHP in Improving Quality

There are several examples of the application of GP in the field of quality. Process control, as a common problem in the manufacturing environment, has been solved by Sengupta (1981) using GP. The model enables manufacturers to align output characteristics with their required specifications. The proposed model is also generally suitable for any process-control problem. Schniederjans and Karuppan (1995) also considered twelve constructs for quality control as a measure for a quality system in a service organization. They designed a GP model with the aim of choosing the best combinations of quality control instruments to “assist decision makers in designing service QC systems for all types of business organization”. Similarly, Cherif et al. (2008) formulated a GP model intended to incorporate decision makers’ perspectives to design QCS. They added that this is a multi-criteria decision making problem that employs GP as a powerful technique to balance input levels and output specifications.

Moreover, Quality Function Deployment (QFD) has been commonly used with GP and AHP (special case of ANP). In fact, combining QFD and AHP is common in quality literature. Specifically, AHP has always been used as a tool for defining and ranking customer requirements (Armocost et al.,

1994; Koksak and Egitman, 1998; Zakarian and Kusiak, 1999; Ho et al., 1999). Additionally, customer requirements and design requirements can be optimally matched by using mathematical programming and GP respectively, as illustrated recently by Karsak (2004) and Chen and Weng (2006).

Karsak et al.'s (2002) work illustrates how these studies combined AHP/ANP with GP, with common methodology. They sought to solve a decision making problem by aiming to select the product technical requirements (PTRs) that should be focused on in order to design exactly what customers need. Firstly, they built the QFD's house of quality (HOQ) using ANP to translate the voice of the customers. This process was achieved by ranking customer needs with respect to the main goal, as well as the "inner dependence of the customer needs". PTRs are also ranked in similar way. The output of the ANP is represented by one goal, which represents the voice of customers in GP. GP is then developed as a second step to consider of other goals, such as "cost budget, extendibility, and manufacturability that need to be taken into account in the analysis". Finally, GP is formulated in a way that selects the best PTRs for the designing process. A similar application of ANP-GP by Liu and Hsiao (2006) achieved the best "product architecture" through consideration of customer requirements.

2.7 Summary

The role of resources in SM has been critically reviewed and it can be concluded that strategies generally can't be executed without resources. It has also been found that all TQM elements, which have always been under investigations by quality gurus, can be classified as human,

organizational, or technological resources, as shown in Appendix (A). Therefore, it was appropriate that the third part of this chapter handled the discussion of QM from a strategic point of view (i.e. SQM, not TQM). While it is difficult to consider all the studies that used ANP/AHP and/or GP, many previous examples provide a better understanding of these techniques that can be formulated and applied in resource and quality issues. Logically, the formulation of any problem depends on its research question. Thus, previous examples showed different scenarios using ANP/AHP and/or GP to demonstrate that these methods are capable of handling resource and/or quality issues. Additionally, these methods have demonstrated their flexibility to be integrated into one model.

Chapter 3

Research Methodology

3.1 Introduction

This research has been executed in two main phases: quantitative and qualitative. The two phases employed a total of three appropriate research tools, which are introduced in this chapter. In regard to the quantitative phase, two tools were employed: the Analytic Network Process (ANP) and Goal Programming (GP). ANP and GP represent the first and the second step of the quantitative phase, respectively. In the qualitative phase, the semi-structured interviews were conducted to explain the quantitative findings. For each tool, the discussion is divided into three sections: providing general background about the method, explaining the reason behind the selection of this method, and describing how the methodology is conducted in this research. This chapter introduces these methodologies while further details are provided in chapter 4 (Research Design) and chapter 5 (Data Collection).

3.2 The Quantitative Phase

In the first step of the quantitative phase, the first four research questions are to be addressed. The attempt to answer these questions considers the interaction among the three types of resource (human, organizational, and technological resources) (RQ1), resources and strategies (RQ2 and RQ3), and the ability of strategies to enhance quality (RQ4). Such an interaction

requires a tool, such as an ANP, that is capable of prioritizing resources and strategies within the context of the developed research questions (RQ1 to RQ4). The ANP is also employed in this step to discover and explore the mismatching between the resources needed for each strategy and the resources actually allocated for each strategy. This raises the issue of the resource allocation (resource allocation problem).

In the second step of the quantitative phase, the GP model is introduced to handle the issue of resource allocation. This addresses the fifth research question (RQ5), regarding the extent to which each strategy is under-resourced or over-resourced. After addressing RQ5, the attempt is to address the sixth research question (RQ6) within the qualitative phase (the second phase) to explain the quantitative findings in term of why each strategy is under-resourced or over-resourced. Figure (3.1) illustrates how the six research questions are addressed within the two phases of this research.

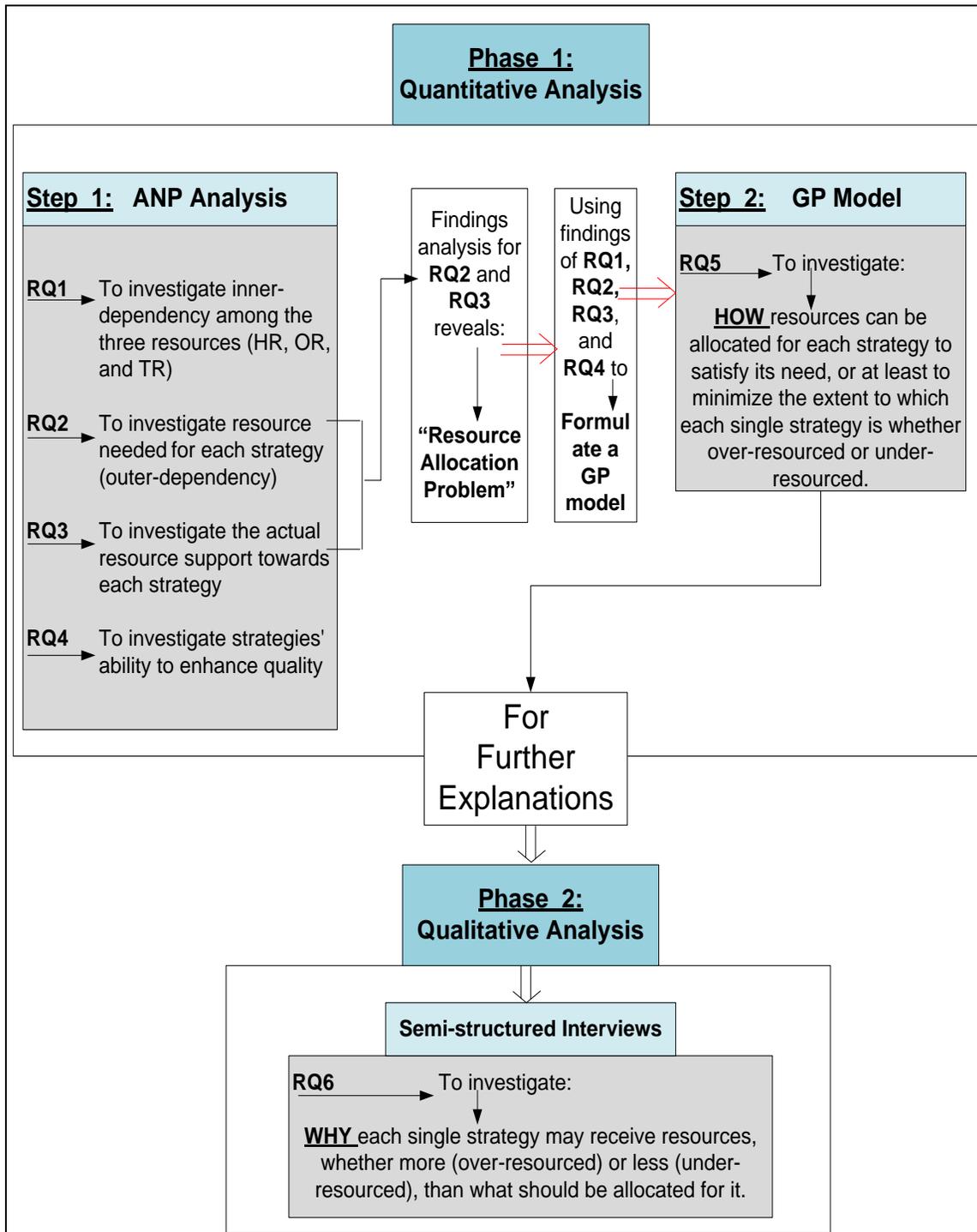


Figure (3.1) How the Six Research Questions are Addressed within the Two Phases of this Research

3.2.1 First Step: The Analytic Network Process (ANP)

3.2.1.1 What is ANP?

Prior to discussing ANP, it is prudent to highlight the methodology from which it is developed. In fact, ANP is a developed form of what is known as AHP. In the 1970s, Saaty developed AHP as a method for allocating resources in the military (Cheng and Li, 2001). AHP “is a general theory of measurement” (Saaty, 1996). Cheng and Li stated that AHP “is becoming quite popular in research due to the fact that its utility outweighs other research methods”. AHP and ANP combine qualitative and quantitative components in one technique. The qualitative component is represented by identifying the decision criteria by which the model is structured; While the *pair wise comparison* that resulted in numerical weights represents the quantitative component of the model (Cheng et al., 2005; Cheng and Heng, 2004; Cheng and Li, 2001). In 1996, Saaty launched ANP as a developed version of AHP. In fact, due to the flexibility of ANP to solve different and more complex forms of decision making problems, Saaty (1999) reported that AHP is a special case of ANP and defined ANP as a “general theory of relative measurement used to derive composite priority ratio scales from individual ratio scales that represent relative measurements of the influence of elements that interact with respect to control criteria”. Saaty (1996) presented his fundamental scale of absolute value that used in AHP to carry out the comparison judgments of ANP. He stated that “this scale has been validated for effectiveness not only in many applications by a number people but also through theoretical comparisons with many other scales”. This scale is shown in Table (3.1).

To explain how AHP works, a simple example is presented. Suppose that there are two options related to three criteria for a specific objective (goal).

The decision maker wants to identify which option is more suitable. Figure (3.2) shows the hierarchal representation of such a problem. In this case, four pair wise comparison matrices should be developed. Firstly, the three criteria supposed to be ranked and weighted with respect to the main goal. The two options should also be ranked and weighted with respect to first, second, and third criteria to represent the second, third, and fourth pair-wise comparison matrices respectively.

Table (3.1) Saaty's (1996) scale for pair wise comparison

Intensity of weight*	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one over another
5	Strong importance	Experience and judgment strongly favor one over another
7	Very strong importance or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values	When a compromise needed
*If activity i has one of the above non-zero numbers assigned to it when compared to activity j, then j has the reciprocal value when compared with i		

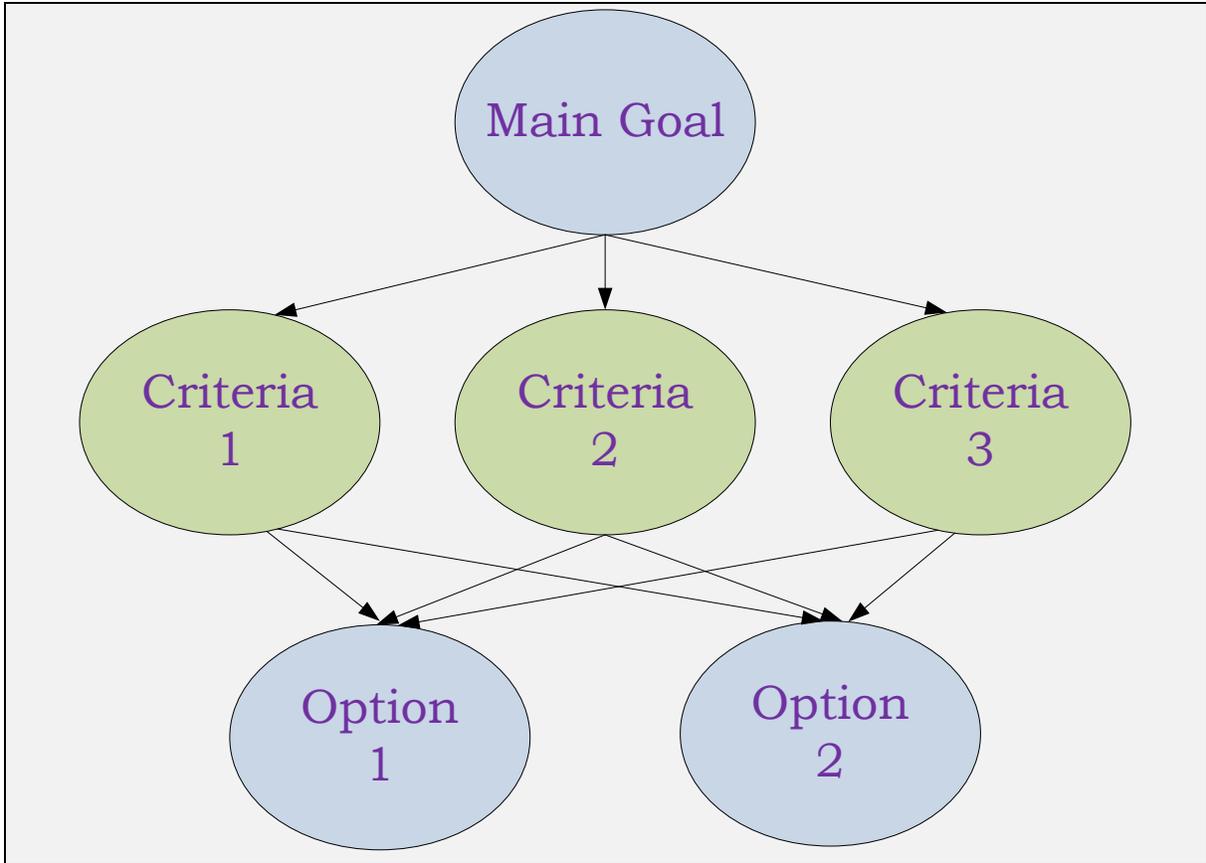


Figure (3.2): The Structure of AHP

After pair-wise comparison matrices are formed, the next step is to calculate and normalize the *eigen-vector* for each matrix. A simple illustration for this step is presented by Cheng and Li (2001) when they reported that this step is done by:

dividing the elements of each column of the matrix by the sum of that column (i.e. normalizing the column); then, obtaining the eigen-vector by adding the elements in each resulting row (to obtain “a row sum”) and dividing this sum by the number of

elements in the row (to obtain “priority or relative weight”).

To obtain the final weights and ranks of the two options, the resulted eigen-vector of the first matrix (weighted criteria) should be multiplied by eigen-vectors of the remaining matrices (weighted options). Figure (3.3) shows how final weights are calculated.

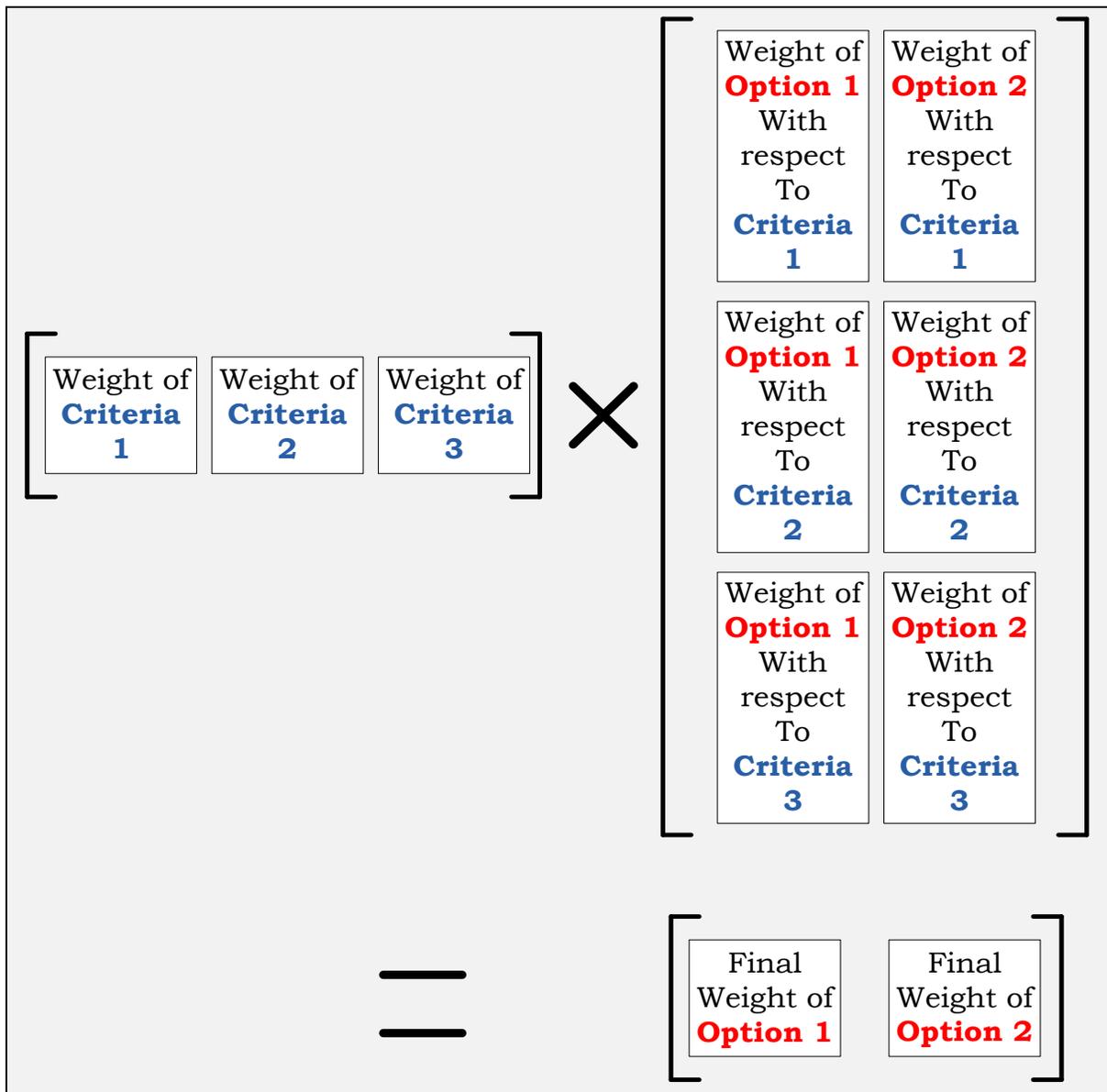


Figure (3.3): Calculations of AHP.

However, ANP differs slightly from AHP and offers more flexible methodology for a decision maker. It is difficult for many decision making problems to be formulated in a hierarchical way (Saaty, 2006; Buyukyazıcı and Sucu, 2003; Saaty, 1996). In AHP, elements in lower level of hierarchy are weighted and ranked with respect to the higher level. Figure 3.2 shows that the rankings of the three criteria depend on the perception of the main objective (i.e. higher level than criteria). It is also shown that ranking of the two options depends on the perception of each criterion, which is placed at a higher level compared to the options. This form of interaction between these levels explains what Saaty (1996) referred to as “dependence”. In ANP, however, the model is not restricted by such a hierarchy. This point is clearly explained by Saaty (1996), the founder of AHP as well as ANP, when he stated that in ANP:

Not only does the importance of the criteria determine the importance of the alternatives, as in a hierarchy, but also the importance of the alternatives themselves determines the importance of the criteria

When Saaty stated that “the importance of the alternatives themselves determines the importance of the criteria”; he was referring to what he called “Feedback”. He added that the dependence-feedback structured model does not have to show the hierarchy as it looks like a network. Significant problems can then be modelled using such a network (Buyukyazıcı and Sucu, 2003). Thus, Saaty (1996) replaced the word “level”, as used in AHP, with the word “cluster”, as used in ANP, to represent a model in a more sensitive manner. These clusters include

element or more than element. In fact, as many decision making problems incorporate feedbacks (Buyukyazıcı and Sucu, 2003), ANP can be employed to solve these kinds of decision problems as it has been developed to deal with such a complexity (Saaty, 2004).

It is better to illustrate ANP in a simple example. Suppose that there are three categories of elements to be structured in an ANP model that shows the dependence and feedback between the elements. Elements with the same category are grouped in one cluster. As shown in Figure (3.4), three groups of elements are represented by three clusters. The arrow that is leaving cluster (1) towards cluster (2) means that elements in cluster (2) are going to be ranked and weighted with respect to the elements of cluster (1). Thus, it can be said that these ranks and weights of cluster (2)'s elements are dependent on elements of cluster (1). In addition, it is also shown that elements in cluster (1) will be ranked and weighted from a perspective of the elements of cluster (2). This is reflected by the arrow that is exiting cluster (2) in the direction of cluster (1). This arrow represents the feedback. Similarly, all other arrows that link clusters to each other can be described in this way. These types of arrow represent 'outer-dependence' while the arrow that both exits and enters cluster (3) (i.e. enters itself) represents the 'inner-dependence' (Buyukyazıcı and Sucu, 2003). Saaty (1996) referred to the outer-dependence as an "interaction between clusters" and defined it as "the relationship between an element in a cluster with others in other clusters". He also referred to the inner-dependence as an interaction within a cluster and defined it as "the influence of one element on another with respect to an attribute they have in common within a cluster".

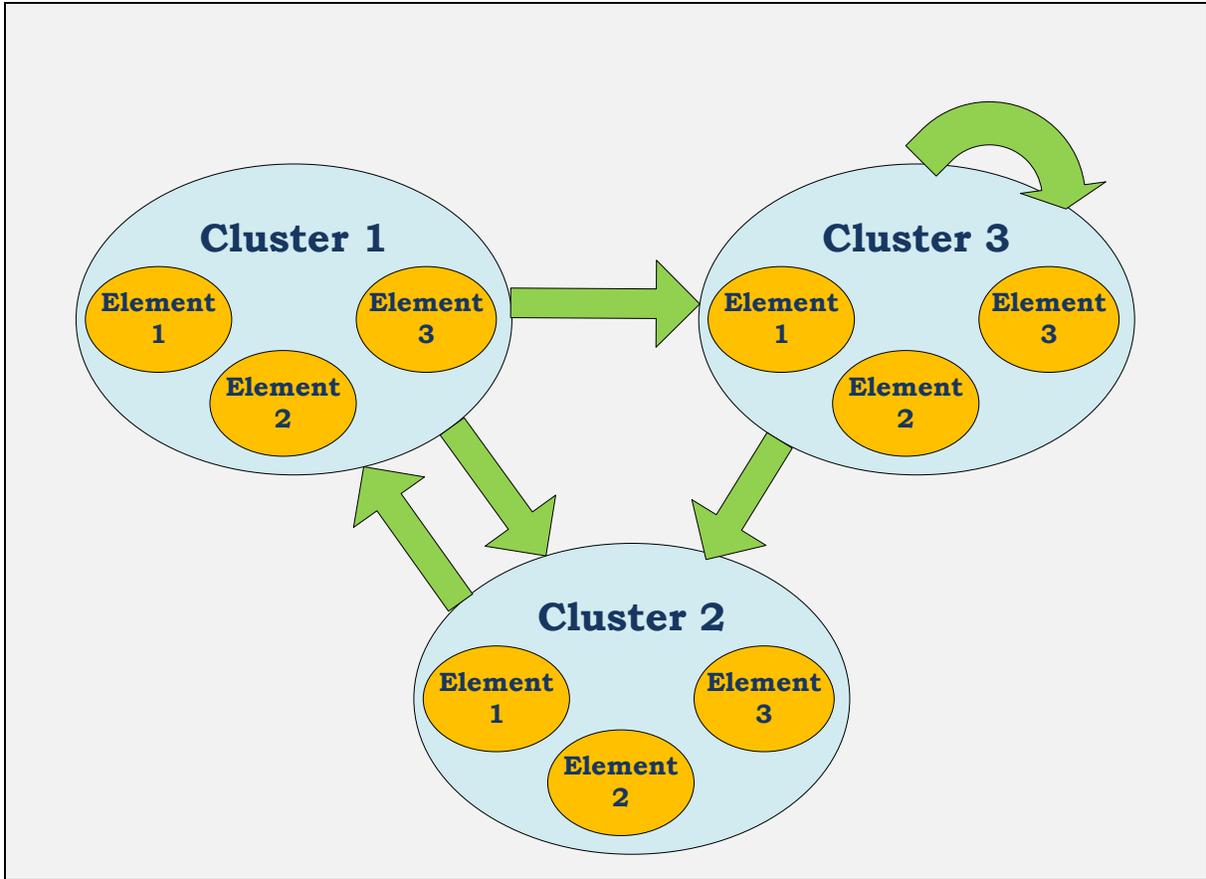


Figure (3.4): Example of ANP

The eigen-vectors that result from the pair-wise comparison matrices of the ANP model are presented in a matrix called “supermatrix” (Saaty, 1996). This matrix is supposed to be multiplied by itself frequently until each column is the same in each block in the matrix. The form of the supermatrix that represents the relationships between the elements and the clusters for the model shown in Figure (3.4) is represented in Table (3.2). Cheng et al. (2005) summarize the qualitative as well as the quantitative steps of ANP, as shown in Table (3.3).

Table 3.2: The Form of the Supermatrix

With respect to		Cluster 1			Cluster 2			Cluster 3		
		Elements			Elements			Elements		
		1	2	3	1	2	3	1	2	3
Cluster 1	Element 1				W	W	W			
	Element 2				W	W	W			
	Element 3				W	W	W			
Cluster 2	Element 1	W	W	W				W	W	W
	Element 2	W	W	W				W	W	W
	Element 3	W	W	W				W	W	W
Cluster 3	Element 1	W	W	W				-	W	W
	Element 2	W	W	W				W	-	W
	Element 3	W	W	W				W	W	-

Table 3.3: Steps of the ANP

Steps		Type
1	To state the decision problem	Qualitative
2	To make sure that the decision problem is to be solved by ANP	Qualitative
3	To structure the unstructured decision problem	Qualitative
4	To determine who the raters are	Qualitative
5	To design a questionnaire for eliciting data from raters	Qualitative
6	To calculate the eigen-vector of each of the developed matrices	Quantitative
7	To measure the consistency ratio (CR) of each of the matrices to find the inconsistency of ratings	Quantitative
8	To form the supermatrix by the eigen-vectors of the individual matrices (also known as submatrices)	Quantitative
9	To compute the final limit matrix	Quantitative

3.2.1.2 Why ANP?

Although the ranking and weighting can be generated by other methods, ANP is found to be more appropriate in meeting the needs of this research. For example, although the Interpretive Structural Model (ISM) is a methodology that can be used to rank and quantify a group of variables (Mandal and Deshmukh, 1994; Singh et al., 2003), it concentrates mainly on the driving power of the variables to identify whether they are dependent, independent (driver), autonomous, or linkage. Additionally,

even though Oke and Ayomoh (2005) and Ayomoh and Oke (2006) recently developed the Hybrid Structural Interaction Matrix (HSIM) as a new methodology for prioritizing elements, the final priorities in HSIM are presented in a hierarchal structure that ignores the network structure. The network structure is able to show the direct relationship between elements. This is not to say that ISM or HSIM are not effective. Both of them may help in identifying which element should be implemented first, but that is not the case here. From this point of view, it can be said that ANP is better suited to providing ranks and weights, as it respects the perspective of each element on other elements. Neither ISM nor HSIM provides such a feature. Furthermore, it is important to reiterate that ANP is a developed form of AHP that has an ability to deal with a more complex decision making problem. ANP is employed in this case as it represents the more appropriate methodology for the first step of this research.

3.2.1.3 ANP Analysis

In this research, the ANP model will be developed following the order shown in Figure (3.5). The structure of this model is designed to simulate the first four proposed research questions. In other words, this model considers exactly what is stated in the following four research question:

RQ1: Given that the three types of resources depend on, and influence, each other; what is the relative contribution made by any two types of resources to enable the third type to play its role effectively?

RQ2: Given that each strategy depends on contributions by the three resources, what is the relative contribution made by each type of resource to ensure successful implementation of each critical strategy?

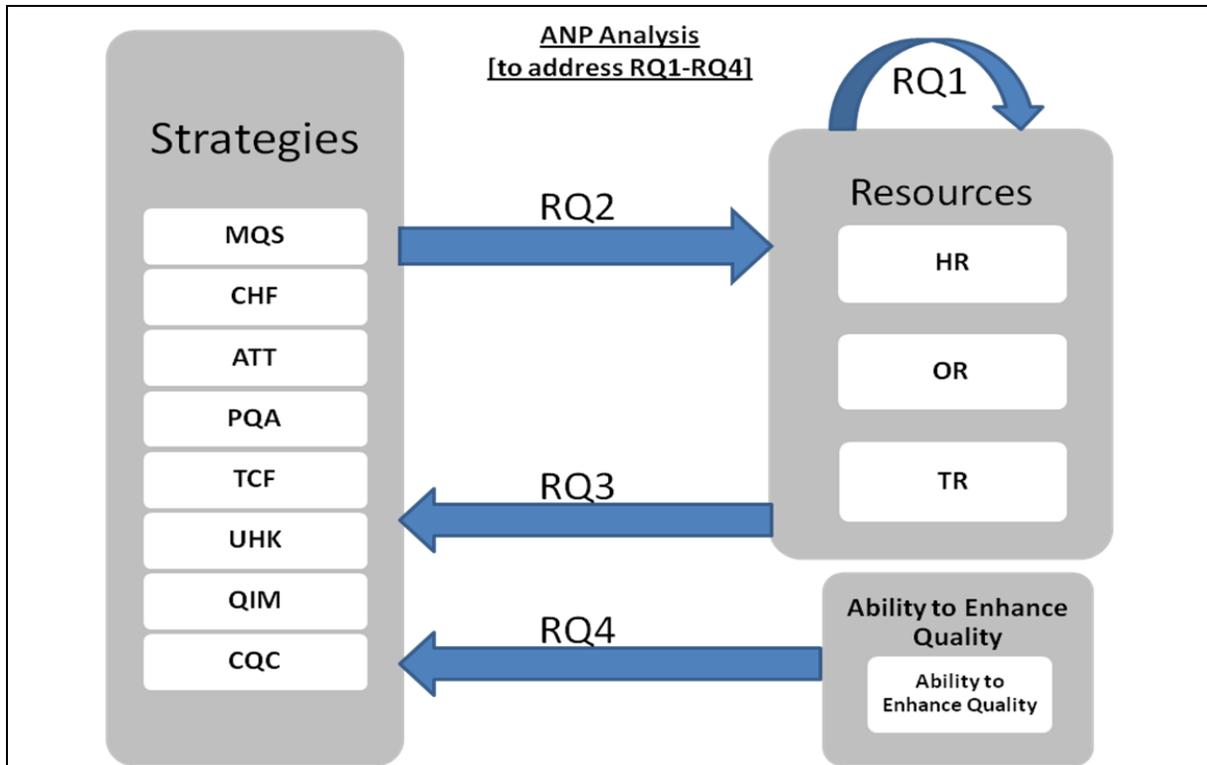


Figure (3.5): The ANP Analysis

RQ3: How is each available resource allocated for the eight strategies to ensure successful implementation?

RQ4: In light of their ability to enhance quality, what is the relative contribution being made by each of the eight critical strategies?

As shown schematically in Figure (3.5), the ANP model was developed by identifying three clusters. The cluster of resources comprises the three types of resource (HR, OR, and TR) while the cluster of strategies includes all eight critical strategies listed in Table 1.1. The third cluster contains one element: the ability to enhance quality. A sequence of pair-wise comparisons has been made among these clusters. These pair-wise

comparisons were developed according to Saaty's scale, where a score of 1 signifies equal importance between the two elements under comparison and a score of 9 indicates that one element is extremely important (or preferred) compared with the other element [see Table (3.1)].

This scale was used firstly to determine the inner dependence among the three resources (RQ1) (see Figure (3.5)) by indicating the extent to which one type of resource has more influence than the other type in enabling the third type to play its role effectively. As shown in Figure (3.5), the arrow exiting the cluster of resources and entering itself (RQ1) implies that the relative contributions of any two types of resources (HR, OR, or TR) will be compared with each other with respect to the third type of resource to address the first research question (RQ1). For example, OR is compared with TR with respect to their relative contribution to HR to be effectively activated. The remaining comparisons are conducted in a similar way to address RQ1.

In regard to the second research question (RQ2), the same scale is used to compare resources (with respect to each strategy) in terms of the contribution they each make to each strategy. As seen in Figure (3.5), the arrow exiting the cluster of strategies and entering the cluster of resources (RQ2) implies that the relative contributions of HR, OR, and TR will be compared with each other with respect to each critical strategy to address the second research question (RQ2). For example, all types of resources (HR, OR, and TR) are compared among each other relatively with respect to their relative contribution to the strategy of MQS to be successfully implemented. Similarly, remaining comparisons are conducted between resources with respect to each single strategy to address RQ2.

