

# Anexo I - Afirmações do questionário

## AFIRMAÇÕES ASSOCIADAS À GESTÃO PELA QUALIDADE TOTAL

### Liderança (LID)

*A gestão de topo está comprometida com a gestão pela qualidade (LID1);*

*A gestão de topo tem objetivos definidos a longo e médio prazo (LID2);*

*A gestão de topo tem definidas linhas orientadoras para a qualidade (LID3);*

*A gestão de topo prevê eventuais alterações do meio envolvente e atua de forma a superar essas alterações (LID4);*

*Todos os membros da gestão de topo partilham opinião similar sobre o "caminho" que a organização deve seguir (LID5);*

*As atividades e investimentos com benefícios a longo prazo têm apoio da gestão de topo (LID6);*

*A gestão de topo motiva os colaboradores a participarem nos processos de mudança da organização (LID7).*

### Focalização no Cliente (FOC)

*A informação sobre a satisfação dos clientes é tida em conta na melhoria do produto ou serviço (FOC1);*

*Os clientes são envolvidos no processo de desenvolvimento de produtos ou serviços (FOC2);*

*Os processos e atividades da organização centram-se na satisfação dos clientes (FOC3);*

*Satisfazer os clientes e conhecer as suas expectativas são atividades prioritárias da organização (FOC4).*

### Envolvimento e Desenvolvimento de Pessoas (EDP)

*Os colaboradores participam na resolução de problemas (EDP1);*

*Os colaboradores recebem formação no âmbito da gestão pela qualidade (EDP2);*

*Existem sistemas de incentivo para os colaboradores (EDP3);*

*A atribuição de funções aos colaboradores é feita de acordo com a competência e aptidão dos mesmos (EDP4);*

*Os colaboradores participam na melhoria dos produtos e dos processos (EDP5);*

*Os colaboradores dão opinião, fazem sugestões e são inquiridos acerca das atividades da organização (EDP6).*

### Gestão por Processos (GPR)

*Os processos da organização estão identificados (GPR1);*

*Os processos da organização estão documentados (GPR2);*

*Os locais de trabalho estão organizados (GPR3);*

*A manutenção preventiva assume enorme importância (GPR4);  
Evitar a produção de produtos não-conformes é muito importante para a organização (GPR5);  
Os processos de conceção de novos produtos ou serviços contribuem, de forma fundamental, para a sua qualidade (GPR6).*

#### **Melhoria Contínua (MCO)**

*A organização incentiva a melhoria contínua dos produtos, serviços e processos (MCO1);  
Os colaboradores têm oportunidade de sugerir alterações de melhoria aos processos existentes (MCO2);  
A maioria dos produtos foi melhorada recentemente (últimos 3 anos) (MCO3);  
A organização é reconhecida publicamente por introduzir melhorias nos seus produtos, serviços e processos (MCO4).*

#### **Relações com fornecedores (RFO)**

*Existe uma relação de confiança e cooperação com os fornecedores (RFO1);  
A informação dos fornecedores é usada na melhoria dos produtos (RFO2);  
A organização incentiva o uso de poucos fornecedores com base na qualidade e não apenas no preço (RFO3);  
Os fornecedores são certificados (RFO4).*

#### **Medição de Resultados (MRE)**

*A informação relativa a resultados da gestão da qualidade está disponível aos colaboradores (MRE1);  
Os colaboradores dos diferentes processos usam ferramentas de controlo da qualidade para avaliarem os seus processos (MRE2);  
São feitas avaliações periódicas da qualidade a toda a organização (MRE3).*

#### **Design do Produto (DPR)**

*As características dos produtos ou serviços são revistas periodicamente (DPR1);  
O “design” dos produtos ou serviços considera os requisitos dos clientes (DPR2);  
O “design” dos produtos ou serviços tem em consideração a informação dos fornecedores (DPR3);  
São realizados testes de conformidade/fiabilidade antes da comercialização dos produtos (DPR4);*

### **AFIRMAÇÕES ASSOCIADAS À INOVAÇÃO**

#### **Investigação, Desenvolvimento e Inovação Tecnológica (IDT)**

*A organização criou ou mantém um departamento de Investigação & Desenvolvimento (últimos 3 anos) (IDT1);*

*A organização desenvolveu novas tecnologias (últimos 3 anos) (IDT2).*

#### **Inovação do Produto (IPR)**

*A organização introduziu produtos novos ou significativamente melhorados (últimos 3 anos) (IPR1).*

#### **Inovação do Processo (IPC)**

*A organização implementou métodos de fabrico ou produção novos ou significativamente melhorados (últimos 3 anos) (IPC1).*

#### **Inovação Organizacional (IOR)**

*A organização introduziu novas práticas nos procedimentos (por exemplo, na gestão da cadeia de fornecedores, na reengenharia de negócios, na gestão do conhecimento, “lean production”, na gestão da qualidade, etc.) (IOR1);*

*A organização introduziu novos métodos de organização das responsabilidades e da tomada de decisão (por exemplo, primeira utilização de novos sistemas de responsabilização dos trabalhadores, de trabalho em equipa, descentralização, integração ou desintegração de serviços, sistemas de formação, etc.) (IOR2);*