For the third research question (RQ3), the scale is used to compare the eight critical strategies considering the support of resources for each strategy. Figure (3.5) also illustrates that the arrow exiting the cluster of resources and entering the cluster of strategies (RQ3) implies that the eight critical strategies will be compared with each other with respect to the actual received support from HR, OR, and TR to identify how resources are allocated for the eight strategies and address RQ3. For example, all eight strategies are compared with each other relatively with respect to the actual support received from HR. Similar comparisons are conducted between strategies with respect to the actual received support from OR and TR.

Finally, the scale is also used to compare the contribution of each critical strategy to enhance quality (RQ4). As noticed in Figure (3.5), the arrow exiting the cluster labelled “ability to enhance quality” and entering the cluster of strategies (RQ4) implies that the eight critical strategies will be compared with each other with respect to their ability to enhance quality (addressing RQ4). A questionnaire was designed to execute the ANP and divided into three parts (part 1, part 2 A, and part 2 B) that include all required pair-wise comparisons for the first four research questions. Further explanations regarding data collection are provided in chapter 5 and a sample of the questionnaire is presented in Appendix (B).

3.2.2 The Second Step: The Goal Programming (GP)

3.2.2.1 What is Goal Programming (GP)?

GP is an application of the Linear Programming (LP) model for considering multiple goals (Levin et al., 1992). In fact, any LP model is aimed to

minimize or maximize a particular criterion of its objective function (Anderson and Lievano, 1986). However, it is not always suitable for the decision maker to formulate an individual objective that is to be maximized or minimized (Anderson and Lievano, 1986; Tamiz et al., 1998; Render et al., 2006). Indeed, managers are always challenged to achieve several goals within a single problem, which can be impossible to achieve at one time (Cooke, 1985). Thus, GP is a method for solving Multi-Criteria Decision Making problems within the structure of LP (Anderson et al., 2003). It is always presented as a quantitative research method (Cooke, 1985; Anderson and Lievano, 1986; Levin et al., 1992; Tamiz et al., 1998; Aouni and Kettani, 2001; Anderson et al., 2003; Render et al., 2006).

Anderson and Lievano (1986) defined GP as an “extension of linear programming in which management objectives are treated as goals to be attained as closely as possible within the practical constraints of the problem”. Render et al. (2006) also reported that in contrast to LP, GP allows various objectives to be considered. Hence, they added that while LP ‘optimize’, GP tries to ‘satisfy’ the goals as much as possible to come closer to the targets. Simply, GP is a quantitative research method that aims to minimize deviations of variables from the identified targets (Cooke, 1985; Anderson and Lievano, 1986; Levin et al., 1992; Tamiz et al., 1998; Aouni and Kettani, 2001; Anderson et al., 2003; Render et al., 2006). Tamiz et al. (1998) stated that:

Within this kind of decision environment the DMs try and achieve a set of goals (or targets) as closely as possible. Although GP was not originally conceived within a satisfying philosophy it still

provides a good framework in which to implement this kind of philosophy.

Indeed, GP as a decision making tool is paid significant attention from academics and practitioners who improved such a technique through their theories and applications (Aouni and Kettani, 2001). Aouni and Kettani added that GP as a research methodology, is going to be more common as it is applicable to many fields including quality management, human resources and production. They also stated that:

Another interesting development is the utilization of GP as a statistical tool for estimation. Recent studies suggest that GP could be an alternative to the conventional statistical methods. In fact, GP provides more flexibility for modeling the estimation process; this flexibility provides the analyst with a platform from which his/her knowledge and experience can be an input to the parameters' estimation.

In LP, the objective function contains only one goal that is subject to a number of constraints. However, in GP, instead of considering each goal in the objective function, goals are considered as constraints (goal constraints) while remaining constraints (if applicable) represent system constraints. Therefore, the objective function is aiming to minimize the amount by which each goal deviates from targets. These amounts are expressed as deviational variables, which mean that to attain the goal exactly, the value must be equal to zero. Thus, GP “allows taking into

account simultaneously many objectives while the decision-maker is seeking the best solution from among a set of feasible solutions” (Aouni and Kettani, 2001). Moreover, if a decision maker finds that one goal is more significant than other goal, GP is able to solve such a complexity (Levin et al., 1992). The GP model in this case is called pre-emptive GP (Winston, 1994). Render et al. (2006) stated that “it is necessary to establish a hierarchy of importance among these goals so that lower-priority goals are tackled only after higher-priority goals are satisfied”. This will avoid “trade-offs” between goals of higher priority and lower priority, and will also ensure that higher priority goals are satisfied before lower priority (Anderson et al., 2003; Anderson and Lievano, 1986). Moreover, the decision maker can add weights as coefficients in the objective function for deviational variables (Anderson and Lievano, 1986; Render et al., 2006) when the decision maker wants to show the associated importance of the goals. Anderson et al. (2003) summarized the procedure of developing a GP model in Table (3.4).

3.2.2.2 Why GP?

The ANP model quantitatively differentiates between the needed (critical or important) resources for each strategy and the support received. Responses to RQ2 may indicate that the needed HR (human resources) for the implementation of the first strategy (MQS), for example, is X %, while responses to RQ3 could indicate that HR (human resources) represents more or less than X %.

Similarly, other strategies may have deviations between the perception of what is needed and what is considered to be allocated from HR, OR and TR

(Further detailed explanations regarding how these differences are obtained is provided in chapter 6). In such a situation, the company cannot exactly satisfy the need of each strategy from each type of resource unless a single strategy receives more or less than what should be allocated. This is because there are seven remaining strategies and each strategy is in the same situation. Hence, the need for GP to handle such an interaction arises.

Table (3.4): Steps for Formulating a GP Model summarized by Anderson et al. (2003)

Steps of Goal Programming	
1	Identify the goals and any other constraints that reflect resource capacities or other restrictions that may prevent achievement of the goals.
2	Determine the priority level of each goal; goals with priority level P1 are most important, those with priority level P2 are next most important, and so on.
3	Define the decision variables.
4	Formulate the constraints in the usual linear programming fashion.
5	For each goal, develop a goal equation, with the right-hand side specifying the target value for the goal. Deviation variables $d1+$ and $d1-$ are included in each goal equation to reflect the possible deviations above or below the target value.
6	Write the objective function in terms of minimizing a prioritized function of the deviation variables.

To illustrate, responses to RQ1 indicate the contribution of each type of resources among each other (inner-dependence), and responses to RQ2 indicates the needed resources for each strategy (outer-dependence). Combining the results of RQ1 and RQ2 (using ANP) indicates the overall contribution of each type of resources. From this point of view, the overall contributions of HR, OR, and TR are considered representative of the available resources for the investigated company. In other words, the

values (in percentages) of H, O, and T that belong to the available HR, OR, and TR respectively are considered as system constraints for the GP model as shown in Figure (3.6). So **the first challenge** for the firm is how to exactly satisfy the need of the strategy of MQS ($h_{(1)}$, $o_{(1)}$, and $t_{(1)}$) for example, within the existence of the remaining seven strategies, which are actually sharing the MQS in an attempt to meet their own needs from the overall HR (H%), OR (O%), and, TR (T%) as shown in Figure (3.6).

In the same way, as answering RQ3 provides the allocated resources for each strategy, and as answering RQ4 provides the contribution of each strategy to enhance quality, using ANP to combine the results of RQ3 and RQ4 obtains the overall significance of each strategy. From this point of view, the resulted overall weights of each strategy are considered to represent the overall resources (whether HR, OR, or TR) that should be allocated for each strategy. In the other word, the values of ($s_{(i)}$), as shown in Figure (3.6), are considered as objective constraints for the GP model. So, regardless of the overall HR, OR, and, TR available (system constraints), **the second challenge** for the firm is **that how it can be guaranteed that even though the actual need of the strategy of MQS, for example, from HR ($h_{(1)}$), OR ($o_{(1)}$), and, TR ($t_{(1)}$) were exactly satisfied, the overall of resources that should be allocated for this strategy ($s_{(1)}$) would be maintained.** With this in mind, the remaining strategies are in the same situation; that is, each strategy has its own objective that needs to be optimized. Specifically, the objective of each strategy is **to maintain what should be allocated for each strategy** [maintain $s_{(i)}$]. However, as there are eight different strategies, the focus should be on ‘satisfying’ the objectives rather than to ‘optimizing’ them. From this point of view, the GP model is needed to see how far each strategy is from its own objective (target), if its objective is to satisfy its own need as much as possible (minimize the deviational variables).

3.2.2.3 The GP Model

As discussed, answering the previous research questions through the proposed ANP model will result in exploring a deviation between what is perceived to be needed and what is considered to be allocated for each single strategy. This may result in a resource allocation issue; that is, a situation may exist when a strategy i might mobilize more than (or less than) what has been assigned (allocated) for it. Hence, in order to identify the extent to which each single strategy is lacking in or overloaded by resources (*i.e.* addressing RQ5), this thesis formulates the following GP model:

Objective Function:

$$\text{Minimize} \quad \sum_{i=1}^n P_i [d_i^- + d_i^+]$$

Subject to:

$$[h(i) \times HR] + [o(i) \times OR] + [t(i) \times TR] + d_i^- - d_i^+ = s(i)$$

$$HR = H$$

$$OR = O$$

$$TR = T$$

$$d_i^-, d_i^+ \geq 0$$

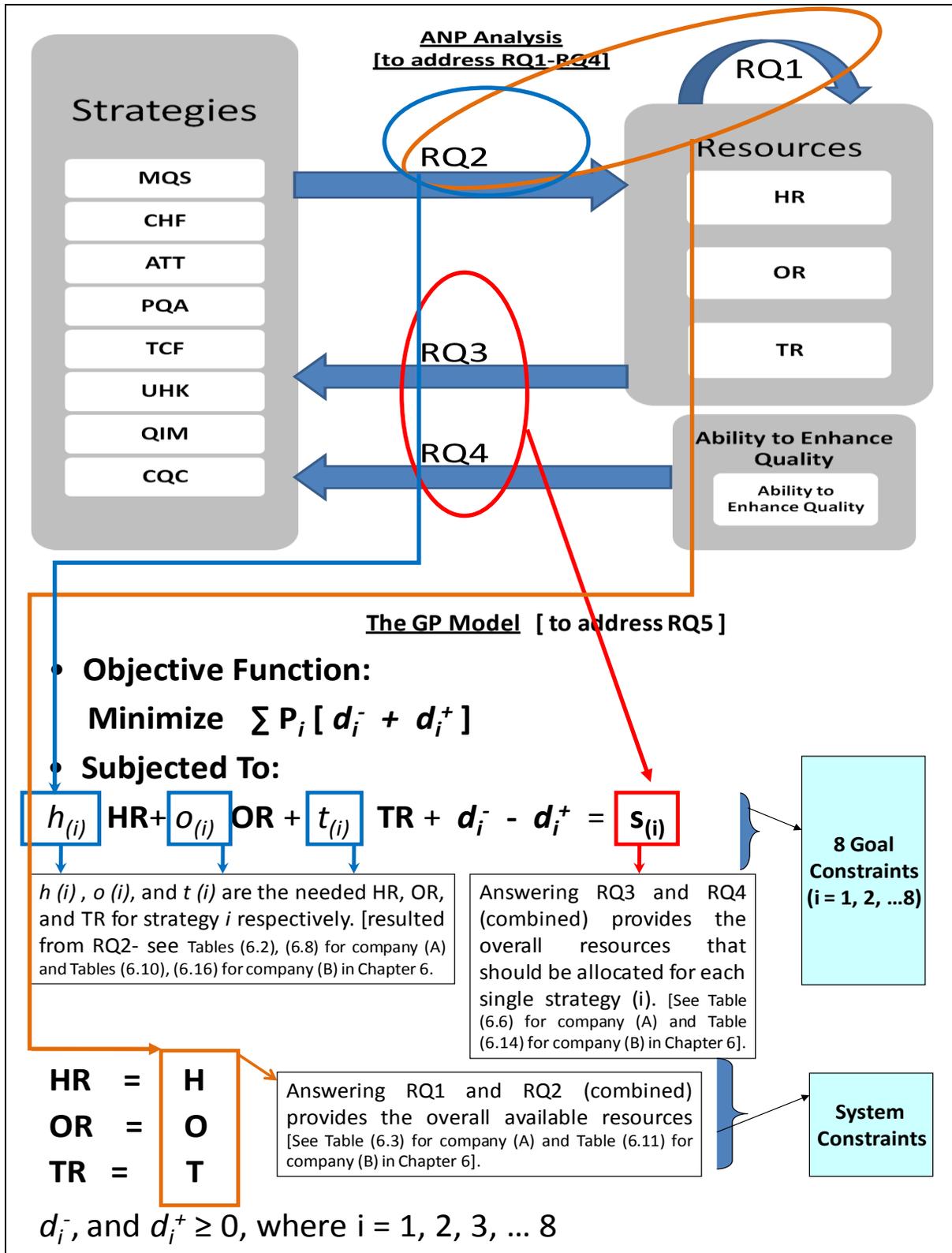


Figure (3.6): The Proposed Hybrid ANP-GP Methodology

Where HR, OR, and TR are decision variables for human, organizational, and technological resources respectively; H, O, and T represent the overall available human, organizational, and technological resources in a firm respectively; $h_{(i)}$, $o_{(i)}$, and $t_{(i)}$ are the needed HR, OR, and TR for a strategy i respectively; $s_{(i)}$ represents the amount of resources that should be allocated for a strategy i ; P_i represents the priority level for a strategy i , where the highest priority is assigned to the strategy that receives more resources; n represents the total number of strategies under the investigation (8 strategies); d_i^+ and d_i^- represent the deviational variables that illustrate to what extent a strategy i is “overloaded by” or “lacking in” resources respectively.

The objective function is to minimize d_i^+ and d_i^- to satisfy the needs of each strategy i while maintaining $s_{(i)}$ (i.e. maintaining the amount of resources that should be allocated for each strategy i) as much as possible. As the inputs of the GP model were generated from the results of the proposed ANP model, further description regarding the formulation of the GP model is presented chapter 6. Figure (3.6) illustrates how the ANP-GP model is developed.

3.3 The Qualitative Phase

This phase is conducted to address RQ6 in a qualitative manner and is to be conducted using a qualitative tool known as semi-structured interviews. Further details about semi-structured interviews are provided in next sections.

3.3.1 Semi-Structured Interviews

Semi-structured interviews are one of the most common types of interview. It might be seen as the most important method of executing an interview

due its flexibility in mixing structured with unstructured questions, which in turn improve the collected qualitative data (Gillham, 2005). Gillham concluded that the semi-structured interview is a type of interview in which prepared questions are asked of all participants to obtain open-ended answers that permit for further unprepared questions to be involved to clarify some issues during the interview. Indeed, Bryman and Bell (2007) confirmed that in this type of interview, the investigator has a list of inquiries on particular issues to be included while at the same time the participant is offered a flexible manner of answering. They explained that these issues might not be presented in the same order that they are “outlined on the schedule”. However, they also clarified that “questions that are not included in the guide may be asked as the interviewer picks up on things said by interviewees”. In fact, many methodologists confirmed that the order of presenting issues and the phrasing of the questions are a matter of investigator’s tact (Corbetta and Patrick, 2003; Denscombe, 2007; French et al., 2001). Denscombe (2007) reported that this is important to allow the interviewee to build up and expand his or her views and thoughts, as well as to enable the interviewee to converse more broadly on the subjects and concerns presented by the investigator. However, this type of interview consumes time and costs and the interviewer must have the required skills or be trained to conduct the interview (Gillham, 2005).

3.3.2 Why Semi-structured Interview?

The two steps of the quantitative phase (ANP and GP) are executed to ultimately answer RQ5, which helps to identify (quantitatively) how far each strategy is from attaining its target. The phrase “how far” quantitatively implies determining the values of d_i^+ and d_i^- . Hence, in

order to know “why” resource shortages (d_i^-) and overloading (d_i^+) appear in quality strategies (i.e. to answer the RQ6), the qualitative phase is conducted through employing the semi-structured interview. The aim of this phase is generally to explain the reasons behind the quantitative findings.

In fact, given that RQ6 requires a flexible technique to obtain as much detailed explanation as possible, the semi-structured interview is considered an appropriate choice. Even though the investigated issue in such interviews is specific, (as in RQ6), interviewees are free to respond as they see fit and, in such a situation, the interviewer has a chance to encourage the interviewee “to expand on their answers by probing and prompting” (French et al., 2001). Similarly, Corbetta and Patrick (2003) stated that “within each topic, the interviewer is free to ... give explanations and ask for clarification ... and to establish his/her own style of conversation”. Denscombe (2007) also confirmed that in semi-structured interviews, the answers are “open-ended”, and the focus is on how to obtain sophisticated details about certain issues from the interviewee. In this regard, qualitative findings are presented in chapter 7.

3.3.3 Conducting the Semi-structured Interviews

Generally, as the objective of the semi-structured interviews is to disclose obtainable knowledge in a manner that can be articulated as answers (Flick, 2009), semi-structured interviews are employed here to obtain further/qualitative explanations through answering RQ6. Accordingly, both prepared and unprepared questions are involved in this phase of research. In regard to the former, they are prepared in a way that encourages the interviewer to provide explanations. For instance, the

second part of each prepared question includes “why?” as an inquiry. Of course, unprepared questions share the same objective, but are only presented when they are needed as described above. It can be said that the prepared questions are considered as guidelines for the interview. In fact, according to Corbetta and Patrick (2003), “the interviewer’s outline ... may simply be a checklist of the topics to be dealt with, or a list of questions (usually of a general nature) having the goal supplying the interviewer with guidelines”. The interview questions are provided in Appendix (C).

As Meuser and Negal, (2002) argue, expert interviews are a form of conducting semi-structured interviews in which the participant “is of less interest as a person than in his or her capacity of being an expert for a certain field of activity” (Flick, 2009). Flick illustrated that the participant is involved in the interview as a part of a “group of specific experts” rather than representing him or herself. Therefore, six experts from each company (total = 12) participated in the semi-structured interview to execute the qualitative phase of this research. In this regard, further details are provided in chapter 5.

3.4 Summary

The methods that are used in this research are described in this chapter. In particular, this chapter shows how the developed research questions will be answered by executing these methods. It illustrates ‘why’ and ‘how’ ANP is considered an appropriate technique to handle the first four research questions due to its ability to deal with the interaction between resources and strategies. Regarding RQ5, it was found to be suitable to formulate a GP model to deal with the multi objectives of quality strategies. Furthermore, as both ANP and GP represent the quantitative phase of this

research, it is illustrated that using the semi-structured interview in the qualitative phase (answering RQ6) can help obtain further explanations. Chapters 4 and 5 provide further details. More specifically, the focus in chapter 4 is to explain in detail how these tools are executed in a mixed design within the context of the case study while chapter 5 concentrates on the aspects of data collection that are related to these methods.

Chapter 4

Research Design

4.1 Introduction

This chapter discusses how this research is designed and, in particular how it is carried out within the context of ‘case study’. Specifically, this research develops a comparative analysis by selecting and investigating two cases/companies within a single study. To the best of the author’s knowledge, the work of Yin (2003) in his book *Case study research: design and methods* is the most respected work in the field of case study research design. Accordingly, this case study research is conducted according to Yin’s elements of conducting case studies and most of the explanations are obtained from his words. Of course, these explanations are supported by the opinions of respected methodologists in the field. The chapter describes how the case study is constructed with respect to employing the appropriate research questions, propositions and unit of analysis as well as the appropriate manner of presenting the findings. Validity as well as reliability of the case study is highlighted. Case study research utilizes more than one source of data, so this chapter also discusses the notion of *mixed method research* and explains how this case study is built by blending two quantitative techniques and one qualitative method. In this regard, Creswell and Clark’s (2007) contribution to the field of mixed method research is paid significant attention in this chapter and in developing this case study research.

4.2 Case Study as a Research Design

Before discussing the aspects of the case study, the related concepts for research design are appropriately introduced. As the notion of ‘research design’ may conflict with the meaning of the ‘methodology’, it is reasonable to illustrate the difference. Methodology refers to theoretical frame and primary suppositions of the study (Van Manen, 1990) while research design in turn is a map of activities that connects the theoretical suppositions to particular methods (Creswell, 2003; Crotty, 1998). Methods are more precise as they refer to particular ways or processes of gathering and analyzing data (Creswell, 2003; Van Manen, 1990). In fact, Yin (2003) defined research design as a rational progression that links the practical data to the original research questions to provide reasonable conclusions. He illustrated that, generally, the research design is the “logical plan for getting from here to there, where here ... the initial set of questions to be answered, and there is some set of conclusions”. However, Yin declared that, “between here and there”, critical milestones could exist such as steps of data gathering and data analysis. Within the context of case study, Yin emphasized that the key reason of research design is to protect the entire study from having answers that do not fit appropriately with the original research questions. Thus, he believes that a research design should deal “with a logical problem and not a logistical problem”.

Case study is a form of research design. In this regard, Schramm (1971) defined case study as an attempt to clarify “a decision or set of decisions, why they were taken, how they were implemented and with what result”. Yin (2003) in turn defined case study as practical research that examines an existing phenomenon in its authentic context, specifically if the borders among the phenomenon and its context are not obviously apparent.

Accordingly, he stated that case study is “a comprehensive research strategy”.

The processes of attempting case study as a research design have to be unambiguous. Riege (2003) reported that designing case study is generally “more subjective” than other research designs. Indeed, according to Yin (2003), it is a fact that case study research needs to be “codified”. Yin explained that case study design is different from other research strategies as there is an absence of an inclusive “catalog” for designing case study which “is a separate research method that has its own research designs”. Even though Yin mentioned that his manner of conducting case study requires continuous revision and adjustment in the future, he emphasized that this manner will help the researchers “to design more rigorous and methodologically sound case studies”. From this point of view, Yin identified five elements for any case study research design:

1. Research questions;
2. The case study’s propositions, if any;
3. The unit of analysis;
4. The logic linking the data to the propositions; and
5. The criteria for interpreting the findings.

This research, attempts to develop a case study research design using the above elements as generic guidelines. Aspects of each element are presented in the following sections.

4.2.1 Case Study Research Questions

The decision to conduct a case study should consider the types of research questions involved. When Yin (2003) handled the issue of research questions, he stressed that case study is suitable for “how” and “why” questions rather than “what”, “who”, “where” , “how many”, or “how much” questions. He explained that such questions are more suited to exploratory studies or when the objective of the study is to “describe the incidence or prevalence of a phenomenon or when it is to be predictive about certain outcomes”. Case study, however, explains inquiries, which can be driven using “how” and “why” questions (Benbasat et al., 1987). Indeed, Edmondson and McManus (2007) reported that answering “how” and “why” questions often strengthens the linkages within the phenomena under investigation.

In this sense, RQ5 (quantitative) and RQ6 (qualitative) in this research are expressed as:

- RQ5:

How can resources be allocated for each strategy to satisfy its exact need, or at least, to minimize the extent to which each single strategy is lacking in (or overloaded by) resource support?

- RQ6:

Why does each single strategy receive resources, whether more (overloaded) or less (shortage), than what should be allocated for it?

RQ5 results from answers to the first four research questions (see Chapter 1). To illustrate, the first phase of this research attempts to employ two quantitative techniques: ANP and GP. Firstly, the ANP differentiates quantitatively between the needed resources for each strategy and the “resource support” each strategy receives. Two cases/companies are involved in this case study research and the ANP step provides quantitative answers to the first four research questions. In the second step of the quantitative phase, the analysis of the ANP model is used to feed and formulate the GP scenario in order to answer (quantitatively) RQ5, which is the final quantitative research question.

The second phase of this research is to conduct a number of semi-structured interviews with selected experts to qualitatively answer RQ6. This phase is conducted to explain the quantitative findings. Indeed, Yin (2003) argued that an interview could be used as a second source of evidence when investigator needs to find out “why” a certain phenomenon is happening. It is clear that ‘how’ and ‘why’ questions have been employed in this research to form the case study and represent the main directions of the study. More descriptions are presented in the next sections.

4.2.2 Case Study’s Propositions

Although it is important for any case study to consider “how” and “why” in formulating the main research questions, “propositions” should also not be ignored. Yin clarified that “how” and “why” handles questions a researcher wants answered, but do not indicate where the focus should be in the study. He explained that the researcher cannot drive the case study

smoothly and reasonable conclusions cannot be obtained unless some initial propositions have been identified to ensure the correct direction of the study. Yin added that as long as a certain case study has precise propositions, the study will be within realistic boundaries.

Hence, as Yin stated that “each proposition directs attention to something that should be examined within the scope of study”, this case study research attempts to answer four research questions that lead to RQ5. The four research questions have been driven from three propositions that are supported by the literature (as shown in Chapter 1 and 2). Specifically, these three propositions are:

- The three types of resources (HR, OR, and TR) depend on, and influence, each other.
- Each strategy depends on contributions of the three resources.
- Each single strategy, in Aravindan et al.’s (1996) SQM model, has a different level of ability to enhance quality.

It is important to note that these propositions are employed as facts rather than propositions. In other words, this research does not attempt to test these propositions; but rather, it uses them as assumptions by which the proposed ANP model is developed. As shown in Chapter 1 and 2, the literature clearly supports these assumptions, which are used to formulate the four research questions. As presented also in Chapter 1, these four research questions are:

1. RQ1:

Given that the three types of resources depend on, and influence, each other; what is the relative contribution made by any two types of resources to enable the third type to play its role effectively?

2. RQ2:

Given that each strategy depends on contributions by the three resources, what is relative contribution made by each type of resource to ensure successful implementation of each critical strategy?

3. RQ3:

How is each available resource allocated for the eight strategies to ensure successful implementation?

4. RQ4:

In light of their ability to enhance quality, what is the relative contribution being made by each of the eight critical strategies?

Answering these questions represents the first step of the quantitative phase of this research. As described above, the second step of the quantitative phase is to answer RQ5.

4.2.3 Unit of Analysis

Identifying the unit of analysis for the case study is a must; it is a vital element in any case study (Tellis, 1997). Although the traditional case study is centered on an individual, case study can also investigate events, entities' decisions, programs, the implementation process, and organizational change (Yin, 2003). In this regard, Yin also differentiated between the "holistic" and the "embedded" case study design. In the latter type of design, the case could have more than one unit of analysis while in

the former type the case, whether single or multiple, is designed to have only one unit of analysis for each case.

According to this clarification, this research is a holistic case study in the sense that two separate cases are investigated. The whole organization is considered as one unit of analysis (i.e. the selected two companies represent the two cases). Yin (2003) stated that, in contrast to embedded design, holistic design can be employed “if the case study examined only the global nature of an organization”. In this sense, this case study is a comparative study that investigates two different companies within the same industry. Specifically, both are selected from the Saudi Arabian food industry and both are producing different products. As each organization represents the unit of analysis, the focus then is to compare the selected organizations within the context of how each one executes quality strategies with respect to its own unique environment.

4.2.4 Logic Linking Data to Propositions and Criteria for Interpreting the Findings.

These two issues are about how to conclude the case study with convincing analysis and reporting. Although many techniques can be used in this regard, such as pattern-matching (Yin, 2003), “the linking of the data to the propositions and the criteria for interpretation of the findings are not well developed in case studies” (Tellis, 1997). Tellis confirmed that the analysis can rely on the theoretical propositions. Indeed, Yin (2003) stated that “linking data to propositions can be done any number of ways, but none has become as precisely defined”. Additionally, he added that

“currently, there is no precise way of setting the criteria” for understanding the case study’s results.

However, case study can still be a base for meaningful research findings. In fact, developing theory is necessary in any case study, whether by forming, examining, or simply exemplifying the theory through the five elements of the case study research design (Yin, 2003). From this point of view, Yin explained that it is important to understand that “theory” is not like what is resulted from the use of “ground theory in social science” rather that the case study investigator should not act as “a masterful theoretician ... the simple goal is to have a sufficient blueprint for your study”. Indeed, Edmondson and McManus (2007) illustrated that “theory-building research” project are, in reality, case studies as they usually seek to investigate “how” and “why” research questions. In this regard, Riege (2003) stated that:

The case study method is about theory construction and building, and is based on the need to understand a real-life phenomenon with researchers obtaining new holistic and in-depth understandings, explanations and interpretations about previously unknown practitioners’ rich experiences.

In fact, Edmondson and McManus (2007) explained that ‘theory’ within the context of management research, can be seen as either mature or nascent. Mature theory deals with developing constructs and models that gain their accuracy through a diverse group of researchers, while nascent theory

answers 'how' and 'why' questions, as they are involved in this case study, to clarify the linkages for the investigated issue.

This case study research aims to explain 'how' resources play their roles as critical enablers for quality strategies. Moreover, the aim is to show that handling the concept of quality management from a strategic perspective results in a better understanding of 'why' quality gurus and practitioners still disagree on the critical elements of TQM. Put simply, considering that "it is important to develop the QM theory, (and) investigate linkages among the QM strategies" (Ahire et al., 1996), QM is studied in this case from a strategic point of view, which adds a reasonable dimension to the QM theory. This dimension reveals that QM as SQM, not TQM, provides a more appropriate picture of how QM is practiced in organizations.

4.3 Why Multiple Cases?

Case studies are different from other traditional methods of conducting research. Although the case study is a unique form of research, many have disregarded it as an unattractive form of investigation compared to, for example, more traditional surveys (Yin, 2003; Cresswell, 2007). According to Yin (2003), there are two main reasons. First, many case study researchers have not followed organized processes or have not reached their conclusions in an appropriate manner. Indeed, Ruyter and Scholl (1998) reported that there is a lack of scientific methods by which precise case studies can be constructed. However, Yin's five elements of research design support such research.

A second common issue is that findings cannot be easily generalized using case study research design. In this regard, Yin (2003) stated that “scientific facts ... are usually based on a multiple set of experiments that have replicated the same phenomenon under different conditions ... the same approach can be used with multiple-case studies”. From this point of view, Yin clarified that case study research is similar to experimental research in that both are seeking analytic generalization in which the sample is not an issue at all; which is different to the traditional way of statistical generalization. Further explanations are presented in the section of validity.

The concept of ‘analytic generalization’ raises the significance of employing multiple cases within one study. In reality, case studies can be conducted with single or multiple cases within one study. Additionally, Yin (2003) stated that investigating two cases is worthwhile because comparative case process is considered “as a distinctive form of multiple-case studies”. He reported that multiple case studies, even when only using two cases (comparative study), are preferred over using a single case study when conducting this type of research. Indeed, the verification from multiple cases is regularly seen as more convincing and multiple studies are then generally viewed as more forceful (Herriott and Firestone, 1983). Yin justified using two case studies saying that:

The first word of advice is that although all designs can lead to successful case studies, when you have the choice (and resources), multiple-case designs may be preferred over single-case designs. Even if you can only do a "two-

case" case study, your chances of doing a good case study will be better than using a single-case design ... More important, the analytic benefits from having two (or more) cases may be substantial ... even with two cases, you have the possibility of direct ... replication. Analytic conclusion independently arising from two cases, as with two experiments, will be more powerful than those coming from a single case (or single experiment) alone. Second, the contexts of the two cases are likely to differ to some extent. If under these varied circumstances you still can arrive at common conclusions from both cases, they will have immeasurably expanded the external generalizability of your findings.

Compared to a single case study, having more than one case consumes more time and effort. Hence, it is a critical decision when a researcher decides to attempt investigating more than one case within a study. This is because, as described above, each case should be selected in order to help the researcher execute the *replication logic*. Certainly, following the replication logic is a key for shaping theory from the case study (Eisenhardt, 1989). Recently, Eisenhardt and Graebner (2007) explained this by saying that “each case serves as a distinct experiment that stands on its own as an analytic unit”. They illustrated that cases are tested for theoretical explanations such as disclosure of remarkable phenomenon, replication of results through comparing the results of other cases, exclusion of unconventional justifications, and explanation and expansion of the growing theory. Thus, using multiple cases facilitates the process of replication (Eisenhardt, 1991). According to Eisenhardt and Graebner

(2007), “theory building from multiple cases typically yields more robust, generalizable, and testable theory than single-case research”. Put simply, this case study seeks analytic rather than statistical generalization. This is realized through conducting a comparative analysis of two different cases/companies through which the concept of replication logic is executed. Further explanations in this regard are presented in the next section.

4.4 Validity

The quality of the case study, or specifically its validity, comes from the ability to generalize the findings. However, generalizing findings from the case study is different from the traditional method of generalization or what is known as ‘statistical generalization’. Many methodologists argue that a case study’s findings seek what is called ‘analytic generalization’. According to Yin (2003), the reason behind this is that “cases are not ‘sampling units’ and should not be chosen for this reason” and researchers in such a situation “should avoid thinking in such confusing terms as ‘the sample of cases’ or the ‘small sample size of cases’”. He explained that any case study attempting to use “sampling logic” is unsuitable as the purpose of case study is not to investigate the popularity of the phenomenon. Moreover, the use of case study implies comprehensive investigation to the specific phenomenon considering its context; which is impossible if the researcher would apply the statistical logic.

Therefore, statistical generalization is suitable for survey research while analytical generalization is more applicable for case studies as the

researcher attempts to generalize the findings to some broader theory (Riege, 2003; Yin, 2003). Without doubt, the strongest point of any multiple case studies is positioned in its replication logic (Riege, 2003). In this regard, Yin (2003) stated that:

The generalization is not automatic ... A theory must be tested by replicating the findings in a second or even a third neighborhood, where the theory has specified that the same results should occur. Once such direct replications have been made, the results might be accepted as providing strong support for the theory, even though further replications had not been performed.

The findings of each selected case identify the pattern of the replication. In fact, Yin (2003) differentiates between literal and theoretical replication. He explained that each case is selected to either seek similar findings to the other case (a literal replication) or a different pattern of findings “but for predictable reasons (a theoretical replication)”. Nevertheless, although applying the replication logic in multiple case studies is a common method of enhancing the validity of a case study (Riege, 2003), it is important for the researchers to identify the scope and boundaries of the case to attain sensible analytical generalization (Marshall and Rossman, 2006).

This case study attempts to execute the theoretical replication to enable the author to extract meaningful findings that can be analytically generalized. The analytic generalization is worthwhile, at least within the

context of the food industry in Saudi Arabia, which represents the boundary of the study. As this study focuses on handling QM from a strategic point of view, the attempt is to show that resources allocated for quality strategies in the two selected companies are mobilized differently because the strategic situation for each company/case is different. This means that once the second case's findings show a different pattern of results compared to the first case, the generalization can then be analytically executed; and theoretically, if a third case was involved, its own strategic position would provide a different form of resource allocation. Thus, it can be said then that resources are mobilized differently as each company has its own strategic objective for quality. This may justifies why quality gurus still compare 'soft' TQM elements with 'hard' elements in term of their effect on the performance, and still no unique model for TQM is accepted. It can then also be said that handling QM as SQM rather than TQM contributes to the field of QM as considering the strategic dimension adds reasonable explanations to the current issue of QM.

4.5 Reliability

A case study's reliability can support the research using different methods. Developing protocol for the case study is one of these methods, and it is preferred that any research has a protocol. Developing a protocol for a case study is important especially if the study includes multiple cases (Yin, 2003). Yin explained that as the protocol includes the tools, mechanism, and step-by-step methodology required to implement the case study, it is the main approach to strengthen the reliability of the case study and represent how the required data has been collected (Yin, 2003). Protocol aims to guarantee that if a researcher attempts to conduct the same

research (case), he or she will achieve same results (Riege, 2003; Yin, 2003). Yin added that this “is to minimize the errors and biases in a study”. In this regard, a protocol for this case study research has been developed and summarized in in Appendix (D).

Reliability of the case study can be further strengthened by employing more than one source of data. In fact, a case study can be fed through many sources of evidence such as documents, archival data, interviews, surveys, observations, and physical artifacts (Tellis, 1997; Yin, 2003; Cresswell, 2007). Yin added that using more than one source of evidence is the key element in the phase of data collection for a case study. Flick (1992) and Peräkylä (2002) reported that using multiple sources of data protect the study from having bias findings. Yin (2003) in turn illustrated that the main benefit of using more than one source of evidence is to maintain the efforts of investigation, or what is commonly known as *triangulation*. Triangulation is considered a tool for enhancing the quality of the research (Lincoln and Guba, 1985). In fact, according to Patton (1987), triangulation may have different forms:

1. Data triangulation,
2. Investigator triangulation,
3. Theory triangulation, and
4. Methodological triangulation.

In this regard, two sources of data were involved in this thesis. First, quantitative data was generated through participants from each company who were involved in a questionnaire that was developed to execute the

ANP (the first step of the quantitative phase). Secondly, semi-structured interviews were conducted with participants from each company to collect the qualitative data for the qualitative phase of this case study research. Noticeably, 'data triangulation' as well as 'methodological triangulation' is used.

In addition, reliability can also be increased by showing the chain of evidence (Hirschman, 1986). Yin (2003) illustrated that this can be done by continuously presenting the "chain of evidence" to the reader by facilitating the linkage between these evidences to the study's research questions. Accordingly, the analysis of quantitative and the qualitative data is presented in the following chapters to show how research questions were answered and to carry out convenience conclusions. Moreover, the reliability of the case study can be supported if the researcher paid the required attention to build a database for the 'case study'. Yin (2003) explained that this can be done through the collection of "notes, documents, tabular materials, and narratives". Thus, during the two phases (trips) of data collection (quantitative and qualitative), notes relating to the investigated companies/cases were combined and documents relating to the history of each company were collected. Additionally, the author was a management trainee in both companies during 2001 and 2002, which facilitated data collection and enhanced reliability.

4.6 Employing Mixed Methods

Case study as a research design, and as described above, requires employing more than one source of data, which makes it appropriate for this case study research to execute mixed methods. Indeed, “case studies can be based on any mix of quantitative and qualitative evidence” (Yin, 2003). In fact, mixed-method research can be defined as a methodology that deals with theoretical suppositions as well as ways/processes of investigation to steer the route of gathering and analyzing data by blending qualitative and quantitative techniques in various stages of the study to carry out a better study of the issue compared with the use of a single methodology only (Creswell and Clark, 2007). Creswell and Clark added that mixing quantitative and qualitative methods positively influences the study and is better than employing one type of method alone. Mixing two methods imposes the potencies of each type to cover the limitations of the other type. For instance, they explained that employing mixed methods facilitates, answers to research questions that cannot be answered by one method alone. They also clarified that mixing quantitative and qualitative research methods is realistic, as people generally like to resolve issues using “both numbers and words”. Hence, this research attempts to follow the approach of mixed-method strategy,

Mixing quantitative and qualitative methods can be executed in many ways. Morse (1991) classified mixed-method research into four types. Firstly, Morse identified two general types: simultaneous triangulation and sequential triangulation. For each type of triangulation, there are two forms. For simultaneous triangulation, qualitative and the quantitative processes are executed at the same time considering two forms where either either the quantitative or the qualitative process is dominant over

the other (QUAN + qual, or QUAL + quan). For the sequential triangulation, the research might be mainly qualitative followed by the quantitative phase to further examine certain qualitative findings (QUAL→ quan). In contrast, the second sequential form is when the research is principally quantitative and the qualitative aspects are employed as a second phase to obtain more understanding for the quantitative results (QUAN→qual). Similar classification has been suggested by Tashakkori and Teddlie (1998), with slight additions. Tashakkori and Teddlie added another dimension, where quantitative and qualitative both share the same dominance whether they are employed in a research sequentially or parallel (simultaneously) (Quan + Qual, Qual→ Quan, and Quan→ Qual). Moreover, they proposed the multi-level approach, where inputs come from different levels of firms or different groups of participants to achieve a full understanding of certain phenomenon. In fact, numerous methodologists from different disciplines have paid significant attention to the issue of classifying mixed-method research design (Greene et al., 1989; Patton, 1990; Morse, 1991; Steckler et al., 1992; Greene and Caracelli, 1997; Morgan, 1998; Tashakkori and Teddlie, 1998; Creswell, 1999; Sandelowski, 2000; Creswell et al., 2003; Tashakkori and Teddlie, 2003; Creswell et al., 2004).

Although there are many classifications of mixed-method research design, similarities exist between them. Recently, Creswell and Clark (2007) attempted to review all previous attempts of classifying mixed method designs and ended up with four major types: Triangulation, Embedded, Explanatory, and Exploratory. In this case study, an explanatory mixed method approach is used as the quantitative phase is followed by the qualitative phase. They describe 'explanatory' as "a two-phase mixed-methods design". The main objective of such a design is to enable

quantitative findings to be explained or extended by involving qualitative data in the second phase of research (Creswell et al., 2003). Furthermore, Creswell and Clark (2007) also illustrated that an explanation can be executed in two forms: the follow-up model or the participant selection model. The latter model is used when the investigator emphasizes qualitative results rather than quantitative results. In contrast, the “follow-up” model is used when the focus of the study is on quantitative findings and participants for the second phase are selected on the bases of the quantitative results. Accordingly, in this explanatory mixed-method approach, the ‘follow-up’ model is employed as the case study here is mainly concentrated on the quantitative findings. Two quantitative techniques are involved in this thesis (ANP and GP) while the qualitative phase is conducted using one technique (semi-structured interview).

Additionally, in regards to the analysis, Creswell and Clark (2007) illustrated that findings of mixed-methods can be analyzed either concurrently or sequentially; however, for the explanatory design, the applicable mode of analysis is the sequential one. They reported that the aim of such an analysis is to use the first phase of analysis (quantitative in this case) to direct the second phase (qualitative in this research). They stated that:

The problem can best be understood by using qualitative data to enrich and explain the quantitative results in the words of participants ... quantitative results need further interpretation as to what they mean or when more detailed views of selected participants can help to explain the quantitative results. A mixed methods design is thus the preferred design.

Firstly, the analysis was conducted on the quantitative data that was collected by the questionnaire developed for the ANP step. The analysis of the ANP model answered the first four research questions. The findings of the ANP analysis were then utilized to formulate the GP model, which was the second step of the quantitative phase. After the analysis of all quantitative aspects, the qualitative data was gathered separately (2 separate trips). Then, all recorded interviews were analyzed and presented in Chapter 7 to explain the quantitative results. Figure (4.1) summarizes the case study design of this research.

4.7 Summary

This chapter explained the vital elements of conducting a case study. It illustrates how the case study developed considers these elements to produce well-structured research. The notion of 'theory' is explained from the perspective of how it applies within a case study. Consequently, it has shown how this case study attempts to obtain a reasonable understanding of the theory of QM, in a way that contributes to the field of QM. It is also concluded that employing two cases adds strength to the research. Accordingly, a comparative analysis was conducted for two different companies/cases. This point is important as the objective of the case study is to seek analytical, not statistical generalization. Hence, conducting the 'analytic generalization' is explained through the concept of 'replication logic' by which the analysis of the selected cases generates convenience findings. Nevertheless, any case study should employ more than one source of data. Therefore, in this case study, quantitative methods (ANP and GP) as well as the qualitative method (semi-structured interview) is executed, as mixed-method design is critical for the success of any case study.

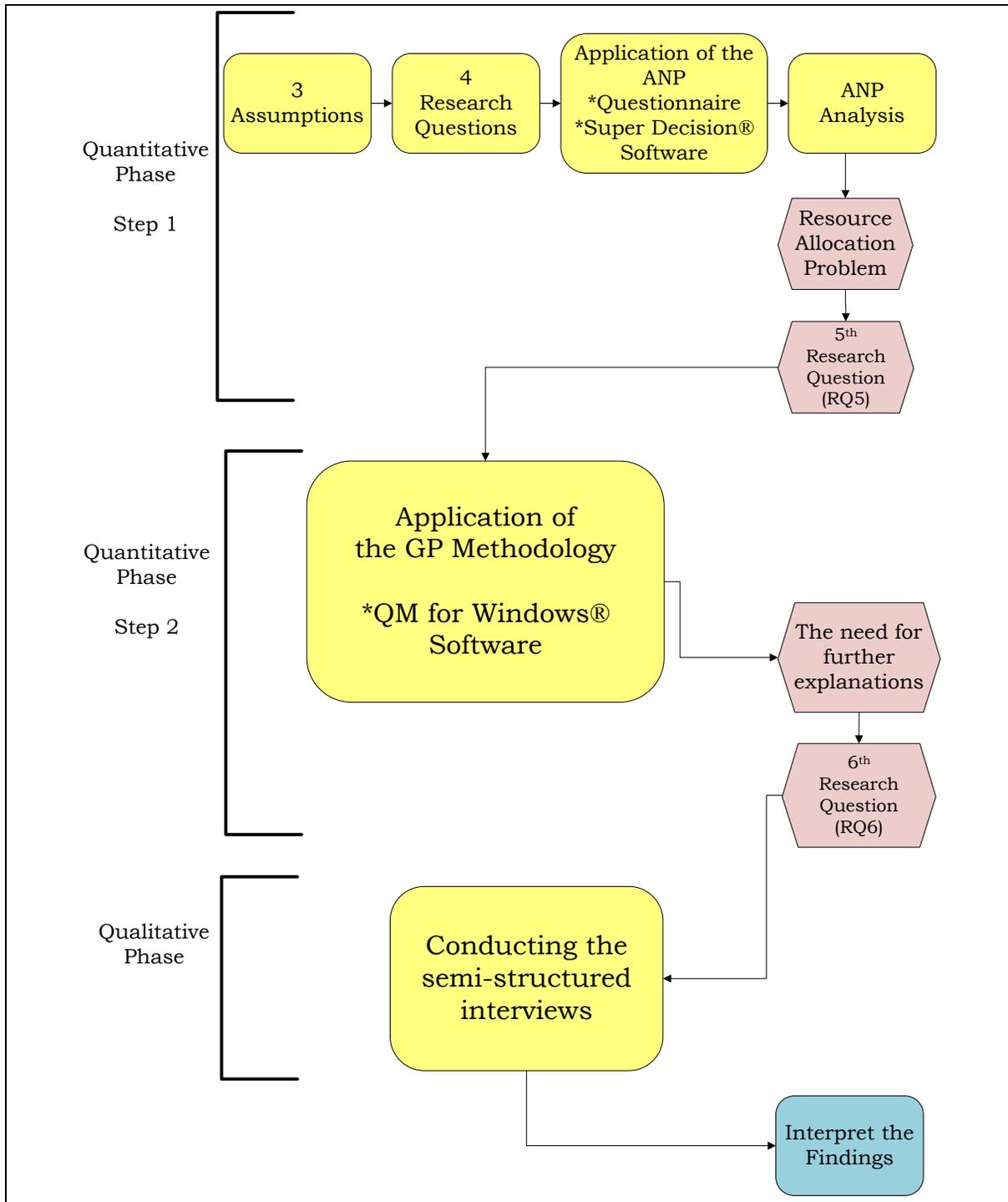


Figure (4.1): The Mixed Method Design of the Case Study in this Research

Chapter 5

Data Collection

5.1 Introduction

The objective of this chapter is to provide further details regarding how the quantitative and qualitative data have been collected. This chapter starts by discussing the selected sampling strategy for this case study, and presenting some explanations and justifications of the sampling, in both quantitative and qualitative phases. This chapter then illustrates how the selected experts (participants) were involved in the two phases of the research. Moreover, as the two selected companies are Saudi Arabian companies, the significance of TQM practices in Saudi Arabia is highlighted. Additionally, the food industry in Saudi Arabia is overviewed as it represents the boundaries within which the two companies/cases have been selected. Finally, the two selected companies are introduced, with a focus on their ability to practice QM and compete with international companies in producing high quality products.

5.2 Sampling for the ANP Step

In regard to sampling, a total of 12 experts are involved in this study - six from each company/case. In the quantitative phase, three experts from the Quality Department of each company are involved while in the qualitative

phase all 12 experts are involved. It is appropriate here to justify employing a small sample size in this case study, particularly for the quantitative phase. Certainly, employing ANP and GP in the quantitative phase reveals that the concept of *operations research* is supposed to be briefly presented. In fact, the focus of *operations research* techniques such as AHP/ANP and GP are usually on how to make a decision within complex situations. Hence, ANP and GP are not traditional quantitative methods; instead, they are an *operational research* method in which statistical sampling is not the issue in all circumstances. To illustrate, *operations research* is considered as a quantitative technique by Morse (2007), who defined *operations research* as “a scientific method of providing executive departments with a quantitative basis for decisions regarding the operations under their control”. However, *operations research* methods such as AHP/ANP do not involve large samples. Indeed, seeking a large number of participants is not a necessity in AHP (Lam and Zhao, 1998) as it is a technique in which the analytical manner of sampling is targeted, rather than statistical one (Herath, 2004; Sambasivan and Fei, 2008).

This sample adequacy issue has been investigated by Wong et al. (2008) through reviewing many applications of AHP/ANP, especially the work of Cheng and Li (2002), and they concluded that:

In fact, both AHP and ANP are subjective methods that focus on specific issue where a large sample is not mandatory... First, both AHP and ANP approaches may be impractical for a survey with a large sample size as ‘cold-called’ respondents may have a great tendency to provide arbitrary answers, resulting in a very high degree of

inconsistency ... Second, survey with small sample has been conducted in previous AHP and ANP research

Indeed, many, if not most, ANP applications have been conducted with a small group of experts. For example, the works of Cheng and Li (2002) and Lam and Zhao (1998) were conducted by involving nine and eight experts, respectively. Cheng et al. (2005) limited the participation in their ANP questionnaire to the limited members of top management. In the same way, only three experts were involved in Coulter and Sarkis (2005)'s application of ANP. Therefore, many AHP studies have been conducted with a small sample size (Cheng and Li, 2001; Mawapanga and Debertin, 1996; Peterson et al., 1994) [Note that AHP is a special case of ANP; see Chapter 3]. Additionally, Shrestha et al. (2004) said that this is applicable as long as participants are experts in the field of the study. Specifically, in regard to the ANP, a significant amount of research has been carried out recently by limiting the participants to a small number of experts (Wong et al., 2008; Jharkharia and Shankar, 2007; Cheng and Li, 2007; Wolfslehner et al., 2005; Coulter and Sarkis, 2005; Cheng et al., 2005).

The resulted ANP analysis was used to feed the second step of the quantitative phase, GP. So GP's inputs are resulted from the outputs of the ANP. Note that GP is also a well known *operations research* method (Schniederjans, 1995) and its applications are commonly used in case studies (Shiong et al., 2008). As GP is a mathematical programming technique that is used widely as a MCDM tool (see chapter 3) and commonly used as an analytic tool (Bertolini and Bevilacqua, 2006) in which ANP's outputs are used as inputs for GP, sampling is not applicable for the GP step.

5.3 Sampling Strategy

In this case study, purposeful sampling is used. Creswell (2008) differentiates between two general types of sampling: *random* and *purposeful* sampling. In quantitative research that aims to generalize findings for the whole population, random sampling is suitable as it attempts to seek statistical generalization through the selected individuals. However, in purposeful sampling, investigators deliberately choose participants and decide on places/fields by which a certain phenomenon can be studied and comprehended. Tashakkori and Teddlie (1998) defined purposeful sampling as choosing a participant or a group of participants according to particular inquiries or particular objectives of the study, as well as according to the information related to those people rather than selecting them randomly. As the attempt here is to develop a case study, one of the objectives is to seek analytic generalization which is suitable for purposeful sampling. Additionally, Creswell (2008) reported that using purposeful sampling implies that the strategy of this sampling should be explained, as many strategies are available in the literature (Patton, 1990; Miles and Huberman, 1994).

One of the purposeful sampling strategies is *maximal variation sampling*. Creswell (2008) explained that in maximal variation sampling strategy, participants or places/fields are sampled according to their different characters or attributes. From this point of view, maximal variation sampling strategy is used to execute the purposeful sampling for this case study research. Three experts from the managerial level of the Quality Department from each company filled out questionnaires that were developed for the ANP stage. Maximal variation sampling is applicable as each participant has their own role within the Quality Department at each

company. Moreover, experts are selected from two different managerial levels in both companies. This sort of diversity generates different perspectives and supports the employment of the maximal variation sampling.

Although purposeful sampling is classified as qualitative (Tashakkori and Teddlie, 1998; Creswell, 2008) in the sense that the sample is small compared to the traditional quantitative sampling strategies, it is employed in both quantitative and qualitative phases. Undoubtedly, this type of sampling is used in this research within the context of the case study, as the goal is to achieve analytic, not statistical generalization. Moreover, the case study itself, as a special type of inquiry, is generally considered as a qualitative method (Cresswell, 2007). It is also important to note that ANP, as a quantitative technique, does not require a large sample (as also described above).

5.4 Data Collection and Involvement of Participants

5.4.1 Quantitative Phase

The three experts selected from each company filled out questionnaires that were developed for the ANP stage. Participants were asked to respond through a sequence of specific pair-wise comparisons, which were presented to the participants as a questionnaire together with a set of instructions on how to conduct the comparisons based on their own experience. The questionnaires were designed to cover the aspects of the first four research questions. Parts (1) and (2 -A) were designed to answer the first and the second research questions respectively, while Part (2 - B)

addressed the third and the fourth research questions. A sample of the questionnaire is presented in Appendix (B).

Various software is available which can be used for modelling and analyzing ANP applications such as Ecnet, Maple, and Super Decisions®, (Gencer and Gürpınar, 2007). In fact, Dr Thomas L. Saaty, the developer of ANP, reported that the ANP team (working for the Creative Decisions Foundation) wrote the program that was used to develop The Super Decisions software (Erdogmus et al., 2005). Gencer and Gürpınar (2007) stated that “Generally, managers might be inclined not to use a sophisticated method, but by using a user friendly software like super decision, developed by Saaty, the decision making process by using ANP will be handled more easy”. Additionally, the software is capable to detect/calculate the consistency ration for each pairwise comparison of the ANP model (Erdogmus et al., 2005, Köne and Büke, 2007). Therefore, many ANP studies were conducted using Super Decisions such as (Erdogmus et al., 2005, Ulutas, 2005, Erdogmus et al., 2006, Gencer and Gürpınar, 2007, Köne and Büke, 2007, Wu, 2008).

Super Decisions® the commercially available software developed for AHP and ANP by Saaty (Creative Decision Foundation, 2006), was used to build the ANP model. The software has the capability to determine the *consistency ratio* (CR), which is the “degree to which the pair-wise comparisons are consistent” (Hsu et al., 2009). Saaty (1994) stated that for pair-wise comparisons between three elements (as in RQ2), the CR should be less than 5%; while for pair-wise comparisons between more than four elements (as in RQ3 and RQ4), the CR should be less than 10%. A

discussion about the CR was carried out with participants to inform them that their judgments in each pair-wise comparison should be consistent “otherwise, all or some of the comparisons must be repeated in order to resolve the inconsistencies” (Kangas et al., 2008).

The findings obtained from each participant were aggregated to represent each company’s data. For example, the three experts’ results for company A were averaged to represent Company A’s overall finding. According to Mardele et al. (2004) and Forman and Peniwati (1998), individuals’ opinions should be represented by *aggregating individual judgments* (AIJ) or by *aggregating individual priorities* (AIP). Forman and Peniwati (1998) explained that, in AIJ, the assumption is that individuals are combined and “behave like one” to represent the opinion of the company while in AIP “individuals are each acting in his or her own right”. In this research, it is believed that AIP is more suitable as participants were selected from different managerial levels and operational perspectives within the Quality Department and their perspectives are supposed to be varied. As argued by Mardele et al. (2004) when they used AIP in their work that, in some fields, “individuals’ opinions are typically distinct and widely varying”.

5.4.2 Qualitative Phase

Regarding the qualitative phase, the use of maximal variation sampling together with the explanatory nature of the mixed methods in this research implies using the same participants as well as adding more. To illustrate, Creswell and Clark (2007) stated that:

... in an explanatory design, ... the same individuals should be included in both data collections. The intent of these designs is to use qualitative data to provide more detail about the quantitative results and to select participant that can best provide the detail.

Therefore, the original three experts from each company have also been included in the qualitative data collection phase. For the same reason (i.e. obtaining more explaining), as well as to strengthen the use of maximal variation sampling strategy in this research, another three experts from three different departments were added to the study in the qualitative phase. The three departments involved from both companies were related to quality issues. They were Human Resource Management (HRM), Information Technology (IT), and Supply Chain departments.

Qualitative data was collected through semi-structured interviews with the 12 participants (six from each company) including both prepared and unprepared questions. The main objective of this phase is to explain ‘why’ each single strategy may receive resources, regardless of whether it is more or less than what should be allocated (RQ6). For the prepared questions, participants were asked to identify to what extent each strategy is efficient in resource utilization (using scale from 0 to 10) and why. Rather than concentrating on the first part of the question, the focus was on the second part, (i.e. why). Similarly the second question was to rank the three types of resources with respect to each strategy and explain why. The third question was regarding the future directions for each strategy and why these directions will be the focus. All questions sought explanations, which is supported by the use of “why” in all three interviews questions. The attempt of the unprepared questions is also to attain the same objective

(RQ6). In other words, unprepared questions were utilized whenever the investigator (i.e. the author) felt that more explanation was required from the interviewee during the interview. Interview questions are presented in Appendix (C). Table (5.1) and (5.2) show some characteristics of the experts who were participated in this case study for company A and B respectively.

Table (5.1): Experts Participants from Company A

Company A					
	Acronym	Position	Qualification	Years of Experience	Participation in this Research
Participant 1	QM1-A	Quality and Safety Manager	Bachelor of Engineering	24	<ul style="list-style-type: none"> Quantitative (ANP Survey) Qualitative Interview
Participant 2	QM2-A	Quality Assurance Manager	Bachelor of Chemistry Master of Science (Environmental Studies)	12	<ul style="list-style-type: none"> Quantitative (ANP Survey) Qualitative Interview
Participant 3	QM3-A	Quality Control Manager	Bachelor of Chemistry	12	<ul style="list-style-type: none"> Quantitative (ANP Survey) Qualitative Interview
Participant 4	HRM-A	Human Resource Manager	Bachelor of Business (Human Resources)	13	<ul style="list-style-type: none"> Qualitative Interview Only
Participant 5	ITM-A	Information Technology (IT) Manager	Bachelor of Computer Engineering	9	<ul style="list-style-type: none"> Qualitative Interview Only
Participant 6	SCM-A	Finished Goods and Supply Chain Manager	Bachelor of Industrial Engineering	9	<ul style="list-style-type: none"> Qualitative Interview Only

Table (5.2): Experts Participants from Company B

Company B					
	Acronym	Position	Qualification	Years of Experience	Participation in this Research
Participant 1	QM1-B	Head of Quality Department	Bachelor of Science (Chemistry)	35 (30 years in Company B)	<ul style="list-style-type: none"> Quantitative (ANP Survey) Qualitative Interview
Participant 2	QM2-B	Quality Control and Product Development Manager	Bachelor of Chemistry Master of Chemistry	25	<ul style="list-style-type: none"> Quantitative (ANP Survey) Qualitative Interview
Participant 3	QM3-B	Supervisor, Quality Assurance and Product Development	Bachelor of Science	17 (15 in Company B)	<ul style="list-style-type: none"> Quantitative (ANP Survey) Qualitative Interview
Participant 4	HRM-B	Department Manager- Human Development and Training	Bachelor of Business Administration Advance Human Resources Courses	10	<ul style="list-style-type: none"> Qualitative Interview Only
Participant 5	ITM-B	Information Technology (IT) Manager	Bachelor of IT Diploma in Systems	26 (12 years in Company B).	<ul style="list-style-type: none"> Qualitative Interview Only
Participant 6	SCM-B	Demand & Logistic Manager	Bachelor of Science	20 years	<ul style="list-style-type: none"> Qualitative Interview Only

5.5 The Selected Cases/Companies

5.5.1 TQM in Saudi Arabia

Saudi Arabia is the main exporter of the oil in the world and “one of the top non-OECD (Organization for Economic Co-operation and Development) economies” (Magd et al., 2003). The current progress of globalization and worldwide trading enhances the expansion of the international market, which provides a better environment for healthy rivalry in offering high quality products/services with reasonable prices (Alsaleh, 2007). In fact, in 2005 Saudi Arabia became a member of the World Trade Organization (WTO) (MCI, 2005). Accordingly, Saudi Arabia released its rules for a free-market that enables international companies to meet the demand of Saudi Arabian consumers (Magd et al., 2003). In Saudi Arabia, the consequences of becoming a WTO member and the existence of strong competition between companies, adds significant pressure to local companies (Alsaleh, 2007). Alsaleh explained that the existence of superior quality products coming from all around the world will force the Saudi industries to enhance their manufacturing standards to achieve customer satisfaction. Indeed, Magd et al. (2003) reported that competitive products coming from the US and Japan encourage the Saudi manufacturing companies to apply and execute ISO 9000.

Generally, Saudi companies are aware of the latest quality practices. In fact, quality concepts and applications in Saudi Arabia have matured as Saudi industry expansion has progressively improved in the last few years. However, the challenge is that quality concepts and applications have improved faster than the manufacturing industry (Al-Harkan, 2007). Thus, Al-Harkan stated that due to this sort of challenge, the focus should be on

evaluating TQM applications in Saudi companies. Curry and Kadasah (2002) believe that Saudi Arabia is an appropriate country in which to investigate TQM issues for two reasons. First, compared to the industrialized countries, Saudi Arabia is less developed and its challenges are definitely different. Second, there is a noticeable lack of inclusive (local) studies for assessing quality management movement.

5.5.2 Food Industry in Saudi Arabia

The Saudi food industry appears to be one of the most significantly is affected by worldwide competition. The Saudi Factories Directory's figures in 2003 report that this industry represented 16 % of the whole Saudi industrial segment (Alsaleh, 2007). Alsaleh stated that the steady increase of imported food implies that the Saudi food industry is competing with overseas companies and that should enhance quality standards in local companies. According to the Saudi Ministry of Economy and Planning, the volume of Saudi Arabia's imports of foodstuffs were SAR 35.5 billion, 44.8 and 62.2 in 2006, 2007, and 2008 respectively. For 2008, foodstuffs represented 14.4% of all imports, which makes them the fourth largest import category overall (SAMA, 2009). Moreover, the same report recorded a growth in exports which reveals that Saudi food companies succeeded in producing to international quality standards. Considering the fact that Saudi Arabia is a non-agricultural country, the food industry is dependent on the processes of refining and packaging imported raw foods from other countries (Alsaleh, 2007). As the quality of the food industry is a critical issue for human health (Kidd, 2000; Fearne and Lavelle, 1996; Ho and Cho, 1995; Alsaleh, 2007), many Saudi food manufacturing companies have practiced quality concepts, believing that these concepts should support their products against overseas imports.

5.5.3 Company A

Company A was founded in Jeddah in 1998. Its factory is strategically situated close to the Jeddah Islamic Sea Port, which facilitates the import of raw foods and the export finished goods. Recent expansion in the company's factory enabled the company to double its production capacity. The company has one of the world's five largest factories for that commodity. Currently, company A holds about 90% of the market share for the commodity in which it is involved. One of the essential responsibilities of the company is to pay attention to and exceed customers' requirements; therefore the company creates a range of different packaging sizes in response to market demand. Senior management believes that the company's responsibility is to constantly supply high quality products with reasonable prices. In addition, one of the company's long term plans is to supply high quality products to international markets. Currently, the company is exporting to Jordan, all Gulf countries, Eastern Africa, and some Asian countries. This has been achieved through the recent expansion of the company's factory in Jeddah.

Company A's training program is regarded as one of the most systematic and comprehensive in Saudi Arabia. The company won awards from the Saudi HR development fund for excellence in training. The company's sophisticated capability programs, by which human resources are evaluated and trained, considers business and personal requirements. The company encourages staff to be leaders and to work in a teamwork environment through awards such as 'Employee of the Month' and 'Team of the Quarter'. Saudization, a national policy of employing a local workforce, is applied in this company and Saudi employees make up almost 60% of the workforce. The company is also willing to increase this

number by 5% annually. The company aims to build an environment where knowledge can be transferred from non-Saudi employees to the nationals. Senior management therefore prefers to limit the appointment of overseas experts to a handful of critical positions only.

At the beginning of each year, all employees are engaged to help shape SMART objectives for each business unit. As these objectives have to be met at the end of the financial year, SMARTs are documented daily and reviewed weekly to monitor progress. One of the aspects that company A has recently paid significant attention to is innovation. The company aims to meet ever-changing customer requirements by launching what's known as *The Innovation Initiatives*. These initiatives are developed by forming different teams across various business units to share ideas that will feed innovation initiatives. For example, as the company concentrates on product development, much consideration has been given to product-related innovation. This has resulted in the recent launch of four different brands with multiple sizes to meet the market needs. In addition, advanced packaging technologies are used to facilitate the creation of innovative forms of packaging.

In Company A, priority is always given to customer satisfaction. Customers, whether retailers or factories, are generally satisfied with the company, as they experience high quality products, as well as services provided to them after sales. Company A utilizes the technologies and software, which means customers are satisfied with the availability of highly developed and computerized functions, including order processing, customer accounts, and dispatch. Moreover, the central aspect behind the

company's success is the integration between the company's business and the associated practices that use up-to-date, advanced information technology (IT). The company's IT service provider is the first IT company in Saudi Arabia to be certified by ISO 9001:2000. Company A's factories are run using advanced software applications. Well known systems such as Oracle, ORSI, and Maximo are employed to support the company's Enterprise Resources Planning (ERP), Supply Chain Management (SCM), Automation Process and Maintenance Management.

5.5.4 Company B

Company B was founded in 1979 in Jeddah, the main port and the second largest city in Saudi Arabia. In 1982, the company launched its first brand, which received massive support in its initial period with aggressive marketing, promotion, pricing and delivery actions. This facilitated the company's brand to become a leader in the local market. In 1996, the company started to build (or buy) its own factories in international markets. Company B is the highest producer in the world of the type of branded commodities that it produces, with an yearly income of approximately SAR 1.5 billion. The company holds almost 70% of the Saudi market for this commodity. Moreover, the company's brands are the market leaders in most Middle East countries, including Egypt, Turkey and Iran. The company's brands also hold a significant share in the rising markets of Morocco, Sudan, and Kazakhstan. The is company now looking for new markets in countries with positive growth potential, including Indonesia, Pakistan, and India.

The company offers a range of resources and training programs to facilitate the achievement of goals through the involvement of all employees. As training is one of the managerial tools that provide the required knowledge and skills to the human resources, it is a vital dimension in company's human resources strategy. In this sense, the company aims to ensure that training is provided in a way that guarantees the attainment of the company's objectives. Generally, and especially when compared to other Saudi companies, the company is entirely committed to investing in its human resources and improving their capacity to achieve individual and organizational success. The company offers an environment that enables people from all managerial levels to share their opinions on how the company's objectives can be met through human assets and this is clearly reflected in the company's recruitment policy. The company believes that quality recruitment and selection processes endorse accurate hiring decisions that can lead to the success of the company. The recruitment and selection process considers a blend of educational background, work experience, and innovation capabilities in order to maximize the quality and dependability of the employees.

Company B has well established quality and food safety guidelines that aim for continuous improvement and an effective quality management system. This in turn guarantees the company will offer products and services that meet consumers' expectations. The company's products are constantly reviewed with regard to relevant requirements and the highest standards of food safety. They are produced under strict rules of hygiene and managed according to the implemented ISO9001-2000, HACCP, and BRC systems. Precise specifications are applied for the company's products, as they already follow the principles of the Saudi Arabian

Standards Organization (SASO). Quality goals have always been evaluated on an ongoing bases and with a focus on satisfying the company's customers, continuous improvement processes, human resource aspects, building teamwork, launching new products, and strategic thinking. The company, and specifically senior management, is aware of the extraordinary or exceptional circumstances that are created and the many strategic options that are driven by company's risk management policy. Therefore, the selection of suppliers is in accordance with their aptitude to meet the company's standards. Moreover, rather than activating Corporate Social Responsibility (CSR) activities that strengthen friendliness and kindness, the company believes that CSR requires strategic business planning. Thus, the company tries to keep its social responsibilities authentic and focused on constructing significant and influential relationships with the community.

5.5.5 Comparing the Selected Companies

The two companies were selected from the Saudi food industry for the case study research. As company A was founded in 1998, the company's products were newer than those of thier competitors. Therefore, company A faced strong competition from competitors, who were actually importers for the same types of products. As company A is the only national producer for these products, the government set tariffs for importers to assist the company and protect it from its competitors. This helps the company to hold about 90% market share. However, this is not the case in company B, which has been a leader in its field since it was established in 1979. Company A sells to the end consumer through retailers and to various factories within the food industry, while Company B mainly sells to

the retailers. To demonstrate their ability to consistently provide products that meet their customer requirements, both companies hold:

- The seal of quality (Quality Mark) from SASO in 1998 and 1985 respectively.
- The ISO 9001:2000 certificate in 1999 and 1994 respectively.
- The Hazard Analysis and Critical Control Point (HACCP) certification and an upgrade of their food safety management system to meet the requirement of ISO 22000 in 2006 and 2005 respectively.

In addition, Company B was awarded the MRP II certification in 1998, the Occupational Health and Safety Standards (OHSAS) in 2007, and the British Retail Consortium (BRC) global standard certification for food and safety in 2008. Company A is still developing its environmental management system and safety management system against ISO 14001 and OHSAS 18001 respectively. The two cases were selected and investigated to show how the interaction between strategies and their allocated resources differs due to the nature of the business, product and history of each company.

5.6 Summary

All issues related to data collection are explained in this chapter. Firstly, in regard to the sampling for the first quantitative step (ANP), it is illustrated, with the support of the literature of the AHP/ANP, that such a technique does not need a large sample size to be employed. Rather, only experts usually participate in such a technique. Conducting this research as a case study also justifies the use of qualitative sampling (small sample size).

From this point of view, it is found that purposeful sampling is the most appropriate type of qualitative sampling for this case study. In particular, maximal variation sampling is conducted as a type of purposeful sampling. This chapter shows how the selected experts are different in terms of their roles and experiences; and how this variation justifies the use of maximal variation sampling in both quantitative (ANP) and qualitative (semi-structural interview) phases. This chapter also shows that the selected companies are similar in terms of the boundaries from within which they are selected (Saudi Arabian food industry), and also shows some differences, which facilitate conducting the comparative study with expected reasonable findings.

Chapter 6

Quantitative Analysis

6.1 Introduction

This chapter presents the quantitative phase of this case study research. Specifically, the objective of this chapter is to present the finding of the quantitative phase, which includes the two vital steps: ANP analysis, and GP analysis. For the purpose of executing the ANP step, the required data are collected during the author's first visit to the two companies in Saudi Arabia. As discussed in Chapter 5, three experts from each company are involved in the ANP questionnaires. Firstly, company A's findings from the ANP step are analyzed to address the first four research questions. This includes presenting the results and demonstrating the need for employing the GP methodology as a second step within the quantitative phase. In particular, the issue of resource allocation is explained through RQ5. The formulation of the GP model is described with explanations and discussion of the developed tables and figures. The GP step concludes with the development of what is proposed here in this research as a Strategic Quality Management Index (SQMI). Following a full discussion and analysis of Company A's results (for ANP and GP steps) the same procedures are then applied for Company B and presented separately.

6.2 Company A

6.2.1 Results of the ANP Analysis

6.2.1.1 RQ1 and RQ2 for Company A

After obtaining the input from each participant using ‘Super-Decision’, aggregation was simply determined using Microsoft Excel. Results pertaining to the first four research questions are presented in Tables (6.1) through (6.6). Specifically, Table (6.1) and (6.2) answer the first two research questions. Table (6.3) is developed to combine the results of the RQ1 and RQ2 as ANP is capable of providing overall “weights” for HR, OR, and TR considering their overall relative contributions as described in RQ1 and RQ2. Table (6.1) shows that both HR and OR (*i.e.* soft TQM) are weakly influenced by TR (*i.e.* hard TQM). To illustrate, the relative contribution of TR is 26% for HR, while OR contributes 74% to HR. Similarly, TR contributes 28% to OR while the relative contribution made by HR for OR is 72%. It is also found that HR contributes significantly (76%) to TR compared to the contribution of OR (24%).

In general, these results confirm that quality in company A is strategically driven more by HR and OR (soft TQM), than TR (hard TQM). Indeed, the overall contribution of resources, as shown in Table (6.3), confirms this situation and specifically shows that HR has the highest contribution (41%) followed by OR (38%). In regard to TR, as shown in Table (6.3), the overall contribution is 21%. These percentages (Table (6.3)) are obtained [using ANP] from answering RQ1, which identifies resources contributions among themselves (Table (6.1)); as well as from answering RQ2, which determines relatively the needed resources for each strategy (Table (6.2)).

Consequently, Table (6.3) represents the overall ranking of resources with respect to the needs of the eight strategies collectively, considering resources contributions among themselves. **Accordingly, these percentages are considered to represent the overall available resources for company A.**

Table (6.2) provides further details. It shows that the relative contribution of HR (the needed HR compared to other resources) for the strategy of MQS, CHF, ATT, PQA, TCF, UHK, QIM, and CQC is 33%, 21%, 44%, 30%, 39%, 25%, 26%, and 36% respectively. It can also be seen in Table (6.2) that the relative contribution of OR for the strategy of MQS, CHF, ATT, PQA, TCF, UHK, QIM, and CQC is 35%, 47%, 15%, 45%, 44%, 27%, 30%, and 31% respectively. Regarding TR, its relative contribution to MQS, CHF, ATT, PQA, TCF, UHK, QIM, and CQC is 32%, 32%, 41%, 25%, 17%, 48%, 44%, and 33% respectively as shown in Table (6.2).

Table (6.1): Relative contributions of each pair of resources to support the third type of resource (RQ1)

	HR	OR	TR
HR	-	72.0%	76.0%
OR	74.0%	-	24.0%
TR	26.0%	28.0%	-
Total	100%	100%	100%

Table (6.2): Relative contribution of resources needed to ensure successful strategy implementation (RQ2)

	1	2	3	4	5	6	7	8
	MQS	CHF	ATT	PQA	TCF	UHK	QIM	CQC
HR	33.0%	21.0%	44.0%	30.0%	39.0%	25.0%	26.0%	36.0%
OR	35.0%	47.0%	15.0%	45.0%	44.0%	27.0%	30.0%	31.0%
TR	32.0%	32.0%	41.0%	25.0%	17.0%	48.0%	44.0%	33.0%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Table (6.3): Overall contribution made by each resource type (combining RQ1 and RQ2)

Overall Contribution	
HR	41.0%
OR	38.0%
TR	21.0%
Total	100%

6.2.1.2 RQ3 and RQ4 for Company A

Moreover, results pertaining to RQ3 and RQ4 were presented in Table (6.4) and (6.5) respectively. ANP was also used to combine the results of RQ3 and RQ4, as shown in Table (6.6), to provide the overall “weights” for each

strategy considering both RQ3 and RQ4. As can be seen in Table (6.4), the **actual** HR supports **that are received** by the strategy of MQS, CHF, ATT, PQA, TCF, UHK, QIM, and CQC is 9%, 17%, 17%, 15%, 12%, 15%, 7%, and 8% respectively. Table (6.4) also illustrated that the **actual** OR supports **that are received** relatively by the strategy of MQS, CHF, ATT, PQA, TCF, UHK, QIM, and CQC is 33%, 11%, 11%, 15%, 8%, 5%, 9%, and 8% respectively. The same table show that the relative TR support **that are allocated** is 14%, 20%, 17%, 8%, 12%, 9%, 13%, and 7% for the strategy of MQS, CHF, ATT, PQA, TCF, UHK, QIM, and CQC respectively. In Addition, the ability of each strategy to enhance quality as presented in Table (6.5) is 13%, 9%, 9%, 22%, 22%, 11%, 10%, and 4% for the strategy of MQS, CHF, ATT, PQA, TCF, UHK, QIM, and CQC respectively.

Accordingly, given that the eight strategies have not been treated equally as each strategy received different support from HR, OR, and TR (RQ3); and that each strategy also contributes differently to enhance quality (RQ4), the results of Table (6.4) and (6.5) are combined using ANP and shown in Table (6.6). This is to obtain the **OVERALL** prioritization of Company A's strategies. As seen in Table (6.6), the eight strategies of MQS, CHF, ATT, PQA, TCF, UHK, QIM, and CQC are prioritized as they are collectively weighted as 16.28%, 14.61%, 13.63%, 13.62%, 13.24%, 10.83%, 10.37%, and 7.42% respectively. **Accordingly, these percentages (Table (6.6)) are considered to be the overall resources that should be allocated for each strategy, as they are obtained from answering RQ3 (Table (6.4)) and RQ4 (Table (6.5)).**

Table (6.4): The relative actual supports of HR, OR, and TR for the eight critical strategies (RQ3)

Support From .:	1	2	3	4	5	6	7	8	Total
↓	MQS	CHF	ATT	PQA	TCF	UHK	QIM	CQC	
HR	9.0%	17.0%	17.0%	15.0%	12.0%	15.0%	7.0%	8.0%	100%
OR	33.0%	11.0%	11.0%	15.0%	8.0%	5.0%	9.0%	8.0%	100%
TR	14.0%	20.0%	17.0%	8.0%	12.0%	9.0%	13.0%	7.0%	100%
Totals per strategy are not Normalized (i.e. not equal to 100%).									

Table (6.5): The relative contributions of each critical strategy to quality enhancement (RQ4)

Ability to Enhance Quality	
1. MQS	13%
2. CHF	9.0%
3. ATT	9.0%
4. PQA	22%
5. TCF	22%
6. UHK	11%
7. QIM	10%
8. CQC	4.0%
Total	100%

Table (6.6): Resource-based prioritisation of the eight critical strategies
(combining RQ3 and RQ4)

	Overall [$s_{(i)}$]
1. MQS	16.28%
2. CHF	14.61%
3. ATT	13.63%
4. PQA	13.62%
5. TCF	13.24%
6. UHK	10.83%
7. QIM	10.37%
8. CQC	7.42%
Total	100%

6.2.2 The Need for GP Model

The analysis of ANP reveals that the need of each strategy, in this situation, cannot be optimized (i.e. exactly satisfied). This can be explained through comparing the needs of each strategy with what is actually allocated for it. Table (6.2) clearly represents the individual need of each strategy from HR, OR and TR. It is obvious that the percentage of each type of resource is presented relatively with the remaining two types of resources.

However, the allocated resources for each strategy are presented differently Table (6.4), which illustrates how the HR, OR, and TR are distributed among the eight strategies. However, the table does not show how each single strategy is mobilizing HR, OR, and TR in a relative form (i.e. their

total = 100%). For example, in the HR row in Table (6.4), each figure represents the relative support of HR for a single strategy compared to the remaining seven strategies. That means the **relative** allocated HR, OR, and TR for a single strategy can be obtained by normalizing the support of HR, OR, and TR for each single strategy. This normalization step should be carried out to obtain the relative allocated HR, OR, and TR in terms of the relative percentages within each single strategy as shown in Table (6.7). For example, in Table (6.7), the allocated HR, OR, and TR for the strategy of MQS are 16%, 59%, and 25%. These figures are calculated by normalizing the values of 9%, 33%, and 14% that correspond to the relative support of HR, OR, and TR to MQS that are directed relatively to the remaining strategies as shown in Table (6.4). In the other words, Table (6.7) is developed using data from Table (6.4) by normalizing the support of the three types of resource (HR, OR, and TR) to obtain the relative support of each type of resource within each single strategy. This means it can be easily compared between the needs of each strategy as shown in Table (6.2) with what is actually allocated for each strategy as presented in Table (6.7).

Table (6.7): Relative actual supports received by each critical strategy (Normalized version of Table (6.4))

	1	2	3	4	5	6	7	8
	MQS	CHF	ATT	PQA	TCF	UHK	QIM	CQC
HR	16.0%	35.0%	38.0%	39.5%	37.5%	51.7%	24.0%	35.0%
OR	59.0%	23.0%	24.0%	39.5%	25.0%	17.2%	31.0%	35.0%
TR	25.0%	42.0%	38.0%	21.0%	37.5%	31.1%	45.0%	30.0%
Total → (Normalized)	100%	100%	100%	100%	100%	100%	100%	100%

As can be seen in Tables (6.2) and (6.7), the ANP model quantitatively differentiates between the needed resources for each strategy and the support received. For example, in Table (6.2) where 33% of the **needed resources** for the implementation of strategy MQS in the company were HR while, in reality, as shown in Table (6.7), HR represents 16% of the **allocated resources** for this strategy. Note that the 16% is about 50% less than what is needed (33%). In such a situation, the company **cannot exactly satisfy the need of each strategy from each type of resource unless a single strategy receives more or less than what actually has been allocated for this strategy.** This is because there are seven remaining strategies, which each strategy face such resource discrepancy.

Similarly, other strategies appear to have deviations between what is perceived to be needed and what is considered to be allocated. Specifically, **the needed HR** for the seven remaining strategies; CHF, ATT, PQA, TCF, UHK, QIM, and CQC, as shown in Table (6.2), are 21%, 44%, 30%, 39%, 25%, 26% and 36% respectively. In reality, **however, the allocated HR** for these strategies are 35%, 38%, 39.5%, 37.5%, 51.7%, 24% and 35% respectively as shown in Table (6.7).

The same issue exists for the OR, as the **needed OR** shown in Table (6.2) is 35%, 47%, 15%, 45%, 44%, 27%, 30%, and 31% for the MQS, CHF, ATT, PQA, TCF, UHK, QIM, and CQC respectively. In reality, **however, the allocated OR** for these strategies, as shown in Table (6.7), is 59%, 23%, 24%, 39.5%, 25%, 17.2%, 31% and 35% respectively.

Similarly, the **needed TR**, as shown in Table (6.2), is 32%, 32%, 41%, 25%, 17%, 48%, 44%, and 33% for the MQS, CHF, ATT, PQA, TCF, UHK, QIM, and CQC respectively. In reality, **however, the allocated TR** for these strategies, as shown in Table (6.7), is 25%, 42%, 38%, 21%, 37.5%, 31%, 45%, and 30% respectively. **Hence, the need arises for GP in order to handle such an interaction.**

6.2.2.1 Further Explanations for the Strategy of QIM

The disparities between the needed and allocated resources are obvious in all strategies except QIM. In particular, it is found that the needed HR (26%), OR (30%), and TR (44%), as shown in Table (6.2), are very close to the allocated HR (24%), OR (31%), and TR (45%), as shown in Table (6.7). That is why this strategy is selected to provide further justification for the development of the GP model. Such an exceptional matching between the needed resources and the allocated resources for QIM may indicate that it is in an optimal situation. However, for Company A, this should not be a strategic goal (or strategically desired) as it represents just one side of the story. Remember, it is important to keep in mind that the aim of the company **is to satisfy, not to optimize, the need of the eight strategies. That is why the GP model is proposed for such an issue.** That means the individual needs of each strategy is considered, but with respect to the consideration of the individual needs of all remaining strategies as well. So the aim is to satisfy these needs rather than optimize the individual needs of one single strategy.

Therefore, in the case of the QIM, although the needed TR (44%), for example, is very close the allocated TR (45%), the needed TR (44%) should

be restricted by the overall available TR in Company A. So the needed TR for QIM is 0.44 of the overall available TR (21%), and after normalization, the percentage of the needed TR is 16.18% [or $t_{(7)} = 16.18\%$] from all the available TR in Company A as shown in Table (6.8). Note that 16.18%, as shown in Table (6.8), is resulted from multiplying 0.44 by 21% (= $0.44 \times 21\% = 9.24$), and then dividing the result (9.24) by (57.12) to obtain the $t_{(7)}$ as a percentage (%) out of 100% (i.e. $t_{(7)} = 16.18\%$ out of 100% TR). However, the overall available TR in Company A is 21%. Therefore, the system constraints for the developed GP model are as following:

$$HR = 0.41;$$

$$OR = 0.38; \text{ and}$$

$$TR = 0.21$$

Table (6.8): Calculation and normalization of the needed resources as portions of the available resources

Strategy i ($i=1,2..8$)	Normalization of $h_{(i)}$		Normalization of $o_{(i)}$		Normalization of $t_{(i)}$	
	HR = 41%		OR = 38%		TR = 21%	
1. MQS	$0.33 \times 41\% = 13.53$	12.99%	$0.35 \times 38\% = 13.30$	12.77%	$0.32 \times 21\% = 6.72$	11.76%
2. CHF	$0.21 \times 41\% = 8.61$	8.27%	$0.47 \times 38\% = 17.86$	17.15%	$0.32 \times 21\% = 6.72$	11.76%
3. ATT	$0.44 \times 41\% = 18.04$	17.32%	$0.15 \times 38\% = 5.70$	5.47%	$0.41 \times 21\% = 8.61$	15.07%
4. PQA	$0.30 \times 41\% = 12.30$	11.81%	$0.45 \times 38\% = 17.10$	16.42%	$0.25 \times 21\% = 5.25$	9.19%
5. TCF	$0.39 \times 41\% = 15.99$	15.35%	$0.44 \times 38\% = 16.72$	16.06%	$0.17 \times 21\% = 3.75$	6.25%
6. UHK	$0.25 \times 41\% = 10.25$	9.84%	$0.27 \times 38\% = 10.26$	9.85%	$0.48 \times 21\% = 10.08$	17.65%
7. QIM	$0.26 \times 41\% = 10.66$	10.24%	$0.30 \times 38\% = 11.40$	10.95%	$0.44 \times 21\% = 9.24$	16.18%
8. CQC	$0.36 \times 41\% = 14.76$	14.17%	$0.31 \times 38\% = 11.78$	11.31%	$0.33 \times 21\% = 6.93$	12.13%
	Total = 104.14	100%	Total = 104.12	100%	Total = 57.12	100%
	Normalized Total		Normalized Total		Normalized Total	

Additionally, the overall resources (whether HR, OR, or TR) that should be allocated for QIM are obtained from combining the support of HR, OR, and TR collectively, as well as considering the ability of each strategy to enhance 'quality' as shown in Table (6.6). As discussed above, these percentages (in Table (6.6)) are considered the overall resources that should be allocated for each strategy. Therefore, these percentages represent the right side (targets) of the equations of the goal constraints [see Figure (6.1)]. So, it can be understood that the overall support from all resources that should be allocated for QIM is 10.37% of all available resources in Company A (whether HR, OR, or TR) as shown in Table (6.6). Thus, the right hand side of the equation of the goal constraint of the strategy of QIM (the seventh strategy) is 0.1037 as shown in Figure (6.1). Note that Figure (3.6), in Chapter 3, illustrates how the GP model is proposed from the detailed ANP analysis.

6.2.2.2 Formulation of the GP model:

The results of the ANP model confirmed that the company **cannot exactly satisfy the need of each strategy from each type of resource (RQ2) unless a single strategy receives more or less than what actually has been allocated for it (RQ3)**. Answering RQ1 and RQ2 resulted in an overall ranking of resources with respect to the needs of the eight strategies collectively. In particular, the overall relative contribution of the HR, OR, and, TR [or the overall need for the eight strategies], as shown in Table (6.3), are 41%, 38%, and, 21% respectively. **Accordingly, these percentages are considered to represent the overall available resources for Company A. These percentages represent the 'system constraints' as shown in Figure (6.1)**.

However, it is important to understand the consequences of such a consideration [which is considering that the overall available HR, OR, and TR is 41%, 38%, and 21% respectively]. To illustrate, if HR represents 33% of the needed resources in MQS as shown in Table (6.2), the need of this strategy is then to mobilize 33% from the overall HR (41%) in the company **or 12.99% of the overall HR (41%) as calculated in Table (6.8) [i.e. $h_{(1)} = 12.99\%$]**. So, as it can be seen in Table (6.8), the strategy of MQS needs 12.99%, 12.77%, and 11.76% from the overall HR, OR, and, TR respectively. However, ***the first challenge*** for the company is how to exactly satisfy the need of MQS, for example, within the existence of the remaining seven strategies. These seven strategies are actually sharing MQS **in terms of obtaining their own needs from the overall HR (41%), OR (38%), and, TR (21%)**.

In addition, regardless of the overall available HR, OR, and, TR, ***the second challenge*** for the company is **how to guarantee that even though the actual needs for MQS (i.e. strategy 1) were exactly satisfied** [which is for HR, ($h_{(1)} = 12.99\%$), for OR ($o_{(1)} = 12.77\%$), and, for TR ($t_{(1)} = 11.76\%$)], **the overall resources that should be allocated for this strategy ($s_{(1)} = 16.28\%$) will be maintained** [16.28% is resulted from the RQ3 and RQ4 (combined) as shown in Table (6.6)].

In other words, **there is no guarantee that if MQS exactly mobilizes 12.99% of HR, 12.77% of OR, and, 11.76% of TR, the overall resources for this strategy will represent exactly 16.28% ($s_{(1)}$) of all resources in the company**. With this in mind, the remaining strategies are also in the same situation; that is, each strategy has its own objective

that needs to be optimized. Specifically, the objective is **to maintain what should be allocated for each strategy** [maintain $s_{(i)}$]. However, as there are eight different strategies, the aim is to ‘satisfy’ the objectives rather than to ‘optimize’ them. From this point of view, this thesis proposed a GP model, as shown in Figure (6.1), to see how far each strategy is from its own objective (target) if its objective is to satisfy its own need as much as possible (minimize the deviational variables, d_i^+ and d_i^-). In the other word, the GP model in Figure (6.1) is proposed to address RQ5 for this case study. [See also Figure (3.6) in Chapter 3 that illustrates how the GP model is proposed from the detailed ANP analysis].

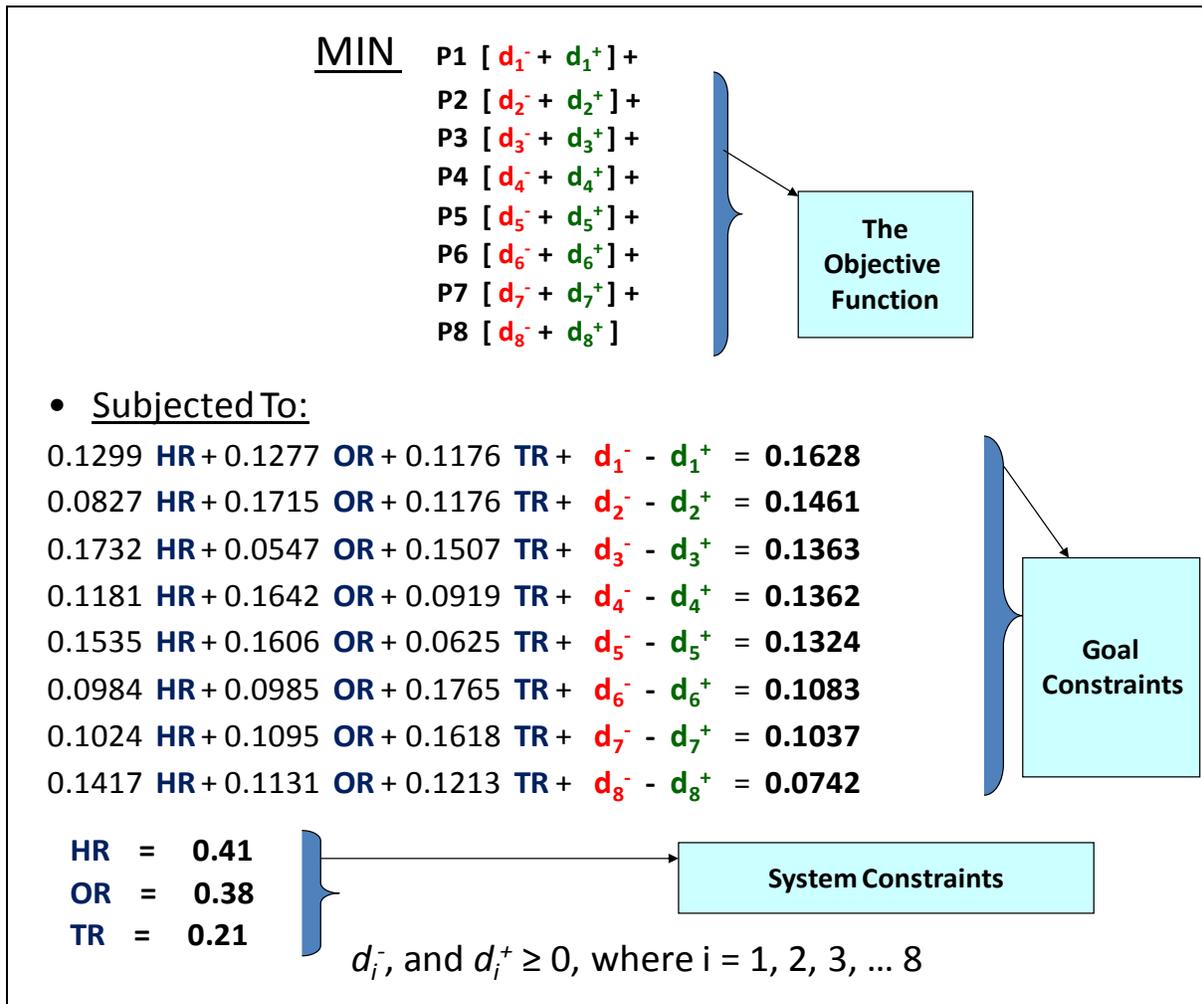


Figure (6.1): The Proposed GP Model for Company A

6.2.2.3 GP Results and Discussion

The results were obtained using 'QM for Windows' and summarized in Figure (6.2). Four strategies had a positive value of d^+ , which means they consumed more resources than should have been allocated for them (i.e. they were over-resourced). As shown in Figure (6.2), strategies TCF, UHK, QIM, and CQC were over-resourced by 3.55%, 6.06%, 13.35%, and 70.59% respectively. As a result, under-resourcing appeared in the remaining strategies that had a positive value of d^- . Namely, MQS, CHF, ATT, and PQA were under-resourced by 22.28%, 15.27%, 9.41%, and 4.45% respectively. Notably, the total under-resourcing or $\sum d_i^- = 0.0775$ (or 7.75%) of the resources is similar to the total over-resourcing $\sum d_i^+ = 0.0775$ (or 7.75%). This confirms the assumption underpinning the model, which is that under-resourcing in some strategies resulted from resources consuming more than should have been assigned for the remaining strategies. In other words, this situation indicates that there is a resource allocation issue.

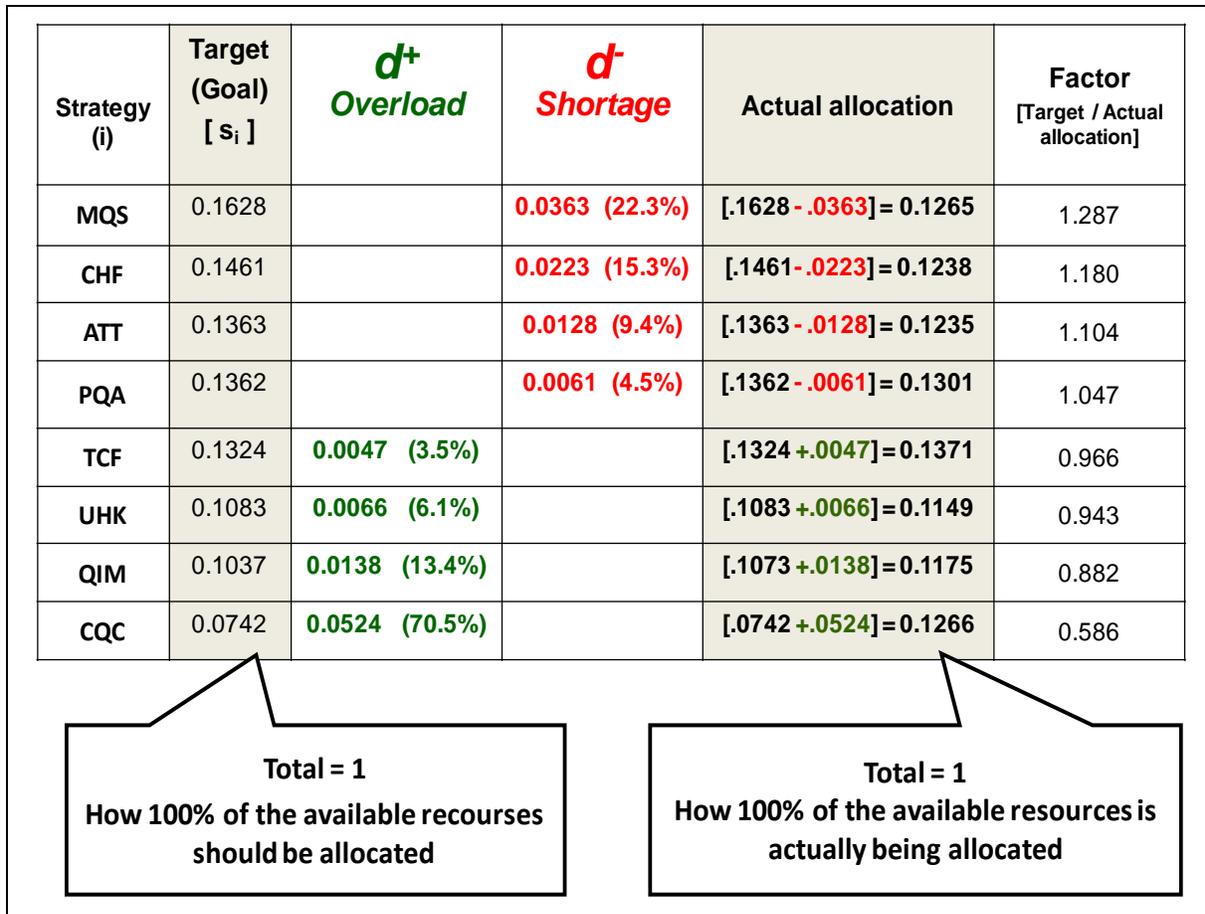


Figure (6.2) Results of the GP Model for Company (A)

6.2.2.4 Developing a Strategic Quality Management Index (SQMI)

From the analysis of the GP model, it becomes appropriate to develop a Strategic Quality Management Index (SQMI), which is developed to assess the level of utilization of the resources. This is important because, for example, in the selected case (Company A), although the strategy of CQC is over-resourced by 70.5% (i.e. 70.5% more than what should be allocated for it; which may indicate ineffective management of resources), the

70.5% represents just a portion of **what should be allocated for** CQC. Specifically, this portion is 70.5% of the 7.42% or [0.705 * 0.0742 = 5.24%]. That means only 5.24% of the overall available resources in Company A were inappropriately consumed in CQC (i.e. placed in a wrong strategy). Therefore, it is important for the company to have an index to determine its efficiency level in term of resources utilization. The SQMI is calculated using the proposed formula as shown below:

$$100 - (\{\% \text{ of the inefficiency}\} / 2)$$

$$= 100 - (\{\sum [\% \text{ of the under-resourcing in Strategy (i)} \times \text{Weight of Strategy (i)}]$$

$$+ \sum [\% \text{ of the over-resourcing in Strategy (i)} \times \text{Weight of Strategy (i)}]\} / 2)$$

The ‘percentage of under-resourcing’ and the ‘percentage of over-resourcing’ of each strategy are shown in Figure (6.2) while the ‘weight’ of each strategy is shown in Table (6.6) [see the column of “overall”]. Accordingly, the SQMI for the company was determined as shown below:

$$= 100 - (\{$$

$$[(\%22.3 \times 0.1628) + (15.3\% \times 0.1461) + (9.4\% \times 0.1363) + (4.5\% \times 0.1362)]$$

$$+ [(\%3.5 \times 0.1324) + (6.1\% \times 0.1083) + (13.4\% \times 0.1037) + (70.5\% \times 0.0742)]$$

$$\} / 2)$$

$$= 100 - 7.75 = 92.25$$

Accordingly, the SQMI for Company A is 92.25; which means 92.75% of all resources in Company A are allocated as they should be (i.e. distributed to the eight strategies correctly). Conversely, this also reveals that 7.75% of all resources in Company A are assigned to incorrect strategies (incorrect positions). Indeed, the total over-resourcing or $\sum d_i^+ = 0.0775$ (or 7.75%) is equal to the total under-resourcing $\sum d_i^- = 0.0775$ (or 7.75%); which in turn, as illustrated above, confirms the assumption that under-resourcing in some strategies were resulted from over-resourcing in the remaining strategies. This implies that 7.75% of the resources are supposed to be transferred from the over-resourced strategies to the under-resourced strategies. This is to cover the under-resourcing of 7.75% as a result of eliminating under-resourcing of 7.75%. Such an action will result in 100% of resource utilization (i.e. SQMI = 100).

The index can also be used by the company to assess its SQM practices, or to benchmark its level of utilization of resources for SQM with other companies. In this comparative study, SQMI for Company B is also calculated.

6.2.2.5 Resource Re-allocation

The target for each strategy, which is **to maintain what should be allocated (the right side of the goal constraint [s_(i)]**, cannot be achieved exactly unless the needed resources for each strategy are reallocated. Achieving targets “exactly” means that the value of $\sum d_i^-$ and $\sum d_i^+$ should be equal to zero. Thus, the amount of the needed $h_{(i)}$, $o_{(i)}$, and $t_{(i)}$ in the left side of the goal constraints should be modified in a way that guarantees the disappearance of the deviational variables in the results (or $\sum d_i^+ = \sum d_i^- = 0$).

To illustrate such a modification, the coefficients of the HR, OR, and TR ($h_{(1)}$, $o_{(1)}$, and $t_{(1)}$) for the strategy of MQS (the first goal constraint) should be multiplied by a factor to cover the shortage [$d_1^- = (.0363)$] that appeared in the results shown in Figure (6.2). This factor is obtained by dividing a targeted amount of resources **[i.e. what should be allocated for this strategy (the right side of the first goal constraint [$s_{(1)}$] that supposed to be maintained)]** by the **'Actual'** amount of resources assigned **in reality (in practice)** for this strategy or [$0.1628 / (0.1628 - \{\text{under-resourced by } 0.0363\}) = 0.1628 / 0.1265$]. Accordingly, the factor for this goal constraint is 1.28. Note that the actual amount received by this strategy in practice (0.1265) is determined as shown in Figure (6.2). Also note that the factor for this strategy equals 1.28, which is greater than 1, which means the coefficient of HR, OR, and TR ($h_{(1)}$, $o_{(1)}$, and $t_{(1)}$) for MQS will be increased and the percentage of the increase for each type of resource is 28.7% ($1.287 - 1 = 0.287$ or 28.7%). The increase of 28.7% in $h_{(1)}$, $o_{(1)}$, and $t_{(1)}$ should cover the shortage (under-resourcing) of 22% that appeared in MQS as shown in Figure (6.2).

In contrast, the factor for the strategy of CQC is less than 1 (factor = 0.586), which reveals that the coefficient of HR, OR, and TR ($h_{(8)}$, $o_{(8)}$, and $t_{(8)}$) should be decreased by 41.4% ($1 - 0.586 = 0.414$ or 41.4%). This action should remove the over-resourcing of 70.5% ($d^+ = 0.0524$) that appeared in the strategy of CQC as shown in Figure (6.2).

Similarly, all goal constraints were modified by determining a factor for each equation. For the remaining six strategies (or remaining six equations of the goal constraints), the factors are 1.180, 1.104, 1.047, 0.966, 0.943, and 0.882 for CHF, ATT, PQA, TCF, UHK, and QIM respectively. In particular, the coefficient of HR, OR, and TR ($h_{(i)}$, $o_{(i)}$, and $t_{(i)}$) for the

strategy of CHF, ATT, and PQA should be increased by 18%, 10.4%, and 4.7% respectively to cover their shortages (under-resourcing) as shown in Figure (6.2). In contrast, this also means that the coefficient of HR, OR, and TR ($h_{(i)}$, $o_{(i)}$, and $t_{(i)}$) for the strategy of TCF, UHK, and QIM should be decreased by 3.4%, 5.7%, and 11.8% respectively to remove the over-resourcing as shown in Figure (6.2). The modified form of the GP model is shown in Figure (6.3). This action resulted in the disappearance of divisional variables from the results as shown in Figure (6.4).

The rationale for developing such factors (modifications) is to change the state of each strategy from ‘what is actually being practiced’ [see the column of ‘The actual allocation’ in Figure (6.2)] to ‘what should be allocated for each strategy’ [see the column of ‘Target’ in Figure (6.2)]. Such modifications will guarantee that the GP model will exactly satisfy what should be allocated for each strategy [$s_{(i)}$] (i.e. $\sum d_i^- = \sum d_i^+ = 0$). Naturally, this will be at the expense of changing the specific, individual needs of HR, OR and TR for each strategy using the identified factors.

Otherwise, without such a modification, attaining the original needs (non-modified needs) of each strategy results in practicing quality strategies with the existence of over-resourcing (d_i^+) and under-resourcing (d_i^-) in the strategies as shown in Figure (6.2); which represents the optimum situation (not optimal because $\sum d_i^-$ and $\sum d_i^+ > 0$). Therefore, it is proposed here that if Company A wants to attain the optimal (not optimum) situation in which $\sum d_i^- = \sum d_i^+ = 0$ as shown in Figure (6.4), the needed HR, OR, and TR that are mobilized in each strategy must be modified with respect to the developed factors, as shown in Figure (6.3).

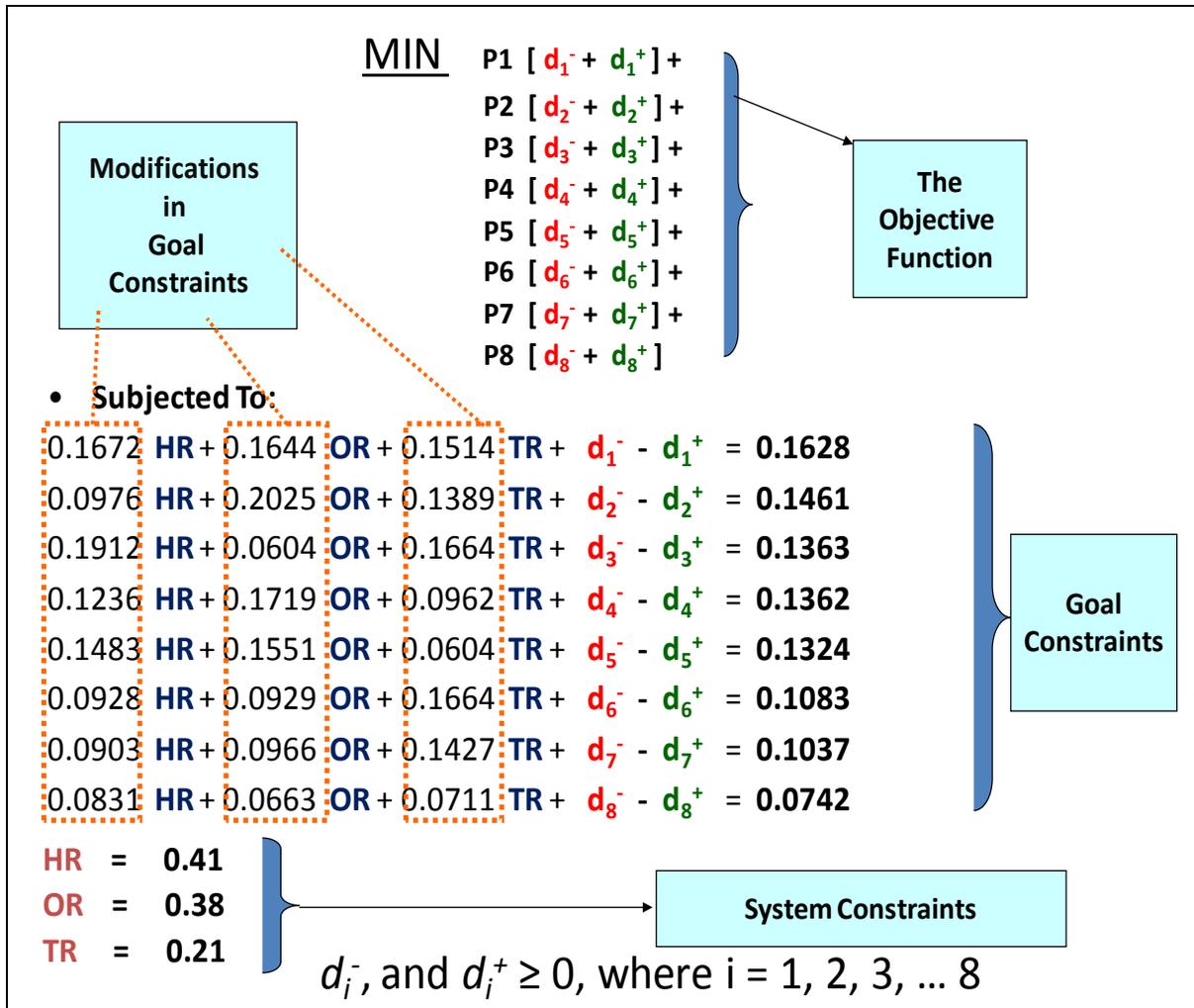


Figure (6.3): The Modified GP Model for Company A

Strategy (i)	Target (Goal) [s _i]	d ⁺	d ⁻	The actual achievement (following resource re-allocation)
MQS	0.1628	0	0	0.1628
CHF	0.1461	0	0	0.1461
ATT	0.1363	0	0	0.1363
PQA	0.1362	0	0	0.1362
TCF	0.1324	0	0	0.1324
UHK	0.1083	0	0	0.1083
QIM	0.1037	0	0	0.1037
CQC	0.0742	0	0	0.0742

Figure (6.4): The Results of the Modified GP Model for Company A

6.3 Company B

6.3.1 Results of the ANP Analysis

6.3.1.1 RQ1 and RQ2 for Company B

The ANP inputs for Company B's participants were analyzed using 'Super Decision' and the results of the three experts involved in the quantitative phase were aggregated using Excel. Results pertaining to the first four research questions are presented in Tables (6.9) through (6.14). Specifically, Table (6.9) and (6.10) answer the first two research questions. Table (6.11) combines the results for RQ1 and RQ2 as ANP is capable of

providing overall 'weights' for HR, OR, and TR considering their overall relative contributions.

As shown in Table (6.9), all types of resources in Company B share a very similar level of significance, which is different to the findings for Company A. However, this significance depends on the context in which these resources are employed. For example, for HR to play its role effectively, it is found that the relative contribution of OR and TR is 65% and 35% respectively. In contrast, to enable OR to play its role effectively, TR contributes significantly (64%) compared with the contribution of HR (36%). Nevertheless, HR contributes 65% while OR contributes 35% to enable TR to be effectively activated. This sort of 'balancing' is reflected in the overall ranking of these resource as shown in Table (6.11) which indicates that the global contributions of HR, OR, and TR in company B are 33%, 34%, and 33% respectively. As discussed for Company A, **these percentages (Table 6.11) are considered to represent the overall available resources for Company B.** Note that these global contributions (i.e. percentages in Table 6.11) also consider the contribution of each type of resource to each single strategy as shown in Table (6.10).

Additional details can be seen in Table (6.10). It shows that the relative contribution of HR (i.e. the needed HR compared with other resources) for the strategies of ATT, MQS, CQC, QIM, TCF, CHF, UHK, and PQA are 25%, 21%, 17%, 18%, 16%, 27%, 18%, and 16% respectively. Table (6.10) also shows that the relative contribution of OR for the strategies of ATT, MQS, CQC, QIM, TCF, CHF, UHK, and PQA are 45%, 56%, 55%, 46%, 61%, 40%, 51%, and 57% respectively. Regarding TR, its relative contributions to ATT, MQS, CQC, QIM, TCF, CHF, UHK, and PQA are 30%, 23%, 28%, 36%, 23%, 33%, 31%, and 27% respectively as shown in Table (6.10).

Table (6.9): Relative contributions of each pair of resources to support the third type of resource (RQ1)

	HR	OR	TR
HR	-	36%	65%
OR	65%	-	35%
TR	35%	64%	-
Total	100%	100%	100%

Table (6.10): Relative contribution of resources needed to ensure successful strategy implementation (RQ2)

	1	2	3	4	5	6	7	8
	ATT	MQS	CQC	QIM	TCF	CHF	UHK	PQA
HR	25.0%	21.0%	17.0%	18.0%	16.0%	27.0%	18.0%	16.0%
OR	45.0%	56.0%	55.0%	46.0%	61.0%	40.0%	51.0%	57.0%
TR	30.0%	23.0%	28.0%	36.0%	23.0%	33.0%	31.0%	27.0%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Table (6.11): Overall contribution made by each resource type (combining RQ1 and RQ2)

Overall Contribution	
HR	33%
OR	34%
TR	33%
Total	100%

6.3.1.2 RQ3 and RQ4 for Company B

Results pertaining to RQ3 and RQ4 were presented in Table (6.12) and (6.13) respectively. ANP was used to combine the results of RQ3 and RQ4, as shown in Table (6.14), to provide the overall ‘weights’ for each strategy considering both RQ3 and RQ4. As seen in Table (6.12), the **actual** HR supports **received** by ATT, MQS, CQC, QIM, TCF, CHF, UHK, and PQA are 14%, 17%, 12%, 9%, 15%, 11%, 9%, and 13% respectively. Table (6.12) also illustrates that the **actual** OR supports **received** relatively by ATT, MQS, CQC, QIM, TCF, CHF, UHK, and PQA are 15%, 14%, 18%, 12%, 11%, 11%, 9%, and 10% respectively. The same table show that the relative TR supports **allocated** are 15%, 10%, 16%, 13%, 11%, 11%, 14%, and 10% for the strategies of ATT, MQS, CQC, QIM, TCF, CHF, UHK, and PQA respectively. In addition, the ability of each strategy to enhance ‘quality’ as presented in Table (6.13) are 12%, 15%, 12%, 15%, 12%, 9%, 15%, and 10% for ATT, MQS, CQC, QIM, TCF, CHF, UHK, and PQA respectively.

Accordingly, given that the eight strategies have not been treated equally as each strategy received different support from HR, OR, and TR (RQ3); and that each strategy contributes differently to enhance ‘quality’ (RQ4), the results in Table (6.12) and (6.13) are combined as shown Table (6.14) [by ANP]. This is to obtain the **OVERALL** prioritization of Company B’s strategies. As seen in Table (6.14), the eight strategies of ATT, MQS, CQC, QIM, TCF, CHF, UHK, and PQA are prioritized as they are collectively weighted as 14.03%, 13.72%, 13.50%, 12.78%, 12.17%, 11.70%, 11.50%, and 10.59% respectively. **Accordingly, these percentages (Table (6.14)) are considered to be the overall resources that should be allocated for each strategy as they obtained from answering RQ3 (Table (6.12)) and RQ4 (Table (6.13)).**

Table (6.12): The relative actual supports of HR, OR, and TR for the eight critical strategies (RQ3)

Support From ↓:	1	2	3	4	5	6	7	8	Total
	ATT	MQS	CQC	QIM	TCF	CHF	UHK	PQA	
HR	14.0%	17.0%	12.0%	9.0%	15.0%	11.0%	9.0%	13.0%	100%
OR	15.0%	14.0%	18.0%	12.0%	11.0%	11.0%	9.0%	10.0%	100%
TR	15.0%	10.0%	16.0%	13.0%	11.0%	11.0%	14.0%	10.0%	100%
Totals per strategy are not Normalized (i.e. not equal to 100%).									

Table (6.13): The relative contributions of each critical strategy to quality enhancement (RQ4)

Ability to Enhance Quality	
1. ATT	12%
2. MQS	15%
3. CQC	12%
4. QIM	15%
5. TCF	12%
6. CHF	9%
7. UHK	15%
8. PQA	10%
Total	100%

Table (6.14): Resource-based prioritisation of the eight critical strategies (combining RQ3 and RQ4)

	Overall [$s_{(i)}$]
1. ATT	14.03%
2. MQS	13.72%
3. CQC	13.50%
4. QIM	12.78%
5. TCF	12.17%
6. CHF	11.70%
7. UHK	11.50%
8. PQA	10.59%
Total	100%

6.3.2 The Need for GP Model

As seen in Company A, analysis of the ANP for Company B reveals that the need of each strategy, in this situation, can't be optimized (i.e. exactly satisfied). This can be explained by comparing the needs of each strategy with what is actually allocated for it. Table (6.10) clearly represents the individual need of each strategy from HR, OR and TR. The percentage of each type of resource is presented relatively with the remaining two types of resources.

The allocated resources for each strategy are presented differently in table (6.12), which illustrates how the HR, OR, and TR are distributed among the eight strategies. However, it does not show how each single strategy is mobilizing HR, OR, and TR in a relative form (i.e. their total = 100%). For example, in the row of HR support in Table (6.12), each percentage represents the relative support of HR for a single strategy, relative to the remaining seven strategies. However, the **relative** allocated HR, OR, and TR for a single strategy can be obtained by normalizing the support of HR, OR, and TR for each single strategy. This normalization step should be carried out to get the relative allocated HR, OR, and TR in terms of the relative percentages within each single strategy as shown in Table (6.15). For example, in Table (6.15), the allocated HR, OR, and TR for the strategy of ATT are 32%, 34%, and 34%. These figures are calculated by normalizing the values of 14%, 15%, and 15%, that correspond to the support of HR, OR, and TR to ATT that are directed relatively to the remaining strategies as shown in Table (6.12). In other words, Table (6.15) is developed using data from Table (6.12) by normalizing the support of the three types of resource (HR, OR, and TR) to obtain the relative support of each type of resource within each single strategy. Then it is easy to

compare the needs of each strategy (as shown in Table (6.10)) with what is actually being allocated (as shown in Table (6.15)).

Table (6.15): Relative actual supports received by each critical strategy

(Normalized version of Table (6.12))

	1	2	3	4	5	6	7	8
	ATT	MQS	CQC	QIM	TCF	CHF	UHK	PQA
HR	32.0%	42.0%	26.0%	27.0%	40.0%	33.3%	28.0%	40.0%
OR	34.0%	34.0%	39.0%	35.0%	30.0%	33.3%	28.0%	30.0%
TR	34.0%	24.0%	35.0%	38.0%	30.0%	33.3%	44.0%	30.0%
Total → (Normalized)	100%	100%	100%	100%	100%	100%	100%	100%

As seen in Tables (6.10) and (6.15), the ANP model quantitatively differentiates between the needed resources for each strategy and the support received. As illustrated in Table (6.10), 25% of the **needed resources** for the implementation of strategy ATT in the company were HR; while in reality, as shown in Table (6.15), HR represents 32% of the **allocated resources** for this strategy. Note that the 32% is “about 28% more than” what is needed (25%). In such a situation, the company **cannot exactly satisfy the need of each strategy from each type of resources unless a single strategy receives more or less than what has actually been allocated for this strategy.** This is because there are seven remaining strategies facing such resource discrepancy.

Similarly, other strategies appear to have deviations between what is perceived to be needed and what is considered to be allocated. Specifically, **the needed HR** for the remaining seven strategies: MQS, CQC, QIM, TCF, CHF, UHK, and PQA, as shown in Table (6.10), are 21%, 17%, 18%, 16%, 27%, 18% and 16% respectively while, in reality, **the allocated HR** for these strategies are 42%, 26%, 27%, 40%, 33%, 28% and 40% respectively as shown in Table (6.15).

The same issue is exists for the **needed OR**, as shown in Table (6.10) is 45%, 56%, 55%, 46%, 61%, 40%, 51% and 57% for the ATT, MQS, CQC, QIM, TCF, CHF, UHK, and PQA respectively. In reality, however, the **allocated OR** for these strategies, as shown in Table (6.15), is 34%, 34%, 39%, 35%, 30%, 33%, 28% and 30% respectively.

Similarly, the **needed TR** for seven out of the eight strategies, as shown in Table (6.10), which is 30%, 23%, 28%, 36%, 23%, 31%, and 27% for the ATT, MQS, CQC, QIM, TCF, UHK, and PQA respectively. In reality, however, the **allocated TR** for these strategies, as shown in Table (6.15), is 34%, 24%, 35%, 38%, 30%, 44%, and 30% respectively. **Hence, the need arises for GP, which can handle such an interaction.**

6.3.2.1 Further Explanations for the Strategy of CHF

The dissimilarities between the needed and allocated resources are obvious in all strategies except CHF (in TR percentages). This strategy is, therefore, selected to provide further justification for developing the GP model. In particular, it is found that the needed TR for CHF is 33% (Table (6.10)),

which is equal to the allocated TR (33%) as shown in Table (6.15). Such an exceptional matching between the needed TR and the allocated TR for CHF may indicate that it is in an optimal situation. However, for Company B, as well as in Company A, this should not be the strategic aim as it represents just one side of the story. Again, it is important to keep in mind that the aim of the company **is to satisfy, not to optimize, the need of the eight strategies; which is why the GP model is proposed for such an issue.** This means the individual needs of each strategy are considered, but with respect to the consideration of the individual needs of all remaining strategies as well. The aim is to satisfy these needs rather than optimize the individual needs of one single strategy. Therefore, in the case of CHF, although the needed TR (33%) is equal to the allocated TR (33%), the needed TR (33%) should be restricted by the overall available TR in Company B. So the needed TR for CHF is 0.33 [see Table 6.10] of the overall available TR (33%) [see Table 6.11], and after normalization the percentage of the needed TR is 14.29% [or $t_{(6)} = 14.29\%$] from all the available TR in Company B as shown in Table (6.16). Note that 14.29%, as shown in Table (6.16), is calculated by multiplying 0.33 by 33% ($= 0.33 \times 33\% = 10.89$), and then dividing the result (10.89) by (76.23) to obtain the $t_{(6)}$ as a percentage (i.e. $t_{(6)} = 14.29\%$ TR). However, the overall available TR in Company B is 33%. Therefore, the system constraints for the developed GP model are as follows:

$$HR = 0.33;$$

$$OR = 0.34; \text{ and}$$

$$TR = 0.33$$

Table (6.16): Calculation and normalization of the needed resources as portions of the available resources

Strategy <i>i</i> (<i>i</i> =1,2..8)	Normalization of $h_{(i)}$		Normalization of $o_{(i)}$		Normalization of $t_{(i)}$	
	HR = 33%		OR = 34%		TR = 33%	
1. ATT	0.25 x 33% = 8.25	15.82%	0.45 x 34% = 15.30	10.95%	0.30 x 33% = 9.90	12.99%
2. MQS	0.21 x 33% = 6.93	13.29%	0.56 x 34% = 19.04	13.63%	0.23 x 33% = 7.59	9.96%
3. CQC	0.17 x 33% = 5.61	10.76%	0.55 x 34% = 18.70	13.38%	0.28 x 33% = 9.24	12.12%
4. QIM	0.18 x 33% = 5.94	11.39%	0.46 x 34% = 15.64	11.19%	0.36 x 33% = 11.88	15.58%
5. TCF	0.16 x 33% = 5.28	10.13%	0.61 x 34% = 20.74	14.84%	0.23 x 33% = 7.59	9.96%
6. CHF	0.27 x 33% = 8.91	17.09%	0.40 x 34% = 13.60	9.73%	0.33 x 33% = 10.89	14.29%
7. UHK	0.18 x 33% = 5.94	11.39%	0.51 x 34% = 17.34	12.41%	0.31 x 33% = 10.23	13.42%
8. PQA	0.16 x 33% = 5.28	10.13%	0.57 x 34% = 19.38	13.87%	0.27 x 33% = 8.91	11.69%
	Total = 52.14	100%	Total = 139.74	100%	Total = 76.23	100%
	Normalized Total		Normalized Total		Normalized Total	

In addition, the overall resources (whether HR, OR, or TR) that should be allocated for CHF are obtained by combining the support of HR, OR, and TR collectively and considering the ability of each strategy to enhance ‘quality’ as shown in Table (6.14). As discussed, the percentages (in Table (6.14)) are considered the overall resources that should be allocated for each strategy and represent the right side (targets) of the equations of the goal constraints [see Figure (6.5)]. Therefore, the overall support from all resources that should be allocated for CHF is 11.70% of all available resources in Company B (whether HR, OR, or TR) as shown in Table (6.14). Thus, the right side of the equation of the goal constraint of the strategy of CHF (the sixth strategy) is 0.1170 as shown in Figure (6.5). Note that Figure (3.6), in Chapter 3, illustrates how the GP model is proposed from the detailed ANP analysis.

6.3.2.2 Formulation of the GP Model

The results of the ANP model confirmed that the company **cannot exactly satisfy the need of each strategy from each type of resources (RQ2) unless a single strategy receives more or less than what has actually been allocated for this strategy (RQ3)**. Answering RQ1 and RQ2 resulted in the overall ranking of resources with respect to the needs of the eight strategies collectively. In particular, the overall relative contribution of the HR, OR, and, TR [or the overall need for the eight strategies], as shown in Table (6.11), are 33%, 34%, and, 33% respectively. **Accordingly, these percentages are considered to represent the overall available resources for Company B [System constraints as shown in Figure (6.5)]**.

However, it is important to understand the consequences of considering that the overall available HR, OR, and TR is 33%, 34%, and 33% respectively. To illustrate, if HR represents 25% of the needed resources in ATT as shown in Table (6.10), the need of this strategy is then to mobilize 25% from the overall HR (33%) in the company **or 15.82% of the overall HR (33%) as calculated in Table (6.16) [i.e. $h_{(1)} = 15.82\%$]**. So, as it can be seen in Table (6.16), the strategy of ATT needs 15.82%, 10.95%, and 12.99% from the overall HR, OR, and, TR respectively. However, ***the first challenge*** for the company is how to exactly satisfy the need of ATT, for example, within the existence of the remaining seven strategies, which are actually sharing the strategy of ATT **in terms of obtaining their own needs from the overall HR (33%), OR (34%), and, TR (33%)**.

Moreover, regardless of the overall available HR, OR, and, TR, ***the second challenge*** for the company is that **how to guarantee that even though the needs for ATT were exactly satisfied** [which is for HR, ($h_{(1)} = 15.82\%$), for OR ($o_{(1)} = 10.95\%$), and, for TR ($t_{(1)} = 12.99\%$)], **the overall resources that should be allocated for this strategy ($s_{(1)} = 14.03\%$) will be maintained** [14.03% is resulted from the RQ3 and RQ4 (combined) as shown in Table (6.14)].

In other words, **there is no guarantee that if the strategy of ATT exactly mobilizes 15.82% of HR, 10.95% of OR, and, 12.99% of TR, the overall resources for this strategy will represent exactly 14.03% ($s_{(1)}$) of all resources in the company.** With this in mind, the remaining strategies are also in the same situation, with their own objectives that need to be optimized. Specifically, the objective of each strategy is **to maintain what should be allocated for each strategy** [maintain $s_{(i)}$]. However, as there are eight different strategies, the attempt should be to ‘satisfy’ the objectives rather than to ‘optimize’ them. This thesis therefore proposed a GP model, as shown in Figure (6.5), to see how far each strategy is from its own objective (target) if its objective is to satisfy its own need as much as possible (i.e. minimize the deviational variables, d_i^- and d_i^+). In the other word, the GP model in Figure (6.5) is proposed to address RQ5. [See also Figure (3.6) in Chapter 3 that illustrates how the GP model is proposed from the detailed ANP analysis].

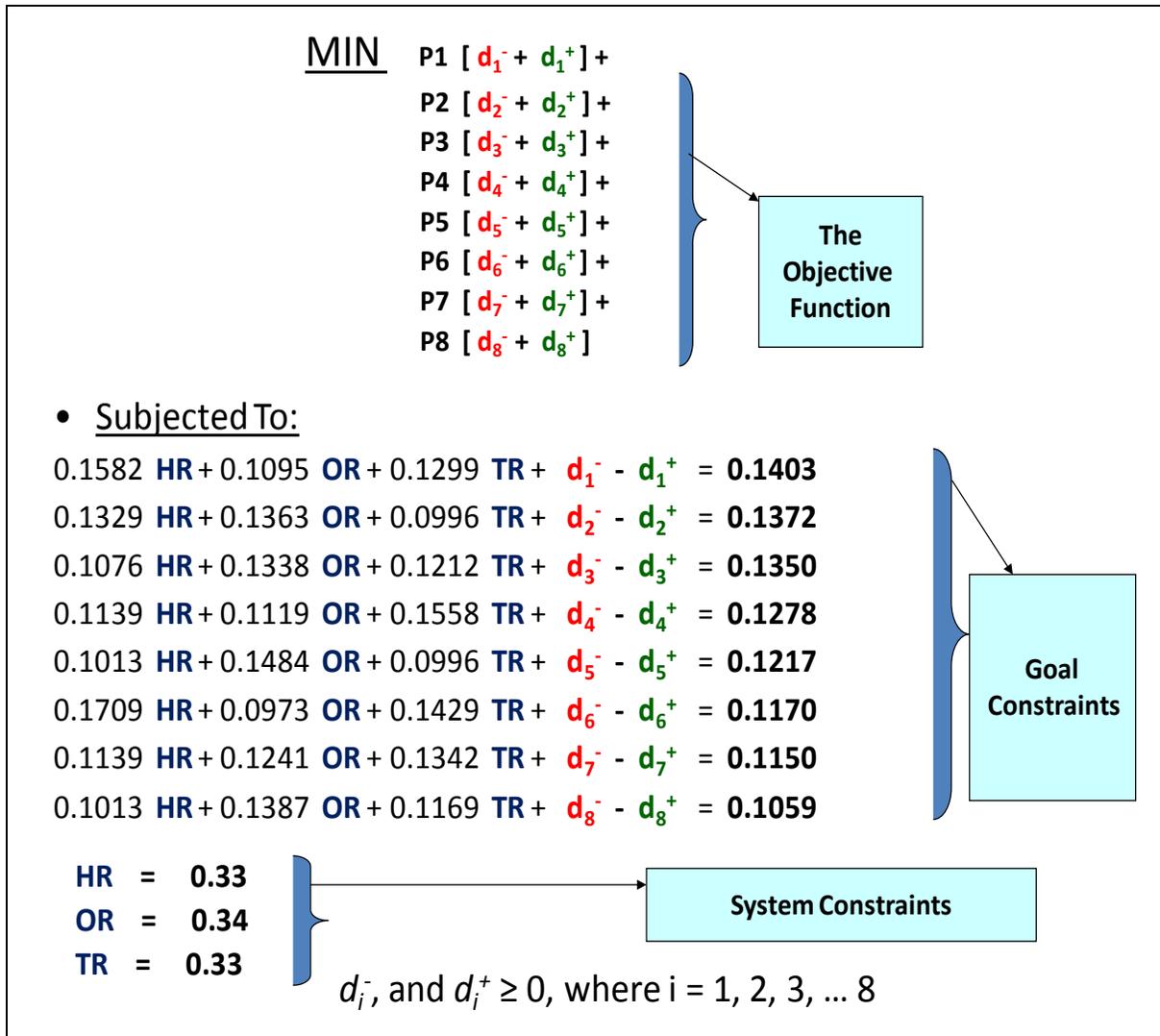


Figure (6.5): The Proposed GP Model for Company B

6.3.2.3 GP Results and Discussion

The results were obtained using 'QM for Windows' and summarized in Figure (6.6). Three strategies had a positive value of d^+ , which means they consumed more resources than should have been allocated for them (i.e. they were over-resourced). As shown in Figure (6.6), strategies CHF, UHK,

and PQA were over-resourced by 16.8%, 7.9%, 12.6% respectively. As a result, under-resourcing appeared in the remaining five strategies that had a positive value of d_i^- . Namely, ATT, MQS, CQC, QIM, and TCF were under-resourced by 5.7%, 10.3%, 10.4%, 0.59% and 4.03% respectively. The total under-resourcing or $\sum d_i^- = 0.042$ (or 4.2%) was also found to be similar to the total over-resourcing ($\sum d_i^+ = .042$ or 4.2%). This confirms the assumption underpinning the model which is that under-resourcing in some strategies resulted from consuming more resources than what should have been allocated for the remaining strategies. In other words, this situation indicates that there is a resource allocation issue.

Strategy (i)	Target (Goal) [s_i]	d^+ <i>Overload</i>	d^- <i>Shortage</i>	Actual allocation	Factor [Target / Actual allocation]
ATT	0.1403		0.0080 (5.7%)	[.1430 - .0080] = 0.1323	1.06
MQS	0.1372		0.0141 (10.3%)	[.1372 - .0141] = 0.1231	1.115
CQC	0.1350		0.0140 (10.4%)	[.1350 - .0140] = 0.1210	1.116
QIM	0.1278		0.000753 (0.59%)	[.1278 - .000753] = 0.127047	1.006
TCF	0.1217		0.0049 (4.03%)	[.1217 - .0049] = 0.1168	1.042
CHF	0.1170	0.0196 (16.8%)		[.1170 + .0196] = 0.1366	0.856
UHK	0.1150	0.0091 (7.9%)		[.1150 + .0091] = 0.1241	0.927
PQA	0.1059	0.0133 (12.6%)		[.1059 + .0133] = 0.1192	0.889

Total = 1
How 100% of the available resources should be allocated

Total = 1
How 100% of the available resources is actually being allocated

Figure (6.6): Results of the GP Model for Company B

6.3.2.4 Developing a Strategic Quality Management Index (SQMI)

Based on the analysis of the GP model, it is appropriate to develop a SQMI to assess the level of the utilization of resources. This is important because, for example, in the selected case (Company B), although the strategy of PQA is over-resourced by 12.6% more than what should be allocated for it [which may indicate ineffective management of resources], the 12.6% represents just a portion of **what should be allocated for PQA**. Specifically, this portion is 12.6% of the 10.59% or $[0.126 * 10.95 = 1.33\%]$. That means only 1.33% of the overall available resources in Company B were inappropriately consumed in PQA (i.e. placed in a wrong strategy). Therefore, it is important for the company to have an index to determine its efficiency level in term of resources utilization. The SQMI is calculated using the proposed formula as shown below:

$$100 - (\{ \% \text{ of the inefficiency} \} / 2)$$
$$= 100 - (\{ \sum [\% \text{ of the under-resourcing in strategy (i)} \times \text{Weight of Strategy (i)}]$$
$$+ \sum [\% \text{ of the over-resourcing in strategy (i)} \times \text{Weight of Strategy (i)}] \} / 2)$$

The “percentage of the under-resourced” and the “percentage of the over-resourced” for each strategy is shown in Figure (6.6) while the ‘weight’ of each strategy is shown in Table (6.14) [see the column of “overall”]. Accordingly, the SQMI for the company was determined as shown below:

$$\begin{aligned}
&= 100 - \{ \\
&[(5.7\% \times 0.1403) + (10.3\% \times 0.1372) + (10.4\% \times 0.1350) + (0.59\% \times 0.1278) + (4.03\% \\
&\quad \times 0.1217)] \\
&+ [(16.8\% \times 0.1170) + (7.9\% \times 0.1150) + (12.6\% \times 0.1059)] \quad \} / 2 \\
&= 100 - 4.2 = 95.8 \text{ [or 95.8\%]}
\end{aligned}$$

Accordingly, the SQMI for Company B is 95.8%; which means 95.8% of all resources in Company B are allocated as they should be (i.e. distributed to the eight strategies correctly). Conversely, this also reveals that 4.2% of all resources in Company B are assigned to incorrect strategies (incorrect positions). Indeed, as illustrated above, the total over-resourcing or $\sum d_i^+ = 0.042$ (or 4.2%) is equal to the total under-resourcing $\sum d_i^- = 0.042$ (or 4.2%); which in turn confirms the assumption that under-resourcing in some strategies resulted from over-resourcing in the remaining strategies. This implies that 4.2% of the resources should be transferred from the over-resourced strategies to the under-resourced strategies. This is to cover the under-resourcing of 4.2% as a result of eliminating under-resourcing of 4.2%. Such an action will result in 100% of resource utilization (i.e. SQMI = 100).

The index can also be used by the company to assess its SQM practices or to benchmark its level of utilization of resources for SQM with other companies. Compared with Company A, where SQMI is 92.25, Company B is more efficient in terms of resource utilization with an SQMI of 95.8.

6.3.2.5 Resource Re-allocation

The target for each strategy, which is **to maintain what should be allocated (the right side of the goal constraint [$s_{(i)}$])**, cannot be achieved exactly unless needed resources for each strategy are reallocated. Achieving targets ‘exactly’ means that the value of $\sum d_i^-$ and $\sum d_i^+$ should be equal to zero. Thus, the amount of the needed $h_{(i)}$, $o_{(i)}$, and $t_{(i)}$ in the left side of the goal constraints equations should be modified in a way that guarantees the disappearance of the deviational variables in the results (or $\sum d_i^+$ should be $= \sum d_i^- = 0$).

To illustrate such a modification, the coefficients of the HR, OR, and TR ($h_{(1)}$, $o_{(1)}$, and $t_{(1)}$) for ATT (1st goal constraint) should be multiplied by a factor to cover the shortage (under-resource) [$d_1^- = (.008)$] that appeared in the results as shown in Figure (6.6). This factor is obtained by dividing a targeted amount of resources **[i.e. what should be allocated for this strategy (i.e. the right side of the first goal constraint [$s_{(1)}$] that supposed to be maintained)]** by the ‘**actual**’ amount of the resources assigned **in reality (i.e. in practice)** for this strategy or [$0.1403 / (0.1403 - \{\text{under-resourced by } 0.0080\}) = 0.1403 / 0.1323$]. The factor for this goal constraint is 1.06. Note that the actual amount received by this strategy in practice (0.1323) is determined as shown in Figure (6.6). Also note that the factor for this strategy equals 1.06, which is greater than 1, which means the coefficient of HR, OR, and TR ($h_{(1)}$, $o_{(1)}$, and $t_{(1)}$) for ATT will be increased and the percentage of the increase for each type of resource is 6% ($1.06 - 1 = 0.06$ or 6%). The increase of 6% in $h_{(1)}$, $o_{(1)}$, and $t_{(1)}$ should cover the shortage (under-resourcing) of 5.7% ($d^- = 0.0080$) that appeared in ATT, as shown in Figure (6.6).

In contrast, the factor for PQA is less than 1 (factor = 0.889), which reveals that the coefficient of HR, OR, and TR ($h_{(8)}$, $o_{(8)}$, and $t_{(8)}$) should be decreased by 11.1% ($1-0.889 = 0.111$ or 11.1%). This action should remove the over-resourcing of 12.6% ($d^+ = 0.0133$) that appeared in PQA, as shown in Figure (6.6).

Similarly, all goal constraints were modified by determining a factor for each equation. For the remaining six strategies (or remaining six equations of the goal constraints), the factors are 1.115, 1.116, 1.006, 1.042, 0.856, and 0.927 for MQS, CQC, QIM, TCF, CHF, and UHK respectively. In particular, the coefficient of HR, OR, and TR (i.e. $h_{(i)}$, $o_{(i)}$, and $t_{(i)}$) for the strategy of MQS, CQC, QIM, and TCF should be increased by 11.5%, 11.6%, 0.6% and 4.2% respectively to cover their shortages (under-resourcing) as shown in Figure (6.6). In contrast, this also means that the coefficient of HR, OR, and TR ($h_{(i)}$, $o_{(i)}$, and $t_{(i)}$) for the strategy of CHF and UHK should be decreased by 14.4%, and 7.3% respectively to remove the over-resourcing as shown in Figure (6.6). The modified form of the GP model is shown in Figure (6.7). This action resulted in the disappearance of divisional variables from the results as shown in Figure (6.8).

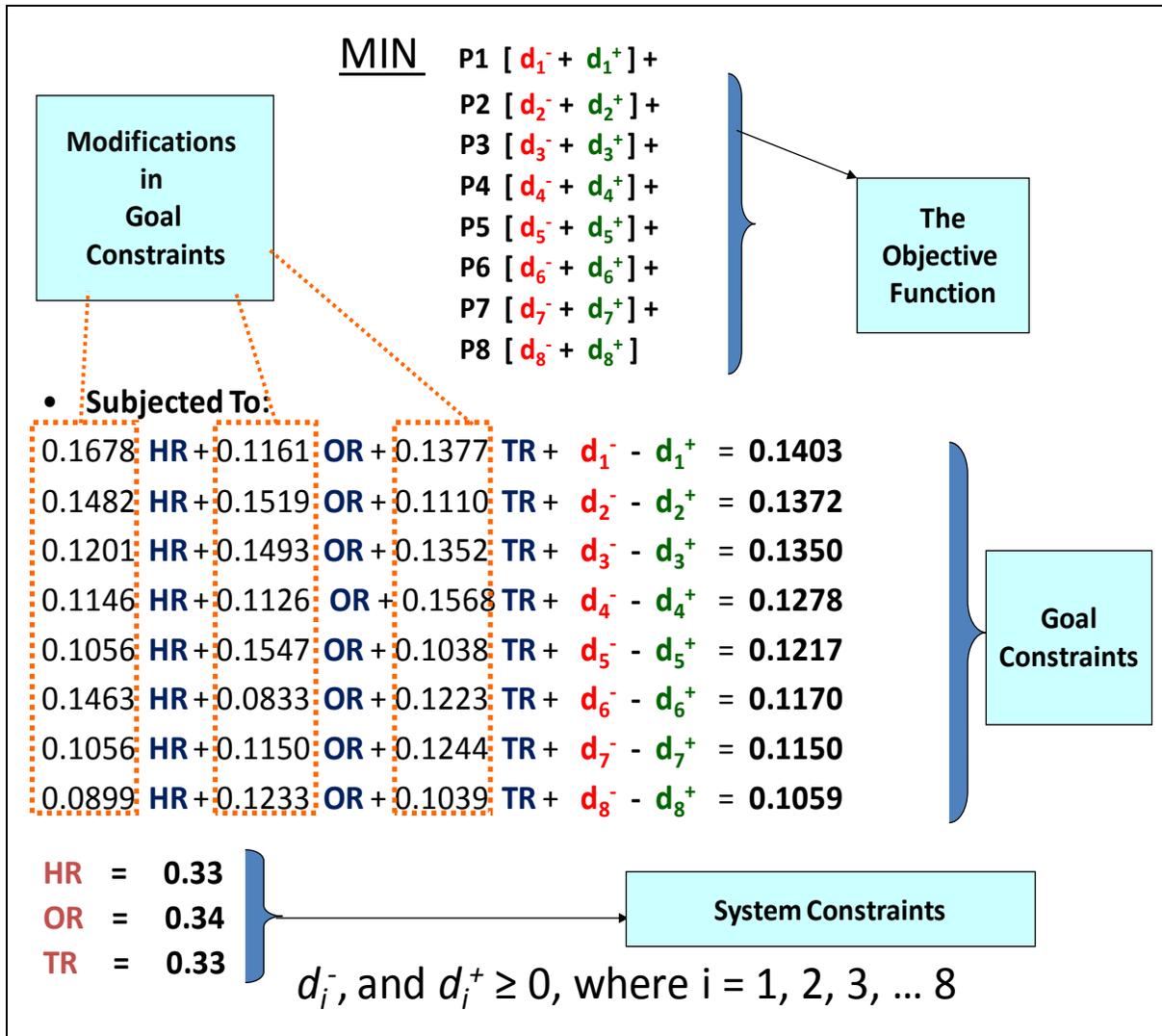


Figure (6.7): The Modified GP Model for Company B

Strategy (i)	Target (Goal) [s _i]	d ⁺	d ⁻	The actual achievement (following resource re-allocation)
ATT	0.1403	0	0	0.1403
MQS	0.1372	0	0	0.1372
CQC	0.1350	0	0	0.1350
QIM	0.1278	0	0	0.1278
TCF	0.1217	0	0	0.1217
CHF	0.1170	0	0	0.1170
UHK	0.1150	0	0	0.1150
PQA	0.1059	0	0	0.1059

Figure (6.8): The Results of the Modified GP Model for Company B

The rationale for developing such factors (modifications) is to change the state of each strategy from “what is actually being practiced” [refer to “The actual allocation in Figure (6.6)] to “what should be allocated for each strategy” [see the column of ‘Target’ in Figure (6.6)]. Such modifications will guarantee that the GP model will exactly satisfy what should be allocated for each strategy [s_(i)] (i.e. $\sum d_i^- = \sum d_i^+ = 0$). This will naturally be at the expense of changing the specific, individual needs of HR, OR and TR for each strategy using the identified factors.

Otherwise, without such a modification, attaining the original needs (non-modified needs) of each strategy results in practicing quality strategies with the existence of over-resourcing (d_i^+) as well as under-resourcing (d_i^-) in the strategies as shown Figure (6.6); which represent the optimum situation (not optimal as $\sum d_i^-$ and $\sum d_i^+ > 0$ [see Figure(6.6)]). Therefore, it is proposed that if Company B wants to attain the optimal (not optimum) situation in which $\sum d_i^- = \sum d_i^+ = 0$ as shown in Figure (6.8), the needed HR, OR, and TR (i.e. $h_{(i)}$, $o_{(i)}$, and $t_{(i)}$) that are mobilized in each strategy must be modified with respect to the developed factors, as modified in Figure (6.7).

6.4 Summary

In summary, this chapter answered the five research questions associated with this case study. The ANP analysis demonstrated the resource allocation problem. Accordingly, the GP model was found to be an appropriate tool to handle such an issue. This issue was critically discussed and analyzed for both: Company A and B. The quantitative analysis concluded and confirmed that each company has its own way of mobilizing resources in response to their own strategic objectives. This chapter proposed a methodology by which the company can utilize its use of resources. This can be attained by ‘satisfying’ the strategic objectives of company’s quality strategies, rather than ‘optimizing’ the objective of a single strategy. From this point of view, this chapter has demonstrated **‘HOW’** resources can be allocated for each strategy to satisfy its exact need, or at least, to minimize the extent to which each single strategy is lacking in or overloaded by resource support (i.e. the fifth research question). This chapter also proposed an SQMI by which the company can

evaluate its level of utilization of resources. According to this proposed index, Company B was more efficient than Company A.

Chapter 7

Qualitative Analysis

7.1 Introduction

This chapter presents the qualitative phase of the case study research. The objective is to explain the quantitative findings of RQ5. Explanations are provided to answer RQ6 to illustrate **WHY** each single strategy may receive resources, whether it is over-resourced under-resourced compared with what should be allocated for it. This is achieved by conducting semi-structured interviews with a total of 12 experts (six from each company/case) during the author's second visit to the two companies in Saudi Arabia. The qualitative analysis starts by analyzing Company A's strategies that are under-resourced, followed by analyzing the strategies that are over-resourced. In the same way, Company B is then investigated qualitatively and the findings are presented. For both companies, the qualitative findings are summarized separately at the end of the analysis of each company in order to form what can be called a *road map* for each company. The eight strategies are listed again in Table (7.1).

Table (7.1): Critical Strategies to Enhance Strategic Quality Management
 (source: Aravindan *et al.* (1996))

<u>Critical Strategy</u>	<u>Acronym</u>
Continuous management of quality system	MQS
Continuous checking of failures	CHF
Continuous approach towards target	ATT
Periodical quality audit (for customers and manufacturers)	PQA
Continuous transfer of customers' feedback	TCF
Continuous use of human knowledge	UHK
Continuous quality information management	QIM
Continuous control of quality costs	CQC

7.2 Strategies that are Under-resourced - Company A

7.2.1 Management of the Quality System (MQS)

Generally, according to the Supply Chain Manager (SCM-A), this strategy has support from senior management. Each department has its own responsibility for monitoring the management system, while the Quality Department focuses more on written procedures and implemented activities. The SCM-A added that “organizational resources are supporting our “follow-up system ... Head of each department gives attention to any related issue”. The QM1-A illustrated that organizational, human, and technological resources are feeding their *balanced scorecard* system as it needs tools and techniques available for employees to control the current practices, policies, and procedures. The QM3-A confirmed the support of

resources by stating that “they support ... if there is no support the whole management system will fall down”.

However, the quantitative analysis indicated that this strategy is under-resourced by 22% of what should be allocated for it. In fact, the issue of “shortage” was mentioned by the SCM-A when he talked about challenges facing this strategy. He emphasized that their management of the quality system focuses on the current situation while the real challenge is to also concentrate on continuous improvement. He added that “there is a big room for improvement ... to be honest ... there are hidden opportunities”. He explained that the Quality Department has the authority to deal with all corrective actions in all departments, which is an opportunity to learn from mistakes. At the same time, he declared that “we miss some opportunities” because staff in the Quality Department claim there is a “lack of resources”. Further explanation regarding this point was obtained when QM1-A stated that quality is associated with all functions in any department and stressed that “everybody needs to be committed to quality ... however, it is difficult to engage all staff”. That is why the QM3-A emphasized that, for this strategy, “the system should be applied to the whole organization and each business unit should be involved”. So, what the QM1-A and the QM3-A are inferring is that the Quality Department is somehow suffering from the lack of cooperation between departments in regard to managing “the quality system” issue. This is a critical issue, as one of the 14 points for ‘management’ that were identified by William Edwards Deming, one of the most well known philosophers in the field of Quality Management, is to “break down barriers between departments and staff areas” (Deming, 2000).

Further details regarding the “lack of resources” are illustrated clearly by the QM2-A. For example, he stated that:

We are squeezing our resources here ... we have a high shortage of manpower for this strategy. For instance, in one shift, we have one inspector responsible for inspecting 13 production lines as well as the raw materials. It is not an issue of training as we, at the managerial level, provide the required training ... The problem is that we have staff shortage at the operational level ... We need new technologies, especially, new devices to inspect raw material and test them in the lab ... Still manpower is the real issue ... The staff of Quality Department should report directly to the CEO, and it was, but now we are reporting to the Supply Chain Department ... So here there is a problem because quality is “the police man” of the organization but as we are reporting to the supply chain in which most of our activities are there, our authority are not as if we are reporting directly to the CEO.

This quotation the QM2-A describes the resource shortage and explains that it relates to the strategy of (PQA), especially in the area of human resources. However, the QM1-A emphasized that all strategies do interact. Specifically the strategy of MQS has the highest priority compared to other strategies because: “it manages other strategies through bringing them all together ... and this needs efforts”. In other words, this strategy needs more resources.

Certainly, the quantitative results showed that this strategy should receive more resources than any other strategy. This strategy needs more organizational support from senior management as the Quality

Department is not reporting directly to the CEO. Indeed, this is confirmed by the SCM-A when he stated: “I’m not required to follow up what the Quality Department recommends”.

In addition, to obtain further explanation, the QM1-A was asked by the interviewer: “What is missing for this strategy?”. He replied that, according to the new national policy for quality, all national companies have to adopt the EFQM model, and the balanced scorecard should be merged with the EFQM model. He stated that “... we have a lot of initiatives but we did not bring them all in one model “. He summarized stating that:

Sometimes ... we do not have a written methodology for executing strategic planning ... The success of the EFQM depends on three things: written methodology, assessment for the implementation of this methodology, and reviewing the methodology from time to time.

Obviously, this strategy has to employ more resources.

7.2.2 Checking of Failures (CHF)

Analysis of the previous chapter reveals that this strategy has a shortage of 15%. Indeed, although all who were involved in the study agreed that checking of failures is one of the main responsibilities of the Quality Department, the QM1-A stressed that, compared to other quality strategies; resources are limited for this strategy. He added that “checking

of failures” is seen as a very specific issue by staff, who think that “checking of failures is not something everybody in the organization should be engaged with ... certain people only should be aware for such an issue”. Moreover, the QM2-A explained that even those certain people are not given enough attention from top management. He affirmed that “we have people who are aware, but not trained (for checking), to carry out the corrective actions ... the cost is also an issue ... the cost sometimes becomes an obstacle here”. In addition, the QM1-A stated that people in this company focus on corrective actions rather than preventative actions and, according to the QM2-A, “not all of these corrective actions get implemented”.

Resources are seen as key drivers for this strategy. Although checking of failures is generally dependent on technological resources, and more specifically on, “the availability of equipment”, effective actions cannot be implemented “in isolation of the skilled staff”, according to QM1-A. He declared that the appropriate equipment is important to help inspectors decide whether or not the inspected item meets company standards and customers expectations. Equipment is also needed to identify the causes of failure. Correspondingly, QM2-A illustrated the significance of resource availability for this strategy by stating that failures cannot be under full control unless “the human itself (human resource) has the required technological resources and receives support from top management (organizational resources)”. Although quality experts in Company A agree that this strategy needs more resource support, the QM2-A believe that failures are generally under control and explained that “even if we don’t have all required “technologies”, people is the key for this strategy and they do their best considering our certain standards of quality”. All participants agreed to this point.

Another perspective came from the QM2-A, who stressed the matter of “belief in quality”, believing it to be a chronic problem in most Arab countries. The QM1-A also mentioned that this could be a cultural issue. From this point of view, the QM2-A recommended linking concepts such as quality, prevention, and correction, to people beliefs such as religious practices. For instance, he stated that:

I have just had a presentation and in the first slide I presented that quality is not only a requirement of our business, but it is also a pre-requisite religious duty (obligation) ... So once people believe that prevention is in no conflict with their religion, it will be then easier to deliver quality related policies.

Therefore, it is no surprise that in Egypt the concept of quality is matched with the business nature better than other management philosophies because “religion is a powerful motive in Egypt” and, hence, Egyptian organizations prefer to be directed to “a spiritual philosophy” such as TQM as such a philosophy is featured by some values such as “loyalty”(Elghamrawy and Shibayama, 2008).

Furthermore, QM2-A also recommended that senior management follows up initiatives to regularly review corrective actions. In the same way, the QM1-A declared that:

To some extent, management is responsible for ‘follow up’ ... we have to have managers who are really taking a step forward to ask why this is happening ... how can we

prevent this? ... and keep asking questions why and why and why...

It seems that both are in agreement that senior management should consider the issue of 'follow up and reviewing' as more important.

All quality managers emphasized that identifying the cause of failure is one of the main issues to guarantee the successful implementation of this strategy. In this regard, they confirmed the need for "more advanced methods and faster methodologies". The QM1-A explained more specifically by stating that "what we miss here is to activate the methodology of root cause analysis, fishbone diagram, or any similar tool ... to be able to eliminate the source of problems". In fact, Doggett (2006) concluded that if decision makers utilize instruments that discover causes and classify these causes according to the field in which the problem exists, they can then focus on and be more specific with the fields that show the most potential.

7.2.3 Approach Towards Target (ATT)

Overall, all participants seem to agree that this strategy is efficient in utilizing the company's resources. This aligns well with what has been obtained from the GP model (i.e. this strategy has utilized 90.6 % of its needed resources and is under-resourced by just 9.4%). The three participants confirmed this situation in their company. According to the SCM-A, "almost all targets are reached". This is because in "every single meeting the target is there", the HRM-A added. These clear target

specifications, according to the QM2-A , have resulted in production of good, quality products.

The participants also confirmed that all three types of resources (HR, OR, and TR) have significant roles to play to achieve such targets. The SCM-A linked people productivity in this strategy with organizational support when he declared that the support from senior management, “thanking by words”, and appreciation of new achievements are what push people to work and perform consistently. Moreover, according to the QM1-A, both technological and human resources are a must for this strategy, which he illustrated by saying:

Sometimes technologies are important because there are certain specifications you cannot achieve them by human effort alone ... however, because staff are operating these technologies and supervising these machines, human resources have to be knowledgeable to achieve these certain specifications.

A deeper understanding of how these resources are mobilized is obtained from the HRM-A. He illustrated that employees know what targets they are responsible for at the beginning of each financial year. Tools such as the “SMART objective” are used to define specific, measurable, achievable, realistic, and time-based targets for each employee. Furthermore, these targets should work within a pre-defined strategic frame through the well known strategic management technique, the balanced scorecard. Quarterly reviews are conducted to control operational and technical target specifications. This is also confirmed by QM2-A who declared that:

At the end of each year ... we have a review of our SMART objectives ... me as a manager, at least 80% of my SMART objectives should be achieved as a part of our Balanced Scorecard ... We have specific targets ... even for each department ... even for each product ... our quality control is running 24 hours to ensure that our products are within the specific range ...

Going back to the quantitative results, reasonable justifications for the 9.4 % shortage of resources in this strategy is generated from interviewees. To illustrate, although there is a consensus that this strategy is efficient in mobilizing its needed resources, some participants mentioned that there is still room for allocating more resources for this strategy. For example, when the QM2-A stated that “at least 80% of my SMART objectives should be achieved”, he means that it is not 100% because it may need more resources. The SCM-A, for example, affirmed that “there are opportunities for utilizing more resources”. He believes that implementing the technique of *six sigma* will result in better data management in the company. He added that this is very important because applying such a technique on data will generate “realistic targets”. In supporting this point, the QM2-A shared the same opinion and when asked if he applied six sigma, he replied “not yet implemented ... it (six sigma) is important in identifying clear targets, objectives, and policies ... it should be linked to our SMART objectives”. In this regard, the SCM-A stressed that training programs for human resources are a must if the company wants to implement six sigma efficiently. In addition, all quality managers agreed that recently launched ‘innovation initiatives’ will support this strategy.

The HRM-A, looked at what was missing for this strategy to be successfully implemented from a different angle. He declared that in the process of developing a business through achieving operational and manufacturing targets, “we always forget what we call developing the organization itself”. He illustrated the point by saying procedures of achieving a certain target should be documented and this documentation should be considered in the business performance assessment. He recommended consideration of “developing self” as well. The QM3-A confirmed the focus in Company A is to achieve targets “for the business (to make money) ... that is why business is there ... If there is no target to be achieved ... business will die”. Put simply, the company should not only be focusing on tangible targets, but on how the company can achieve those targets while considering the benefits to the company’s human capital as well. That is what the HRM-B meant by “developing organization” and “developing self”.

In this sense, Linderman et al. (2006) stated that:

Behavioral theories interact with technical tools and method in interesting ways; that is, the use of technical tools and motivational factors must be managed jointly rather than in isolation ... goals can be effective when used with quality tools and method. This is particularly important for Six Sigma ... operations management is not just a technical problem but also requires behavioral consideration.

Linderman et al. (2006) concluded that executives who are involved in goal setting “can regulate how much organizational knowledge is created through Six Sigma”.

7.2.4 Periodical Quality Audit (PQA)

The previous chapter showed that this strategy (PQA) is the second best strategy for utilization of resources. Quantitatively, only 4% of the resources that should be allocated for it are missing, indicating that this strategy is well implemented in the company. In fact, the SCM-A stressed that they have a strong link to their customers through their technical visits to customers' factories. The QM2-A explained that the aim of these visits is to make sure that customers' requirements match the existing manufacturing processes. All participants confirmed that the Marketing Research Department as well as the Quality and Safety Departments are capable of carrying out audits that cover both customers and the production line. "By technical visits, all feedbacks are recorded and important reports are generated", the SCM-A stated. The QM2-A described that their system of auditing "deals with customers' complaints formally using surveys and informally through technical visits". He emphasized that technical visit is "done without and regardless of any complaints ... It is part of our strategy". The company better understands their customers from such visits. For example, the QM2-A stated that:

In the Jordan market, our customers require specifications that are not implemented yet in our production line, but we will ... Our team found that Jordanians prefer our products to be packaged in a smaller size because they lived generally in villages and they (customers) divided the current "large size" between them.

In addition, according to the QM1-A, production lines, facilities, and the quality system itself are investigated periodically by external auditors and by the company's key customers.

However, in order to justify the 4% shortage of resources, it might be useful to know how the QM1-A looked at this shortage as a "lack of cooperation". He stated: "It is mainly commitment of people ... once auditing is assigned to employees they think this comes as a second priority because it is not a part of their main or daily activities". Therefore, the ITM-A said that staff sometimes handle the auditing assignment 'carelessly' and he emphasized that "people from all departments should be involved". That is why the QM3-A stressed that involvement of people will add diversity and that "switching auditors is important to improve the experience of people". For example, he illustrated that if a certain process is investigated by one auditor, the next assignment for this auditor should be a different process. Indeed, "the best way to ensure quality of operations is to rely on the collective efforts of all individuals ... rather than on the efforts of just the few in the QA Unit and management. Quality is indeed everyone's responsibility" (Foss and Breannndan Moore, 2003).

The lack of resources can also be justified by the QM1-A when he stated that "we need resources for some specific issues that require limited resources, not huge". Although he confirmed that TR are required, he stressed that HR should be the focus because the "auditing itself is a technique done by people and this needs skilled people ... trained people". Indeed, the QM2-A agreed when he stated that "Wallah (he swears by God), we need more people in auditing". He also hoped that the company would strengthen the relationship with customers through activating what he

called a “free customer inquiries phone number”. All previous declarations may justify why this strategy has the 4% shortage of resources.

7.3 Strategies that are Overloaded by Resources - Company (A)

7.3.1 Control of Quality Costs (CQC)

Although all quality managers emphasized the significance of resource availability for activating this strategy, the quantitative results in the previous chapter showed that the strategy of control of quality costs CQC has the lowest priority compared to the remaining seven strategies in terms of the resources that should be allocated. Indeed, the QM1-A stated that:

People normally ignore the costs ... Control of the quality costs is not a priority at all ... Priority is always given to getting the job done ... I'm talking in general ... even though cost issues generally are critical, but still the general tendency of the top management here is that they want to produce a good quality product ... This is their ultimate objective regardless of how much they spend in producing these products in a good quality.

This does not conflict with the quantitative results that showed that this strategy is over-resourced by 70%. It seems that, in company A, they considered the significance of resources for this strategy regardless of how

critical the strategy itself was compared to other strategies. This is not the case when the GP handled the problem of resource allocation in the previous chapter. That is way, quantitatively, the GP, as a multi-criteria decision making tool, showed that this strategy consumes 70% more than what should be allocated for it, which represents just 7% of the overall allocated resources for all strategies. So the 70%, in reality, represents just 4.9% of the overall resources because what should be allocated for this strategy is just 7%.

In fact, all quality managers in Company A stressed that resources are significant for this strategy. The QM1-A stated that this strategy “needs a lot of resources ... in reality we are controlling the cost using a lot of resources because many activities are involved here”. He explained that these activities are supervised by skilled staff and supported by the top management (i.e. OR). He also added that TR are supporting this strategy in terms of analyzing hidden costs. Indeed, the QM3-A confirmed this when he stated that this strategy “is tough and consumes a lot of resources”. The fact that this strategy is consuming more than needed can be seen clearly by the QM2-A when he said that “till now, I think we did not apply the concept of COQ as it should be ... to be honest, we are excellent in controlling failures (failure costs) but we spend more on prevention and appraisal”. Without doubt, “prevention and appraisal are also subject to cost reduction” (Rao et.al, 1996).

The QM2-A explained how resources can be lost or become useless for this strategy. He claimed that although the company provides excellent training programs related to this strategy and also supplies tools such as latest software, the issue is that “the system should be applied to implement the concept of COQ in a professional way ... They teach us, but unfortunately,

COQ is not applied as it should be". He means that training programs for human resources, together with the latest technologies, should be utilized effectively; otherwise, they are waste of investment. In this regard, for this strategy, the QM3-A declared that "resources needed to be organized to be more efficient". So it is a not a matter of a shortage of resources, but rather that resources have to be activated and well organized. The QM1-A stated "the best approach for this strategy is to have a 'focused' area". He explained that key performance indicators (KPI's) for the COQ should be reviewed and then linked to the balanced scorecard. In other word, he wants the spending in prevention and appraisal activities to be limited to this 'focused area'. In this regard, Srivastava (2008) reported that to improve the internal screening for COQ or even for conducting exterior benchmarking, companies can apply various forms of KPIs "such as quality costs as percentage of sales, ratio of quality costs to profits, quality costs as percentage of cost of goods sold, quality costs as percentage of Return on Investments (ROI) etc".

However, having more resources means a strategy is executed successfully, regardless of the efficiency of using the resources. Quality managers validate this through the interviews. The QM1-A mentioned that the issue of COQ "is becoming the focus", especially during the last two years. For example, the QM2-A reported that water consumption has been reduced by 25% resulting in cost saving of SR 2,000,000 per year by reviewing the process of water consumption by technical staff. All managers stressed that the concept of 'innovation', which is becoming part of the culture of the organization, supported this strategy and, according to the QM2-A, the last example is one of the evidences. Although there are a lack of researchers that handle the connection between 'quality' and 'innovation', a number of researchers agree that the two concepts

represent “the central concepts of new forms of economic theory of the firm” (Perdomo-Ortiz et al., 2006).

7.3.2 Quality Information Management (QIM)

The strategy of continuous quality information management (QIM) is one of the ‘over-resourced’ strategies, which according to the quantitative analysis in the previous chapter receives 13% more than resources that it should be. In other words, it has enough resources for implementation. Indeed, during the interview, it was repeatedly stated by the QM2-A that the “resources are enough”. Regarding organizational resources, Company A seems to have a good communication environment to support this strategy. The QM2-A and the SCM-A stressed that their company has a “good communication environment”. According to the QM2-A, “there is an exchange of information through meetings, especially morning meetings ... In each quarter we have a major meeting with the CEO ... We have meetings with supply chain people on a weekly basis”. This was supported by the SCM-A who declared that company A’s employees “are very keen to look after the information, meet and call everybody and, sometimes, people contact each other to make sure the information is delivered with the right understanding ... That helps the communication to be successful”.

If the previous citations confirmed the existence of ‘soft’ communication, participants also verified that the ‘hard’ communication or the “technological infrastructures” for the communications are playing their supportive role in Company A. To illustrate, the SCM-B stated that “we are excellent in using emails in an efficient way”. The QM2-A added that

“rather than the existence of information in each department, we have ‘The Reporter’ (software) by which I can access to any department in order to read or create reports”. The QM1-A confirmed this saying that:

Some people in IT were specialized in gathering information from each department and built what is known as datawarehouse ... Now, instead of creating reports using the traditional way of data entry, reports now can be created automatically using datawarehouse ... Now, some of reports are automatically generated ...

In addition, the ITM-A explained that the datawarehouse has recently been implemented to link the database to the four dimensions of the balanced scorecard. He also illustrated that the success of this strategy begins with recruiting the right people and then training them “to ensure that they have the skill of managing the Oracle system or any ‘ERP system’ in the future”. A general perspective for this strategy can be obtained from the ITM-A, who stated that “we are becoming a more multinational company ... overall, we are in the right direction of implementing this strategy”.

However, it can also be understood from the last sentence that there is room to improve this strategy. To explain, statements such as “we are in the right direction” from ITM-A do not guarantee that Company A is mobilizing resources effectively for this strategy. Substantiation can be obtained from the QM1-A when he stated that “some of the reports are automatically generated” which may mean that not all reports need to be created automatically. It seems that it is not a matter of a shortage of resources. Indeed, the QM2-A confirmed that “it is not an issue of lack of

resources” rather than an issue of “how we going to use them”. To support this, the SCM-A explained that “we are have the infrastructures of e-meeting across the company ... but it is not activated ... the networks are not utilized or utilized very rarely”. In fact, all participants agreed that infrastructure for e-meetings is non-value=adding technology in their organization. Although the QM2-A affirmed that “technology is already existing and it is implemented by default” and claimed that IT people should activate these technologies to be more efficient, the ITM-A, conversely, explained that this is not the responsibility of the IT Department, but rather is a misunderstanding from staff that, occasionally, these technologies are not needed in the business. This clarification from the ITM-A therefore justifies why this strategy receive more than its actual need of resources. Note that the ITM-A said that this occurred “sometimes”, not all times. It is important to understand that, according to SCM-A , people sometimes travel to the company’s branch in Egypt to have a traditional meeting despite the company’s of “e-meetings” infrastructure. That is why some interviewees, conversely, stressed that these technologies should be activated. Regardless, both cases generate costs due to unorganized resources.

The ITM-A provided some further examples to explain this issue. He emphasized that it is a matter of “business process reengineering” rather than a lack of supporting technologies. For example, he talked about issues related to the process of the flow of information between departments. Issues related to “damaged products, missing invoices, and sales for unknown customers” were common. For example, he described that damaged products come firstly to the Dispatching Department then to the Quality Department to do their checking. At the end, all paper work goes to the Sales Department for data entry. Regarding these data entries,

he added that “sales people do not know about the damaged products till the second or third week” because the process itself needs reengineering. Here, the ITM-A indirectly explained that the current process is consuming resources but can be done with less if it is restructured. Moreover, he mentioned that all paper work is sent to the Sales Department manually in hard copy format. However, the information could be documented automatically once damaged products are received by the company, which is possible because the company has already implemented the needed technologies for that. He listed some advantages of ‘reengineering’ such a process by activating certain technologies saying that “if that happens, nobody has to come early for data entry, data will be accurate, and people can then be involved in the analysis work rather than doing what computers should do”.

Similarly, the QM1-A confirmed that training for IT people is not the issue for this strategy when asked if IT people need training. He stated:

Not specifically training rather than they have to know what are our requirements in each process to be simplified ... I have to sit with one of them to discuss the flow of the processes to enable them to understand and to improve the system to generate the required reports ... also to make these reports accessible easily for all people to simplify the decision making process ... Sometimes, instead of having meetings, people may just need to look at the screen to make their decision.

Thus, the ITM-A mentioned that ‘change’ is the key for this strategy to effectively utilize resources. He stated that “we have the system but people do not want to change ... we have to make sure that the organization is ready to accept the change”. Accordingly, the QM1-A and the QM2-A emphasized that ‘innovation initiatives’, with the current cooperation between employees, will be the main driver to simplify complicated processes and eliminate the ‘non-added values’ processes. In this regard, the ITM-A stressed that the company has to concentrate on key initiatives (i.e. not all initiatives) to keep resources under control. Specifically, he said that:

We need to focus ... now what is happening is the business or the department comes with a lot of initiatives, projects, new ideas that are consuming a lot of resources but many of these initiatives and projects are not focused on supporting this strategy and many of them are not critical to be implemented immediately ... and we end up with nothing been implemented or effectively implemented ... We have to select, for example, one or two initiatives and focus on them and then deliver them considering their priority.

In the same way, the QM1-A confirmed that if the company believes in the philosophy of ‘innovation initiatives’, people in the company “have to streamline the process and have a clean sheet of paper to identify their objectives and then re-map the process again to make it simpler, faster, and generate lesser costs ... they have also to eliminate non-added value processes”. Obviously, participants affirmed that resources should be

reduced for this strategy as it consumes a lot of resources for non-added value processes.

7.3.3 Use of Human Knowledge (UHK)

Quantitatively, this strategy utilizes resources more effectively than other strategies as it consumes only 6% more than what should be allocated for it. Through interviewing the six experts, who are working in different managerial positions in Company A, the overall opinion validates the quantitative results. The SCM-A emphasized that “job description and job responsibilities are not barriers” when asked to justify why he considered that resources are utilized appropriately for this strategy. He believes that once employees have the knowledge they can give more, and the company usually assigns more responsibilities to them. Indeed, all participants agreed that the company provides a suitable environment for knowledge sharing. The company “utilizes people who are capable and have enough experience”, SCM-A stated. He added that “then we go for developing people” through training programs designed and presented by those capable employees. This implies that the human knowledge flows inside the company, which indicates good signs for knowledge sharing.

Evidence also came from the QM2-A who confirmed that the available resources are sufficient for this strategy. However, he stressed that “some knowledge cannot be shared unless you have specific technology” because of the existence of “interaction between technological resources and other resources to support this strategy” in the company. This supports the argument in the literature as well as the quantitative results of this research that resources have to interact to effectively support some

strategies. The head of quality and safety as well as the ITM-A also supported this point.

However, a deeper understanding is obtained from the HRM-A. Although the previous discussion demonstrates that Company A is a knowledge-sharing company, it does not show how this knowledge is managed. For this strategy, it is believed that the HRM-A should be most capable of explaining where the hidden 6% of the resources is. He was the only one who declared that this strategy is not “efficient” in utilizing the available resources by saying:

I think part of the problem relates to the traditional understanding of the organization ... engineers are going to work in the factory ... marketing staff in marketing department...HR in HR development ... This traditional way of classifying people ... of labeling people ... limits our capabilities ... if x graduated from HR ... does that mean he/she can contribute only in that area? ...We do not go beyond the departmental boundaries ... As long as you have years of experience, the educational background becomes meaningless ...

The HRM-A was asked to comment on how this statement conflicts with what the SCM-A’s statement that “job description and job responsibilities are not barriers”. He answered “yes ... that is true ... but not in managerial levels, which are more critical”. He tried to explain through the following example:

Just two days ago ... someone from the supply chain department, I want to move him to a senior level in the international trade and export department ... I found a lot of resistance in the company because they claimed the man is not suitable for the new position because he does not have “sales experience”... But I believe that he has good management capabilities and the important thing is that the man is smart ... Within six months he will know everything about these technical issues of the new position ... He knows how to manage operations ...

He stressed that this issue has to be solved by senior management. He added that the company has to have the “emergency sense” by which it can squeeze their human capitals through involving them in various responsibilities instead of hiring new experts, which is an expensive choice. He justified this saying that it is especially important now, because “...we had a pressure in the last two years in the labor market ... there is a lack of experts in the labor market so ‘top management’ has to be willing to accept this idea”. Indeed, the QM2-A confirmed saying that:

People have the knowledge ... but sometimes we lose this knowledge because there is head-hunting surrounding us ... Those skilled people who have learned in this company ... we lose them because of inappropriate positions or salaries paid to them.

QM2-A’s final words clearly demonstrate that there is sort of squandering in the use of resources for this strategy.

7.3.4 Transfer of Customers' Feedback (TCF)

Compared with the other strategies, this strategy is best in the utilization of resources, with the quantitative analysis revealing that just 3% of resources are overloaded. In fact, the HRM-A stated that:

A couple of weeks ago, I was talking with the CEO and we concluded that the traditional marketing research does not work alone ... Our technical people through their visits to different factories (customers) are selling as well ... Rather than selling products, we sell solutions.

To illustrate, he explained that one customer has continually and persistently asked about prices and, consequently, sales staff noticed that this kind of customer needs to be understood. They analyzed the process inside the customer's factory and discovered that the real need of that factory is for another type (form) of product, which is, fortunately, also produced by the company's production lines. The customer is informed that the machines inside the factory need a modified formula and the company begins selling according to the new requirements. Regarding this work, the QM1-A stated that "we added value to their (the customers) processes". Again, the HRM-A stressed that "our technical people provide beyond what traditional marketing do ... they were able to sell a solution for that customer". This indicates a 'healthy' relationship with customers. The HRM-A also highlighted the significance of 'innovation' and reported that "we have to be creative as one of our competitors succeeded in entering a new market through just converting "part of the waste" of the

production process to a “valuable product””. Indeed, “what was considered as rubbish in the past is making profit now”, the ITM-A confirmed.

With regard to internal customers, IT services represent one way that feedback from internal customers is implemented. The ITM-A illustrated that they are activating ‘innovation’ by forming different teams to obtain the requirements of internal customers. These teams meet with people from different departments and negotiate with them about their critical issues. He reported that they “usually get surprised and receive valuable ideas”. This is because people from different backgrounds are involved in brainstorming exercises that link ideas together and result in suggestions for implementation by IT Department.

However, although the QM1-A stressed that customers’ issues are appreciated in all business units and everyone is aiming to meet customer requirements, some participants confirmed that this strategy should receive just the minimal resource requirements. This is because the Saudi government supports some commodities, including Company A’s products, by imposing a ‘Tariff’ on local importers’ products. This results in weakened the competition between the company and local importers. Keeping in mind that the company is the only national producer for this commodity, some participants affirmed that sales’ targets can be achieved easily. From this point of view, the quantitative analysis has not considered this strategy as the most important strategy. It is also shown quantitatively that this strategy is the best strategy in terms of utilizing the resources, as it mobilizes almost exactly what should be assigned for it (only 3% over-resourced). Thus, all participants confirmed that the existence of the ‘tariff’ justified why this strategy is not consuming more resources. The QM2-A explained that it is a fact that the “tariff supports us

against importers which may lead to not listening well to our customer”. He also explained that sometimes, “some feedbacks conflict with the company’s strategy and generate extra costs” and a focus on analyzing and implementing these feedbacks is ‘waste’ because they do not believe that this affects the quality of our products. He confirms that, generally, this strategy only utilizes what it needs from resources. However, he guaranteed that their products meet their customers’ needs. To illustrate, he stated that:

We are producing ‘high quality’ products using our current technologies and techniques ... and at the end of the day, customers will not be affected by not having the latest technologies ... so it is not a big issue for the company.

However, even though this strategy is generally efficient with resources, the 3% over-resourcing has some justifications, which were obtained from interviews and can be summarized into two points. Firstly, the HRM-A and the SCM-A believe that the existence of ‘tariff’ as a government support should limit the focus on feedback from customers. They believe however, that this is not the case as they claimed that quality staff provide an “over concentration” on customers’ feedbacks that consuming the Quality Department’s resources. This leads to the second point, which is that the Quality Department, in some cases, mobilizes resources unsuitably. For example, the QM1-A confirmed that they “do a customer satisfaction survey on a yearly basis through a third party”. When asked why the company uses a third party, he replied that “...because we don’t want to be bias... we need somebody independent to analyze and help us to implement these feedbacks”. Some participants disagree with such a perspective as it conflicts with the company’s current strategy for dealing

with customers. The strategy implies that with government protection supporting the company's products, there is no benefit from listening carefully to customers. This is the perception of sales staff, which is quite different to what staff in the Quality Department staff believe. These perspectives may justify why there is a 3% over-resourcing, but the fact is that compared to all other strategies, this strategy is the best in resource allocation.

7.4 The Road Map for Company A

This section presents the major issues in Company A that have resulted from the qualitative findings. There are three issues characterizing the company's operating environment: cooperation, innovation, and human resources. In this section, these issues are highlighted to show the extent of their influence on quality strategies. Focusing on such issues will help the company to facilitate optimum strategic allocation of resources.

7.4.1 Cooperation

Company A is affected by a 'lack of cooperation' between departments as some business units are not as committed as they should be to the overall quality management system. This issue has a negative impact on decisions made by the Quality Department as some departments do not pay the required attention to the Quality Department's recommendations. The Quality Department is also reporting to the CEO indirectly, which adds

complexity to the issue. For example, it is found that some employees still believe that any quality issue is not part of their responsibilities. In addition, it is found that even if somebody is selected for auditing activities, they think these activities are a lower priority. That is way the participants recommended that all departments should be involved in any quality-related issue to add diversity. Without doubt, building a culture of TQM is not limited to certain people; rather, it is everyone's responsibility (Strolle, 1991).

Although the existence of 'good' exchange of information among people from different departments has been considered as evidence for the successful implementation of QIM, issues such as missing invoices and damaged products confirmed the existence of 'lack of cooperation'. Some activities are carried out manually (paper work) and automatically (intranet) at the same time for no specific reason, which proves the lack of cooperation. Although job descriptions and job responsibilities do not prohibit people from being involved in other activities, senior management prefer to hire new experts rather than finding a solution from within other departments' expertise. This, in turn, weakens the cooperation.

Cooperation plays a significant role in Company A. However, the qualitative analysis showed some examples of a lack of cooperation. This causes a shortage of organizational resources in some strategies, and leads to the appearance of over-resourcing in some strategies too. Therefore, it is considered that Company A is partially influenced by a 'lack of cooperation'.

7.4.2 Innovation

All six participants strongly agreed that the company is driven by innovation initiatives. The concept of innovation was launched recently as a new belief in the company, and is found to have a great impact on ATT, CQC, QIM, and TCF. For example, the consumption of water in the factory is reduced by 25% by reviewing the related processes by technical people. They ended up with an innovative idea that resulted in a reduction of the water consumption and a saving of SAR 2,000,000 per year (1 AUD \$ = 3.3 SAR [approximately]) for the company. It is also found that 'innovation initiatives' are going to be the main enforcer for simplifying the complicated processes or reducing non-value added activities. Moreover, the company wishes to keep the resources under control through the innovation initiatives. However, it is also found from the analysis that these initiatives have to be organized to provide realistic solutions that fit with company's strategies, especially, the strategy of QIM. The IT Department succeeded in arranging 'brainstorming exercises' and received valuable feedbacks and new ideas from their internal customers. What really proves the company's attentiveness 'toward innovation' is the relationship with customers. It is found that 'Traditional market research' cannot work alone as technical people have to be involved creatively to provide more accurate recommendations. The company started to sell 'solutions' to their industrial customers, rather than just selling the company's products to them. Perdomo-Ortiz et al. (2006) confirmed the existence of the connection between 'quality' and 'innovation' as both of them are 'sources of competitive advantage'. Thus, within the context of SQM, regardless of whether the 'innovation initiatives' cause 'over-resourcing' or 'under-resourcing' in company's strategies, these initiatives played a significant role in Company A and it guided the future directions of the company.

7.4.3 Human Resources

People are the strategic key for this company. A lack of qualified people represents one of the causes of the shortage of resources in the strategy of MQS. In regard to CHF, it is also found that technical people need specific training programs targeting corrective actions. It can also be said that, for Company A, the qualitative findings support the quantitative results, which show that the company's strategies are generally driven by soft TQM rather than hard TQM. Although quality tools and related techniques and technologies are important, especially for a strategy such as CHF, all participants confirmed that the existence of skilled and qualified people is more significant. It is also recommended by participants that for PQA, people should be the focus. Although hard TQM played a significant role in ATT, it is found that trained people facilitate the attainment of product specifications. For ATT and CQC, training for technical employees is a must if the company is going to implement Six Sigma. Additionally, recruiting qualified people and providing the appropriate training for them assists the company in maintaining its 'Oracle' system. Capable people are involved in designing and providing practical training programs for other employees, which in turn supports the environment of 'knowledge sharing' within the company. Put simply, although tools such as the 'balanced scorecard', fishbone diagrams, SMART objectives, and other IT infrastructures are essential for 'quality' to be strategically implemented, the qualitative findings reveal that Company A's experts believe that aspects of 'human resources' are more critical for the company. Then people can be effectively involved in activating all quality tools and implementing all quality strategies.

7.5 Strategies that are Under-resourced - Company B

7.5.1 Control of Quality Costs (CQC)

Compared to other strategies, CQC is the most under-resourced, with a shortage of 10.4% of what should be allocated for it. This does not indicate ineffective use of resources. In regard to this strategy, the QM2-B explained that, in the past, the perspective within the company was that “producing high quality products” generates costs. However, this is no longer the belief as the company has become aware of “quality”, and decision makers are now convinced that “quality” saves. He added that, fortunately, the company is now of about Quality Department as the Quality Department has always stressed that the concept of “cost of quality” should be understood firstly by senior management. In this regard, he stated that “quality costs are controlled and we are very conscious ... we are working very efficiently on how to produce at minimum cost without ‘compromising’ on quality”. He added that if costs need to be cut in any activity his first question to the decision maker is always: “Are we going to lose ‘quality?’”. He confirmed that, compared to the past, decision makers have come to understand what the Quality Department means by “cost of quality”.

However, according to HRM-B-M, even though he feels that senior management is becoming aware of COQ, he still believes that cutting costs can sometimes affect the ability to comply with “quality standards”. He always judged that the logistic department could perform better if more resources were allocated. That is why the QM1-B stressed that he cannot claim that this strategy is fully implemented as long as he still notices, for

example, “delays in responses” to the results of auditing reports. He remembered that, for example, the checkweigher of one machine was not working and it took one month to be repaired. He stated that “this delay generate a cost as it has an impact on ‘quality’”. Thus QM3-B reported that, for this strategy, although senior management are committed to ‘quality’, “commitment has to be stronger”. Even the QM2-B himself affirmed that the “company should not compromise on quality ... no commitment without paying”. He explained that the impact of this strategy is very strong as all quality strategies might be affected negatively due to “cost issues”. He also emphasized that advanced technologies as well as trained workers are a must for producing high quality products, and the associated costs of these resources should be considered as “prevention costs”. In addition, QM2-B and QM3-B mentioned that implementing updated software and providing relevant training is important and needs to be considered. The QM2-B also added that “prevention costs” should also consider a “reward system” to motivate people, build awareness of quality, and strengthen the loyalty of employees. He also recommended visiting different symposia, seminars, organizations, and countries to see examples of best practice for running COQ (benchmarking).

Although all quality managers confirmed that the company is strategically headed in the right direction of controlling its quality costs, they agreed that more resources should be allocated for this strategy. The QM2-B stated that “although ‘quality’ is a big concern for the company and we, in general, are satisfied with our performance, the continuous improvement of this strategy (CQC) required resources as TQM is a continuous improvement process”. Specifically, the QM1-B clearly emphasized that recruitment of the right technical people is, in some cases, one of the issues. The QM3-B stated that “resources have to be 100% utilized and,

strategically, we are in the right direction but operationally, more work should be focused on this strategy”.

7.5.2 Management of Quality System (MQS)

Similar to the strategy of CQC, MQS has a shortage of resources. The percentage of the shortage is around 10%, which means that this strategy mobilized 90% of resources that should be allocated to it. In fact, the QM2-B confirmed that the company has always been driven by its well implemented quality management system. The QM1-B stated that “ISO certifications prove our success”. In addition, the SCM-B confirmed this and stated that “the company uses its resources to the best of extent ... all procedures are documented”. The QM3-B reported that “compared to others [competitors], we are satisfied”. The QM1-B illustrated that this strategy is supported by the latest quality methods and techniques as well as by the various HR programs and functional training.

Regarding the shortage of resources in this strategy (10.3%), the QM1-B agreed that resources are not completely allocated for this strategy and stated that “it is an issue of lack of support ... lack of commitment”. He stressed that a “consistent” commitment from executives is needed. The QM2-B has also agreed with this point and added that the lack of commitment leads to an increasing number of corrective actions. (Note that quantitatively, the relevant strategy of CHF is the highest strategy in term of consuming resources and is over-resourced by 16.8%). In fact, as various TQM practices were failed because of a “lack of commitment”, executives have to be individually motivated if the aim is to achieve a successful TQM implementation (Goffin and Szwejcowski, 1996). The

QM2-B summarizes their needs in the MQS strategy in three points: commitment, accountability, and follow up.

Regarding the commitment, the QM3-B also supported this opinion saying that commitment is a must to make the quality system more efficient. In regard to the point of “accountability”, the QM1-B said that:

We need support with accountability ... We have a good reputation but, internally, as I spent many years here [Company B], I believe, and many employees are sharing the same feeling, that the company should care more about accountability.

Foss and Breannndan Moore (2003) confirmed that senior management, without doubt, is responsible for assuring that the compulsory quality “culture, facilities, resources, training, and oversight of reporting systems are in place” to allow people to involve and be accountable for quality activities. The QM2-B believes that accountability should be applied to all employees, and especially top managers as “managers have more responsibilities so more focused accountability should be logically assigned”. For the “follow up”, the SCM-B emphasized that each business unit has to make sure all activities are following ISO standards and added that “manuals related to quality system must be 100% followed and they are occasionally reviewed”. In the same way, the QM2-B added that although the company is committed to employing educated people and has always been aware of “ethics” in the workplace, “follow up processes are important to be activated in this company” to guarantee complete and successful implementation of the quality system.

Another issue that has been highlighted by participants relates to the “recruitment process” as the SCM-B stressed that what is really required for this strategy is “recruiting expertise”. This is due to the fact that the Saudi government is pushing companies to employ nationals as a part of its strategy (known as Sauadization or Nationalization) for reducing unemployment. The QM2-B clarified saying “recruiting experts now is very difficult because of ‘Sauadization’”. The QM3-B considered this issue as one of the most challenging for the company as the needed human resources should not be limited to a certain nationality. Aanother issue related to “qualified people” has been presented by the QM3-B, who claimed that this is significant to increase the efficiency of monitoring and controlling the quality system. He illustrated that for any new product development process, the Quality Department deals with two business units: the purchasing department and the raw material department. However, he added that the Quality Department sometimes suffers from “failed deliveries coming from the suppliers”. He stated that this is because of the lack of qualified people in the purchasing department. He stated that:

What we need is more skilled people in the purchasing department to reduce the number of failed deliveries ... Even though we have a commitment towards a certain supplier, some deliveries have variations, especially the first delivery ... I am talking here specifically about the first delivery....so in that case; we cancel the agreement with the supplier.

When asked “what if there is a lack of suppliers?” he replied by saying “we have many options but the problem is that each time we need the same

type of monitoring”; which justifies the need for qualified people and also justifies why CHF consumes extra resources (over-resourced by 16.8%).

7.5.3 Approach Towards Target (ATT)

Quantitatively, ATT has a shortage of 5.7%, which means it receives 94.3% of what should be assigned for it. The QM3-B clarified that resources are utilized properly saying: “I can say that I am satisfied ... the needed resources are available and used in a scientific way to attain products specifications”. The HRM-B confirmed this, saying “overall, we are in a very good position”. The QM1-B stressed that this strategy is in the right direction as he stated that “we are not just consuming resources ... we are, in reality, developing resources from existing resources”. He provided an example that the machine devices were previously able to measure (read) four decimal places while now they are able to measure up to six decimal places. He explained saying that:

These two decimal places save huge quantity of raw materials used in production ... The saving last year was SAR 16,000,000 and it is expected this year to save around SAR 20,000,000 ... So that is the reason of saying that we developed resources from resources.

The QM2-B stressed that the existence of qualified people as well as the implemented systems, processes and procedures represent the road map by which the company reaches its destination. The QM1-B informed that “many employees in the company are ‘qualified and talented’ ... some of

them have 25 to 30 years of industrial experiences ... so the company considers them as critical assets”. Moreover, the efforts of those technical experts, according to the HRM-B, have recently been evaluated by the company’s Performance Management System (PMS). The HRM-B considers those qualified people as enforcers for this strategy.

From this point of view, the QM1-B emphasized that the company has always attempted to utilize manpower and machining capacity to the maximum limit. The QM3-B agreed that human and organizational resources helped in “achieving a set of specifications for the products”.

However, in an attempt to investigate how the shortage of resources (5.7%) appeared in this strategy, the QM2-B was asked “Why can’t you say that this strategy utilizes 100% of its resources?”. He replied saying that:

Honestly, we have succeeded in implementing this strategy but there are some minor things missing ... These things can contribute to this strategy ... People should know their responsibilities ... If they know their responsibilities, the question is: are they committed to these responsibilities? ... If someone is responsible but not committed or ‘vice versa’, jobs would not be completed as they should be ... commitment between managerial levels is also important to attain the pre-defined technical specifications of the products.

He also emphasized that the focus of this strategy should be on “the knowledge of how to do ... training”. He stressed that the company should strengthen the linkage between functional training and managerial

training as the company believes that the secret of the success is to align “what to do (systems and procedures) with how to do it (HR training)”.

In fact, although the QM2-B highlighted what might be considered as “missing” from this strategy, this doesn’t imply that the strategy is heading in the wrong direction. The QM1-B explained this, saying that “the best thing is to maintain the current situation and to keep it as a base for development ... If we keep this momentum we will be one of the best food-processing companies in the Middle East”. Nevertheless, he also affirmed that continuous improvement reveals “refreshment of resources” through adding new resources. When asked why resources need to be refreshed, he replied that “why resources have to be refreshed?” stating that “the current resources are important to be maintained to be a base for development, but to make quality sustainable, the new resources have to be employed” as a part of the continuous improvement process.

7.5.4 Transfer of Customers’ Feedback (TCF)

Quantitatively, TCF is the second best strategy in terms of utilizing resources as it actually receives 96% of resources that should be allocated for it and is therefore under-resourced by only 4.03%. Regarding how efficient this strategy is in utilizing resources, the HRM-B stated “to the maximum efficiency ... as we respond effectively to both internal and external customers”. Similarly, the QM2-B believes there is a “high level of efficiency”. The SCM-B believes that “this strategy for this company is very critical because it is a marketing-led company”. He feels that the company has always assigned the required resources for this strategy and,

operationally, the related departments (such as quality, sales, and marketing) are committed to analyzing and implementing customers' feedback. Specifically, he confirmed that both capable people and updated techniques are professionally worked to carry out new shapes as well as new designs for new products. He clarified that quality tools such as the "fish-bone diagram" are used to attain customer requirements, which change from time to time. He also reported that recently "the taste and the labels of some of the new products have been changed as a response to the feedback from our valuable customers". All quality managers agree that this strategy is implemented successfully as a result of the existence of effective communication channels with customers. The QM1-B confirmed that they are very strict in following their quality management system in all issues related to customers. In addition, the QM3-B explained that the availability of resources for this strategy facilitates their understanding as well as their commitment to their customers.

In regard to the shortage of resources (4.03%) discussed in the previous chapter, some justifications have been offered by the participants, who affirmed that there is a lack of communication between sales, marketing research, and the Quality Department, specifically in terms of implementing customer suggestions. To be more specific, some participants agreed that an "overlap in responsibilities" among these departments causes such an issue. Note that an "overlap in responsibilities" leads to consuming extra resources in the strategy of PQA, as each of the three departments has its own ways of auditing with customers. In contrast, this has a negative impact on implementing customer feedback due to lack of cooperation between these departments. The HRM-B supports this, saying that "we (as a company) have to build up credibility through sharing the results of auditing". In addition, although

both QM1-B and SCM-B emphasized that communication is very important between the Quality Department and other departments that deal directly with customers, the QM3-B stressed that the Quality Department should have the main responsibility for developing new products. He stated that:

There is an overlapping in responsibilities ... overlap in specializations ... This, in some cases, leads to delay in responding to customer suggestions ... This is because of lack of cooperation between some departments.

Therefore, a “delay in responding” is one of the issues that results from an ‘overlap in responsibilities’. Hence, “overlapping of responsibilities” among senior managers as a result of a “lack of vision and planning” is seen by Soltani et al. (2005) as one of the aspects that is considered as a barrier and vital challenge to TQM in various companies.

Although the QM2-B stated that they are “very serious regarding complaints and try to convey this to customers” through their customer complaint system, he affirmed that they “have to better understand the customer to expect what is in their mind ... doing more preventive actions rather than corrective actions”. The QM1-B confirmed saying that “we should not wait till the complaint came ... we should act instantly”.

It should be noted that this strategy has only a small shortage and all participants generally agreed that customers are satisfied. To support this, the QM1-B summarized the situation of this strategy saying that:

On average, we have 20 complaints per year ... our market share is 60-70% ... so relatively speaking the amount of the complaints is not critical at all ... but we have what I call an internal complaint ... for example, if I see our products are not positioned appropriately on the shelf, I judge with staff in the marketing and sales department.

Although complaints are few and far between, the Quality Department believes that it is important to receive no complaints from external customers as staff have to be alert and detect the problem or defect before the external customers.

7.5.5 Quality Information Management (QIM)

Company B, QIM is the best strategy in the utilization of resources. In fact, ITM-B reported that well implemented “procedures and process” and “information security” support control of the quality of the information system environment in the company. He added that, for example, “our ERP (Enterprise Resource Planning) is centralized and fully controlled at one point to facilitate secure and accurate delivery of the information”. Additionally, he confirmed that the “IT” side of the “ISO” is reviewed and all aspects of IT are successfully controlled. He added that the IT department is also aware of maintenance and backup activities. He also clarified that the internal relationships among different managerial levels reinforce the capability of the IT department to understand their internal customers (employees). Specifically, he stated that:

To be honest, if there is no support, definitely we can't achieve anything ... there is a harmonious relationship between employees and their managers and as a service provider, yes, I feel they understand each other very well; which is one reason of why our IT services are accurate and target specific requirements for our internal customers.

In the same way, the SCM-B expressed his satisfaction with the IT services saying that “in general, IT services are very strong ... whatever we need we can get it ... all employees have become good users and familiar with, Internet and emails”. He added that, rather than providing such technologies, the IT department has always been adapting these technologies to fit with the strategic business units' requirements.

The success of this strategy is also considered to be the result of the effective communication environment in the company. To illustrate, the SCM-B stated that “each single piece of information” related to the company's functions or its future strategies is known and accessible. He added that the monthly performance reports and the CEO reports have continuously been discussed in all departments. This sort of environment, according to the SCM-B's opinion, supports the accuracy of the shared information in the company. Moreover, he added that “recently, the company organized a monthly conference to share “information” among all business units about their achievements, objectives, and obstacles”. According to the QM2-B, the information sharing at these seminars guarantees accurate feeding for the company's database system. He also believes that these seminars support the company's technical environment as he stated that “at least, once a month, each manager presents what new technologies they have to share with all departments”.

Without doubt, the success of this strategy is a reflection of its efficiency in resource utilization. Further evidences can be obtained from the QM1-B who emphasized that, the company does not “spend more than the needed resource” for this strategy. He also stated that “we have to keep this type of management to keep our information system useful and powerful”. He added that this strategy is very efficient because all resources are mobilized appropriately. He clarified that the resources for this strategies include experts, clarity of procedures, and adopting any new technologies or software such as Reporter (software used to generate reports using company’s database).

However, although the QM1-B agreed that the company is strictly following policies and procedures strictly, he stressed that “full implementation of information technology system needs full commitment”. He illustrated saying that

We have resources and we properly use them ... all required technologies are implemented ... but if something has to be improved, it might be better for the company to focus on monitoring, planning and controlling our existing information system.

Note that he said “if something has to be improved”; which indicates that he is, in general, satisfied. Indeed, although the QM2-B informed that they need specific (qualified) people for specific job positions, he affirmed that “I confidently can say this strategy is quite efficient in using resources compared to other strategies”. He added that the company, in general, succeeded in “seeking minimum cost with maximum benefit”. QM2-B’s

statements clearly prove that this strategy is the best in term of resource utilization, as also shown in the quantitative results. Although there is no clear evidence to justify the “very small” shortage in resources in this strategy (0.63%), the ITM-B provides justification regarding how efficient this strategy is by saying that:

I can't say it is 100% efficient as quality is not static; it is a continuous improvement process ... In that sense, it can be said that what is missing or what we should seek is employing more resources in proactive management ... for example, improving time of delivering reports or providing sustainable technical training.

Indeed, the quality is a “continuous improvement process”, which is why the company recently updated its “Oracle” system. The QM1-B stated that “we are a member of OPM (Oracle Processing Management System) and have just updated our system to integrate all business units in the company ... we are in progress”.

7.6 Strategies that are Overloaded by Resources in Company (B)

7.6.1 Checking of Failures (CHF)

This strategy is one of the over-resourced strategies and, according to the previous chapter mobilizes 16.8% more than what should be allocated for it. So regardless of how efficient this strategy is in terms of utilizing the

resources, the amount of allocated resources implies that there are enough resources for the strategy to be successfully implemented. The QM1-B stated that “In regard to this strategy, Quality Department is very strict to be committed to our quality system”. He added that the secret behind that is that they have three gateways to ensure the quality of their products is up to the desired standards. The QM2-B confirmed that the existence of the inspection gates supports the successful implementation of this strategy, stating that “we are in a position that I can guarantee that we are capable to detect any failures”. On top of that, the QM1-B and the QM3-B stressed that intellectual people are the heart of this strategy even though technological resources have a significant role. The QM1-B reported that tools such as Six Sigma drive the implementation of this strategy.

However, “capability” does not reflect the “utilization” appropriately and this point may justify why this strategy is over-resourced by 16.8%. That is why the QM3-B stated that “from my perspective, resources are not ‘excellently’ utilized...they are utilized efficiently but better utilization can be considered”. When asked why resources could be better utilized, he stated regardless of the great capability compared with competitors, failures do still exist even though they are rarely detected by customers. He stated that “we are capable in monitoring and checking but still we can be better”. To understand this issue, it is suitable to link this with the significant point that has always been reported by the QM1-B, which is that managers have to be consistent in their decisions. In this regard, the QM2-B illustrated that the focus should be on enhancing the coordination between different managerial levels to avoid conflicting decisions. He explained that “conflicting decisions” lead to actions that consume resources and add little value. Over-resourcing in this strategy can be clearly understood from the last quotation. In this regard, the QM3-B said

that coordination is important to sustain the checking system. Without doubt, TQM's fundamentals are driven by the assumption that all business units are totally integrated in their efforts of management (Gronstedt, 1996).

For instance, another point has was by the QM2-B when he recommended that training for the national employees should be offered using Arabic, which is the official language in Saudi Arabia. He emphasized that this is important to obtain the benefits of such trainings otherwise it is a "waste of time". Of course, "waste of time" is a non added-value activity (i.e. resources in the wrong place). He added that "Japanese are pioneers in quality management and they use their national languages officially in their companies".

The QM3-B discussed an interesting point saying that:

Although we have a lot of certificates related to quality and safety, these certificates needed to be reviewed from time to time through our monitoring system ... I believe, sometimes, these follow up actions, including auditing, consume resources though repeating the same work ... especially when errors are repeated occasionally ... mistakes should be analyzed to guarantee efficient use of our resources in next checking.

He also clearly affirmed the over-resourcing in this strategy saying that the "availability of resources is not an issue rather than we have to maintain our resources through organizing them". Overall, all interviews confirmed either directly or indirectly, that this strategy is over-resourced.

7.6.2 Periodical Quality Audit (PQA)

Quantitatively, PQA is the second most over-resourced strategy in Company B. Reasonable justifications for the “overloading” have been obtained from participants. This might be due to, according to the QM2-B, the fact that auditing activities consume resources to match between the factory’s capabilities and customers’ requirements. The QM3-B believes that as the company is committed to sustaining its quality standards, auditing as a strategy plays a key role in understanding customers’ specifications in products. The QM1-B reported that “our success in getting different certifications related to quality and safety proves that we are able to conduct any kind of auditing as we are strictly following our well implemented quality management system”. The QM3-B confirmed that the company has “expertise and talented people” who work in parallel with the required technologies to run this strategy successfully. Indeed, QM1-B emphasized that only certified people only who are permitted to do the auditing work as a result of our cooperation with the Human Resources Department in this regard.

Deeper understanding, of auditing production lines has been obtained from the SCM-B, who illustrated that “we have what we call mass production and to track each single unit of product is not easy ... That is why auditing consumes resources such as ... people machines, tools, and techniques”. The SCM-B justified that the company has recently implemented latest technologies to work in parallel with auditors, to reduce the time required to release each patch that has to be investigated. Moreover, he reported that, in regard to auditing works, “although we are satisfied, we are working on taking a step forward to have what we call ‘class A technologies’ this year”.

However, another significant point illustrated by all participants is the overlapping in auditing responsibilities between different departments. This point has also been discussed in the strategy of TCF. The QM3-B stated that although the Quality Department has always been professional in preparing and analyzing customers' surveys for auditing, there is still room for strengthening the utilization of resources. To be specific, he stated that:

The reason in my opinion, is that there is a sort of sharing between different departments (Quality, Sales, and Marketing) who perform sometimes similar assignments and they contact customers directly as we in Quality Department do ... but occasionally they do not cooperate and share their findings with us.

Although Gronstedt (1996) reported that the focus of TQM is on the internal cooperation between departments, Lakhe and Mohanty (1994) confirmed that practicing TQM is not a straightforward application because one of the obstacles is to clarify the responsibilities to avoid "overlapping" in activities. The QM2-B agreed that these departments also, whether they use similar or different software to analyze their auditing job, are not connected properly to a shared database or network. The HRM-B has also confirmed this sort of sharing in responsibility. The QM1-B stressed that recommendation reports that result from auditing should not be ignored and that the company has to respond faster to such reports. [Note that 'fast response' is related to the strategy of TCF; which is under-resourced by (4.03%).] He justified that this is important to avoid detecting the same errors in the next auditing exercise, as this consumes resources for non added values activities. That is why, according to the QM1-B, a lot

of meetings have been conducted with auditors to discuss the repeated mistakes (which is caused by a “over-resourcing” in this strategy) and also to discuss the delaying in responses (which indicates “shortage of resources” in the strategy of TCF). He stated that “our system for auditing has to be customized”. Similarly, the QM2-B confirmed this issue saying that “we have to respond immediately to the auditing report findings”. The QM1-B summarized by saying it is all about “consistency of commitment” from senior management. That is, as long as the company is aware of auditing results, the company will facilitate its assignment in the next audit and therefore consume less resources.

7.6.3 Use of Human Knowledge

The QM3-B said that staff generally provide their maximum effort to share their knowledge as the company “gives value to the knowledge of the people”. He confirmed that all contribute successfully to this strategy and thus have a positive impact on “improving the quality system”. The company believes that all implemented systems, policies, and strategies are run through people knowledge. Additionally, he affirmed that this strategy attained a “great utilization of resources”. Indeed, this reflects the results from the quantitative analysis that this strategy is over-resourced by 7.9%. To illustrate, the HRM-B stressed that for this strategy, “the Company is very keen on using state of the art technology”. He added that they are now updating their human resources management system (HRMS) to facilitate the dealing with their databases and generate fresh enquiries, reports, statistical figures, and self services. He reported that all these aspects are “feeding the human knowledge”.

However, the SCM-B believes that resources can be managed in a more efficient way to serve this strategy. For example, he explained that although the HR department provides “special training for special purposes” to build staff capabilities, there is a need to ensure that “trainees are ready and suitable for that training”. He stressed that utilization of resources has to be improved in a sense of evaluating who should attend the training programs so not to waste the company’s resources. He stated that “this area needs to be improved ... they announce for training and people like it ... but before that I want to know whether this person (trainee) is capable or not”. Similarly, although the QM2-B stated that “we have a practical demonstration ... we develop education by providing a practical demonstration for workers or new employees who run the factory”, he emphasized that “some training sessions should be specified for certain people”. The HRM-B confirmed that saying “we had training but it was not implemented with the best practice ... it was just an extra responsibility added to the HR director”. His statement clearly demonstrates inappropriate utilization of resources (i.e. the 7.9% over-resourced).

It is a fact that the company is concerned about offering a suitable knowledge-based environment for its employees through the “existence of a number of libraries” (the HRM-B stated) or through subscribing in different famous business/scientific magazines (the QM2-B stated). However, these aspects may indicate an inefficiency in utilizing the available resources due to a lack of “consistency in commitment”. The QM1-B reported that:

We still need to customize our usage of resources because there is no consistency in commitment on how to

continually gain the benefits of these aspects ... We need steady approaches to keep things sustainable.

It can be understood, as the QM1-B always mentioned, that the lack of “consistency in commitment” resulted in over-resourcing for this strategy as the available resources have not been appropriately utilized to gain their full benefits. For example, although the QM2-B believes that senior management is capable of providing the required support, he stressed that “one of the key things is commitment ... what we say is what we have to do” and explained that “lack of commitment”, sometimes, causes the company to buy or implement something that it does not need. In addition, the QM1-B gave an example of employing over-qualified people who are not needed immediately saying that “bringing experts means spending money ... if the company (top management) is not ready for the reason of bringing those people over, the company will not get any benefit from them”. His use of “the company is not ready”, could indicate that senior management is not committed to its strategic need. This example further explains how a strategy may consume resources inappropriately due to a “lack of consistency in commitments”. Although it is common that the role of the CEO and senior management is vital to successful implementation of TQM, “lack of commitment” from them could justify why TQM sometimes fails (Soltani et al., 2005). Soltani et al. concluded that one of the issue is that the CEO and senior management are “avoiding taking risk in the interest of keeping the status quo”.

To obtain a deeper understanding, the QM2-B agreed that knowledge can be shared in the company through different communication channels such as the intranet, seminars, and visiting symposiums. Strategically, however, as HRM-B explained, these channels are just part of the issue.

Specifically, he believes that these communication channels will not add value as long as the linkage between the company's strategic objectives and these channels is not clear. What he meant is that the strategic objectives should drive the company towards how these channels are going to be used; otherwise, they are a waste (i.e. over-resourced).

The QM1-B always stressed that "if we want to keep things going at the same level of performance, we have to be consistent in our commitment to keep our directions positive". When asked about the consequences of not having consistent commitment, he replied: "slow system, breaking down, direct impact on cost of production, direct impact on sales, and the most important thing is the opportunity cost ... because you have skilled people but you don't have the approach of consistent commitment". The last sentence supports the quantitative result (over-resourcing= 7.9%).

7.7 The Road Map for Company B

This section summarizes the qualitative findings by presenting the main characteristics of Company B. Specifically, it is found that commitment, overlap in responsibilities, and balancing soft and hard "quality" have a significant effect on Company B's quality strategies. This section discusses these issues in order to provide a "road map" for Company B to allocate its resources in a more efficient manner.

7.7.1 Commitment

Participants frequently cited that the issue of “commitment” from senior management is one of the critical issues in Company B. It can be said that the lack of consistency in commitment played a major role in many strategies that resulted in under-resourcing, or even over-resourcing. To illustrate, according to the qualitative findings, the “inconsistency in commitment” is one of the main causes of the issue of a “delay in response”. It is found that the issue of “delay in response” affects company B’s performance towards perfection in “quality”. For example, for a strategy of CHF, increasing the corrective actions compared to the prevention activities requires a lot of resources to correct the resulted errors. Similarly, this issue led to “inconsistent” decisions made in different managerial levels. It is found that conflicting in decisions resulted in consuming resources for non-value added activities.

For example, senior management still ignore the request to improve the training programs using national languages, which is one of the recommendations made by the QM2-B. The inconsistency of commitment weakens the follow up actions, including the auditing processes, which in turn weakens the accountability, and leads to resource consumption as errors have to be detected and fixed. As a result, these issues support the appearance of over-resourcing in CHF and PQA. As these issues are aspects of “delay in response”, the strategy of TCF has also been affected as it has a shortage of resources. It is confirmed that the company has to respond faster to the auditing reports in a “consistent” manner as part of the company’s commitment to its internal and external customers. The under-resourcing in CQC is also considered a result of inconsistent commitment because the company has to attain high quality products

through strengthening its commitment to “prevention costs”. For a strategy of UHK (over-resourced), it is found that the company has to be consistent in its commitment to “customizing” the usage of resources as some specialized practical training programs are still provided to any person, rather than specific, relevant people. Full benefits of the available resources cannot be obtained unless senior management becomes consistently committed. Otherwise the company will suffer from a lack of resources (shortage) or having inactivated resources (overloading).

Nevertheless, the issue of “inconsistency in commitment” does not mean that the company is not committed to “quality”. Rather, the attempt here is to show the critical nature of the issue of “commitment” regardless of the extent to which senior management is committed. In other words, “commitment” is also considered critical due to the positive impact of the senior management commitment in some aspects. It is found that “consistency in commitment” protects the positive direction of the performance of the company and helps to attain “sustainability” in the company’s quality practices. The significant role of “consistency of commitment” appeared clearly in QIM, which is the strategy that utilizes resources most optimally in Company B. One of the secrets behind the successful implementation of QIM is that senior management is noticeably more committed to this strategy compared with other strategies.

7.7.2 Overlap in Responsibilities

The second reason for the “delay in responses” is “overlap in responsibilities”. Specifically, the “over-resourcing” in CHF and PQA and

the “under-resourcing” in TCF can be seen as consequences of the “overlapping in responsibilities” among different departments. The quality, Sales, and Marketing Departments analyze the findings of their own auditing activities without sharing their recommendations with each other. This, of course, led to “delay in responses” as each department is supposed to discuss and share the recommendations with other departments, which consumes time and efforts. That is why quality experts in Company B stressed that many auditing activities should be linked to the Quality Department to avoid “delay in responses” and to best utilize the company’s efforts. Moreover, it is found that the issue of “overlapping in responsibilities” weakens the coordination between different managerial levels, which has a negative impact on ATT. Without doubt, this issue is critical for Company B as different strategies are involved.

7.7.3 Balancing Human, Organizational, and Technological Resources

Although none of the participants directly stated that all types of resources are sharing the same importance, the three types of resources do contribute collectively in all strategies. This supports the quantitative findings for Company B. Although intellectual assets (people) represent the heart of CHF, tools such as Six Sigma are implemented to run the strategy successfully. For PQA, the process of investigating each patch needs qualified auditors with the support of the latest technologies. Recruiting technical people and training them to use updated software are critical issues related to “prevention costs”. In CQC, aspects related to rewarding (soft TQM), recruitment (soft TQM) and benchmarking (hard TQM) are significant. In addition, latest quality methods as well as HR training programs are core in UHK and MQS. For TCF, the process of creating new shapes and designs for the new products using the latest technologies (i.e.

TR) is fed by effective communication channels with customers (i.e. OR). Moreover, although QIM seems to be technology-driven, the harmony relationships (i.e. OR) between all managerial levels support the success of the IT services. Moreover, qualified people are needed for this strategy. For ATT, maximizing machine capabilities and manpower are essential. On top of that, all these aspects of blending HR and TR are involved in all strategies under the umbrella of the company's systems and procedures as necessity of the continues improvement processes (i.e, OR). Noticeably, Company B is balancing the use of the three types of resources.

7.8 Summary

This chapter attempted to explain and present full details of **WHY** each single strategy mobilized resources more or less than what should be allocated for it (i.e. RQ6). In the other word, this qualitative phase validates the quantitative findings of the previous phase. A full qualitative discussion for Company A and Company B is presented. The discussion explains reasons and presents reasonable justifications from the participants. Regardless of all the obtained details, a general perception for each company can be carried out from this qualitative analysis. It can be concluded that, in general, Company A is mainly driven by human and organizational resources rather than technological resources. For instance, aspects such as 'cooperation' and 'innovation' were found as vital drivers in company A. In contrast, in Company B, HR, OR, and TR were sharing the same level of significance; which in turn clearly validates the quantitative findings of the ANP step. Two critical issues can be obtained from the qualitative analysis of Company B: 'commitment' and 'overlap in responsibilities'. A Focus on resolving such issues could lead to better utilization of resources.

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Appendix A: Categorization of TQM Critical Elements into Three Types of Resources: Technological, Organizational, and Human resources

Authors	Technological Resources	Organizational Resources	Human Resources
Saraph et al. (1989)	<ul style="list-style-type: none"> • Product/Service design • Process management 	<ul style="list-style-type: none"> • Management leadership • Role of the Quality Department • Supplier quality Management • Quality data and reporting 	<ul style="list-style-type: none"> • Training • Employee relations
Flynn (1994)	<ul style="list-style-type: none"> • New product quality • Product design characteristics • Process control 	<ul style="list-style-type: none"> • Top management quality leadership • Feedback • Cleanliness and organization • Interfunctional design efforts • Supplier relationship • Customer interaction 	<ul style="list-style-type: none"> • Rewards for quality
Anderson et al. (1995)	<ul style="list-style-type: none"> • Process management • Continuous improvement 	<ul style="list-style-type: none"> • Visionary leadership • Internal and external cooperation • Customer satisfaction 	<ul style="list-style-type: none"> • Learning • Employee fulfilment
Badri et al. (1995)	<ul style="list-style-type: none"> • Product/service design • Process management/operating procedures 	<ul style="list-style-type: none"> • Role of divisional top management and quality policy • Role of Quality Department • Quality data and reporting • Supplier quality management 	<ul style="list-style-type: none"> • Training • Employee relations
Powell (1995)	<ul style="list-style-type: none"> • Benchmarking • Measurement (statistical methods) • Zero-defects mentality • Flexible manufacturing • Process improvement 	<ul style="list-style-type: none"> • Executive commitment • Adopting the philosophy • Closer to customers • Closer to suppliers • Open organization 	<ul style="list-style-type: none"> • Training • Employee empowerment

Authors	Technological Resources	Organizational Resources	Human Resources
Ahire et al. (1996)	<ul style="list-style-type: none"> • SPC usage • Benchmarking • Design quality management • Product quality 	<ul style="list-style-type: none"> • Top management commitment • Supplier quality management • Supplier performance • Customer focus • Internal quality information usage 	<ul style="list-style-type: none"> • Employee involvement • Employee training • Employee empowerment
Black and Porter (1996)	<ul style="list-style-type: none"> • Quality improvement measuring systems 	<ul style="list-style-type: none"> • Corporate quality culture • Strategic quality management • Suppliers partnerships • Teamwork structure • External interface management • Operational quality planning • Customer satisfaction orientation • Communication of improvement information 	<ul style="list-style-type: none"> • People and Customer management (linking HR and customer relations)
Grandzol and Gershon (1998)	<ul style="list-style-type: none"> • Continuous improvement • Process management • Product/service quality 	<ul style="list-style-type: none"> • Leadership • Customer focus • Cooperation • Finance (as a result of organizational success) • Customer satisfaction 	<ul style="list-style-type: none"> • Employee fulfilment • Learning • Employee satisfaction

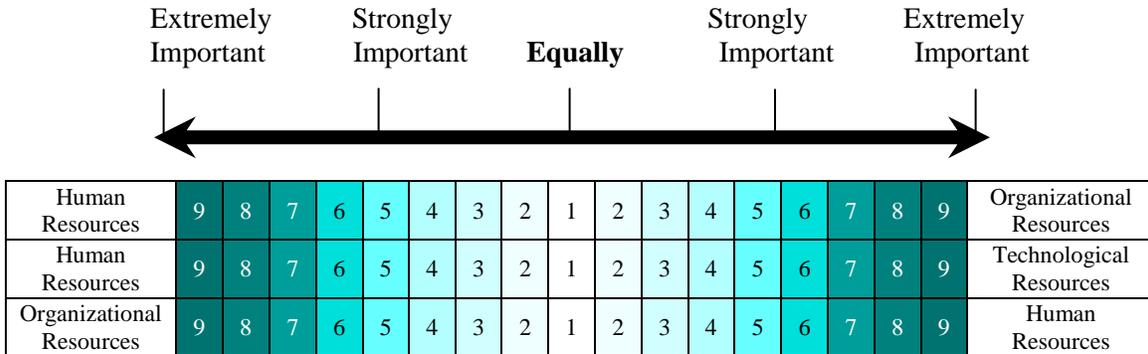
Authors	Technological Resources	Organizational Resources	Human Resources
<p>Quazi et al. (1998) refining the model of Saraph et al. (1989)</p>	<ul style="list-style-type: none"> • Product/Service design • Process management/operating procedures 	<ul style="list-style-type: none"> • Role of top management and quality policy • Role of the quality department • Supplier quality • Quality data and reporting 	<ul style="list-style-type: none"> • Training • Employee relations
<p>Rungtusanatham et al. (1998) used Anderson et al's (1995) framework in Italy</p>	<ul style="list-style-type: none"> • Process management • Continuous improvement 	<ul style="list-style-type: none"> • Visionary leadership • Internal and external cooperation • Customer satisfaction 	<ul style="list-style-type: none"> • Learning • Employee fulfillment
<p>Tamimi (1998)</p>	<ul style="list-style-type: none"> • Product/service innovation 	<ul style="list-style-type: none"> • Top management commitment • Supervisory leadership • Cross functional communications to improve quality • Supplier management 	<ul style="list-style-type: none"> • Education • Quality training, Providing assurance to employees

Authors	Technological Resources	Organizational Resources	Human Resources
Dow et al. (1999)	<ul style="list-style-type: none"> • Use of benchmarking • Advanced manuf systems • Use of just-in-time principles 	<ul style="list-style-type: none"> • Workforce commitment • Shared vision • Customer focus • Use of teams • Co-operative supplier relations 	<ul style="list-style-type: none"> • Personnel training
Joseph et al. (1999)	<ul style="list-style-type: none"> • Product design • Technology utilization • Operating procedures 	<ul style="list-style-type: none"> • Organizational commitment • Supplier Integration • Quality policy • Role of quality department • Quality information systems 	<ul style="list-style-type: none"> • Human Resources management • Training
Hua et al. (2000)	<ul style="list-style-type: none"> • Processes 	<ul style="list-style-type: none"> • Leadership • Policy and strategy • Quality assurance • Supplier quality • Business results • Customer satisfaction • Impact on society 	<ul style="list-style-type: none"> • People management • Employee involvement
Zhang et al. (2000)	<ul style="list-style-type: none"> • Evaluation • Process control and improvement • Product design • Quality system improvement 	<ul style="list-style-type: none"> • Leadership • Supplier quality management • Vision and plan statement • Customer focus 	<ul style="list-style-type: none"> • Employee participation • Recognition and reward • Education and training

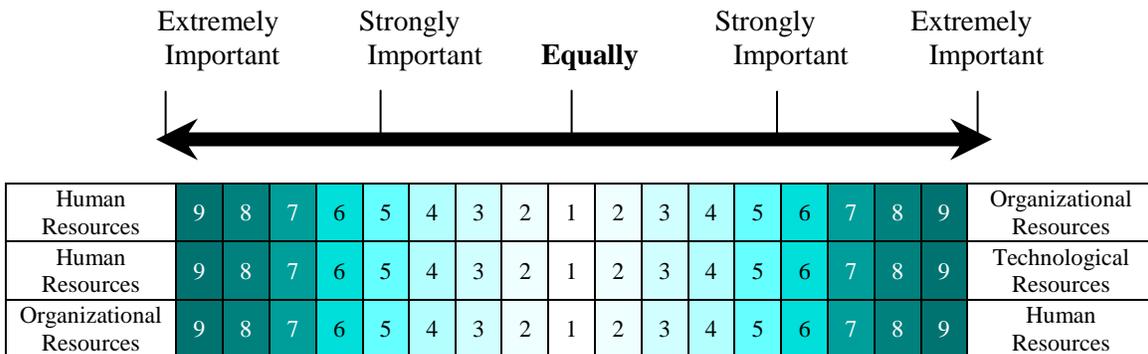
Authors	Technological Resources	Organizational Resources	Human Resources
Antony et al. (2002)	<ul style="list-style-type: none"> • Continuous improvement 	<ul style="list-style-type: none"> • Quality data and reporting • Management commitment • Customer satisfaction orientation • Role of quality department • communications to improve quality 	<ul style="list-style-type: none"> • Training and education
Perdomo-Ortiz et al. (2006)	<ul style="list-style-type: none"> • Process management • Product design 	<ul style="list-style-type: none"> • Management support • Information for quality* • Relationship with suppliers and customers 	<ul style="list-style-type: none"> • Human Resources management
Tari (2006)	<ul style="list-style-type: none"> • Process management • Continuous improvement 	<ul style="list-style-type: none"> • Customer focus • Customer satisfaction • Leadership • Suppliers management • Quality performance • Quality planning • Social impact 	<ul style="list-style-type: none"> • Staff indicators • Learning • Employee management • Employee satisfaction

Part (2-A):

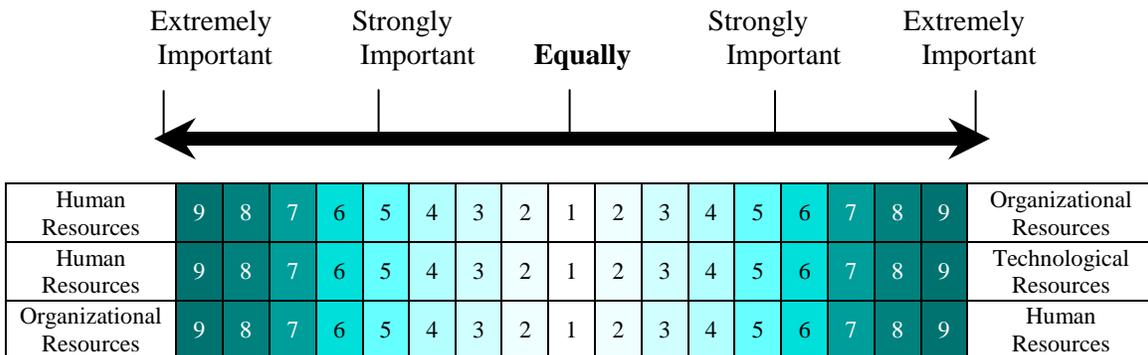
With respect to “**Strategy1: Continuous use of human knowledge**”, what is the relative importance of the resources appearing on the left side of the page to its counterpart appearing on the right side?



With respect to “**Strategy2: Continuous quality information management**”, what is relative importance of the resources appearing on the left side of the page to its counterpart appearing on the right side?



With respect to “**Strategy3: Continuous approach towards targets**”, what is the relative importance of the resources appearing on the left side of the page to its counterpart appearing on the right side?



Part (2-B):

“Human Resources” have significant role in maintaining the eight strategies. In your opinion, please compare the relative significance of this role between each pair of the strategies listed on opposite side of each row?

	Extremely Important		Strongly Important			Equally			Strongly Important			Extremely Important						
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	QIM
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ATT
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CHF
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ATT
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CHF
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CHF
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
CQC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
CQC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
CQC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
TCF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
TCF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
MQS	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA

“Organizational Resources” have significant role in maintaining the eight strategies. In your opinion, please compare the relative significance of this role between each pair of the strategies listed on opposite side of each row?

	Extremely Important		Strongly Important			Equally			Strongly Important			Extremely Important						
																		
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	QIM
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ATT
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CHF
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ATT
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CHF
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CHF
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
CQC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
CQC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
CQC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
TCF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
TCF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
MQS	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA

“Technological Resources” have significant role in maintaining the eight strategies. In your opinion, please compare the relative significance of this role between each pair of the strategies listed on opposite side of each row?

	Extremely Important	Strongly Important	Equally	Strongly Important	Extremely Important													
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	QIM
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ATT
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CHF
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ATT
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CHF
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CHF
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
CQC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
CQC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
CQC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
TCF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
TCF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
MQS	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA

Ignoring all three resources and their influence, please compare each pair of strategies (appearing on opposite sides) with respect to their ability to strategically enhance quality?

	Extremely Important		Strongly Important			Equally			Strongly Important			Extremely Important						
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	QIM
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ATT
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CHF
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
UHK	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ATT
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CHF
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
QIM	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CHF
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
ATT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CQC
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
CHF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
CQC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TCF
CQC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
CQC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
TCF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	MQS
TCF	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA
MQS	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PQA

Appendix C: The Prepared Questions for Interviews

<p style="text-align: center;">Prepared Questions (proposed for each strategy)</p>	<p style="text-align: center;">Justification (why to be asked?)</p>
<p style="text-align: center;"><u>Question 1.</u></p> <p><u>A:</u></p> <p>If “10” indicates highest level of efficiency and “0” indicates lowest level of efficiency, how efficient is your strategy of “X” in term of its overall utilization of the available resources (human, organizational, or technological resources, which are required for its implementation)?</p> <p><u>B:</u></p> <p>And Why?</p>	<p>to obtain any information that is supposed to be helpful to justify why this strategy is taking more (or less) than their need of resources</p> <p>“why” is added to generate further explanations</p>
<p style="text-align: center;"><u>Question 2.</u></p> <p><u>A:</u></p> <p>With respect to strategy “X”, rank the three types of resources (human, organizational, and technological resources) in term of its utilization of each type?</p> <p><u>B:</u></p> <p>And Why?</p>	<p>the previous question may not obtain the required or completed justification, or even for further details and evidences.</p> <p>“why” is added to generate further explanations</p>

Prepared Questions (proposed for each strategy)	Justification (why to be asked?)
<p style="text-align: center;"><u>Question 3.</u></p> <p><u>A:</u></p> <p>Based on your own perspective/experience, what do you recommend for this strategy to be successfully implemented?</p> <p><u>B:</u></p> <p>And Why?</p>	<p><u>Similar to the above.</u></p> <p><u>Moreover,</u> this open-ended question will make the expert feel free to talk more about the strategy.</p> <p>“why” is added to generate further explanations</p>

Appendix D: Case Study Protocol

1. Phase 1: The Quantitative Phase

1.1 Selecting the case/company

1.2 Visiting the company

1.3 Selecting the most appropriate employees/experts from the Quality Department to be involved.

1.4 Step 1: The ANP Analysis

1.4.1 Presenting the pair-wise comparisons between the three clusters (resources, strategies, and ability to enhance quality) to the selected experts in a questionnaire

1.4.2 Providing a set of instructions to the participants/experts on how to conduct the comparisons based on their own experience and distributing the questionnaire

1.4.3 Collecting the questionnaire

1.4.4 Analyzing the data using Super Decisions® (software)

1.4.5 Checking the Consistency Ratio (CR) for each pair-wise comparison for each participant/expert

1.4.6 Aggregating the findings (averaging experts' results to represent the company's overall finding)

1.4.6.1 Using Aggregating Individual Judgments (AIJ) if the preferred situation is to consider that participants are combined and “behave like one” to represent the opinion of the company

1.4.6.2 Using Aggregating Individual Priorities (AIP) if the preferred situation is to consider that the participants “are each acting in his or her own right”

1.4.7 Analyzing ANP’s findings to explore the differences between the needed resources for each strategy and the actual support of resources towards each strategy

1.5 Step 2: GP Model

1.5.1 Developing the GP Model (ANP’s Outputs to be GP’s inputs)

1.5.1.1 Combining findings of RQ1 and RQ2 to formulate system constraints

1.5.1.2 Combining findings of RQ3 and RQ4 to formulate objective constraints

1.5.1.3 Determining the coefficients (h_i , o_i , and t_i) of each decision variable (H, O, and T) in each objective constraint (each strategy, s_i)

1.5.2 Running the GP model using ‘QM for Windows®’ (software) to determine d_i^- and d_i^+ (Answering RQ5)

1.5.3 Developing the SQMI

1.6 Repeat Phase 1 for the second company

The end of the first phase

2. Phase 2: The Qualitative Phase

2.1 Re-visiting the first company

2.2 Selecting the interviewees

2.2.1 The involved experts in the first phase.

2.2.2 Involving other experts from different departments related to the Quality Department for further explanations

2.3 Conducting the semi-structured interview with one of the experts

2.3.1 Asking the first prepared question for the semi-structured interview

2.3.2 Asking any unprepared questions during the answer for further explanations

2.3.3 Asking the second prepared question for the semi-structured interview

2.3.4 Asking any unprepared questions during the answer for further explanations

2.3.5 Asking the third prepared question for the semi-structured interview.

2.3.6 Asking any unprepared questions during the answer (for further explanations).

2.4 Repeating the semi-structured interview with individual expert from the first company as described above

2.5 Re-visiting the second company

2.6 Conducting the semi-structured interviews in the second company as conducted in the first company

2.7 Analyzing the qualitative findings

The end of the second phase

3. Interpreting quantitative and qualitative findings for both companies