*A organização introduziu novos métodos de organização das relações externas com outras organizações (por exemplo, primeira utilização de alianças, parcerias, “outsourcing” ou subcontratação, etc.) (IOR3).*

#### **Inovação da Gestão (IGE)**

*A organização introduziu novos métodos de gestão (por exemplo, informatização administrativa, novos sistemas de motivação e remuneração, criação de novos departamentos, etc.) (IGE1);*

*A organização introduziu novos sistemas de gestão de conhecimento (por exemplo, uso e troca de informação, uso de conhecimento dentro da organização, recolha e interpretação de informação fora da organização) (IGE2).*

#### **Inovação de Marketing (IMA)**

*A organização introduziu mudanças significativas no aspeto/estética ou na embalagem dos produtos (excluir mudanças que alteram as características funcionais do produto) (IMA1);*

*A organização introduziu novas técnicas ou meios de comunicação para a promoção dos produtos (por exemplo utilização pela primeira vez de um suporte publicitário, nova imagem de marca, introdução de cartões de fidelização de clientes, etc.) (IMA2);*

*A organização introduziu novos métodos de distribuição e colocação de produtos ou novos canais de venda (por exemplo, utilização pela primeira vez de “franchising” ou licenças de distribuição, vendas diretas, novos conceitos para apresentação dos produtos, etc.) (IMA3);*

*A organização introduziu novas políticas de preço para os produtos (por exemplo, utilização pela primeira vez de sistemas de "pricing by demand", de sistemas de descontos, etc.) (IMA4).*

#### **AFIRMAÇÕES ASSOCIADAS AO DESEMPENHO FINANCEIRO**

*Aumentou o retorno médio dos ativos (últimos 3 anos) (DFI1);*

*Aumentou o valor das receitas (vendas, prestação de serviço, etc.) (últimos 3 anos) (DFI2);*

*Aumentou o valor médio de lucro sem impostos (últimos 3 anos) (DFI3).*

#### **AFIRMAÇÕES ASSOCIADAS AO DESEMPENHO ORGANIZACIONAL**

*Os clientes da organização encontram-se satisfeitos (DOR1);*

*Os colaboradores da organização encontram-se satisfeitos (DOR2);*

*Os acionistas da organização encontram-se satisfeitos (DOR3);*

*As instituições financeiras parceiras da organização encontram-se satisfeitas (DOR4).*

#### **AFIRMAÇÕES ASSOCIADAS AO DESEMPENHO OPERACIONAL**

*O produto tem qualidade (as necessidades dos clientes são satisfeitas) (DOP1);*

*A organização tem um bom desempenho relativamente ao prazo de entrega (DOP2);*

*A organização consegue alterar rapidamente as quantidades produzidas/fornecidas (DOP3).*

## Anexo II - Artigo publicado

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# Exploring the Synergy Between Total Quality Management and Innovation

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**Abstract:** This paper aims to analyse the relationship between total quality management (TQM) and innovation, and the relationships between these variables and organizational performance. The literature reviewed indicates some disagreement among the authors that have studied the relationship between TQM and Innovation. Some consider, total quality management as a support for innovation. Others concluded that total quality management practices do not directly improve innovation. Even though there is no consensus on the relationship between TQM and organizational performance, most researchers concluded that performance can be improved through TQM practices. Regarding the relation between innovation and organizational performance, there has been a consensual opinion, among researchers, supporting a direct positive relationship. Based on the literature reviewed, a global conceptual model, that encompasses the different relationships, is proposed. This model needs to be tested, but it is expected that it will help finding alternative ways of improving organizational performance.

**Keywords:** total quality management; innovation; organizational performance

## 1. Introduction

The market globalization, the extremely aggressive competition and greater demands from consumers have forced organizations to adopt competitive strategies which highlights the TQM and Innovation. According to Han et al. (2007), firms have adopted practices of Total Quality Management (TQM) as a strategy for responding to customer requirements. This is a management approach, where the main concern is to meet the needs and expectations of customers through the integration of all functions and processes of the organization to achieve continuous improvement of quality of goods and services (Fuentes et al, 2006; Han et al. 2007; Lenka and Suar 2008). Moreover, strengthening the competitive advantages of each organization may be accomplished by developing a systematic and sustained innovation which has become a critical success factor. Innovation may be defined as the tendency of the firm to support new ideas, experiences and creative processes, earlier than competitors (Covin and Miles 1999). It is considered one of the most important factors of economic competitiveness (Pohlmann 2005). The relationship between TQM practices and innovation, and the influence of these dimensions, in terms of organizational performance have been studied in several investigations. However, there is no agreement on the findings presented by researchers. A research project to study the relationships between the dimensions and simultaneously include all three dimensions may provide some contribution in this area of research. Therefore, the aim of this paper is to study if there is a relationship between practices of TQM and Innovation, and relationships between these dimensions and organizational performance. Specifically, the objective is to identify: 1) the influence of TQM practices on innovation, 2) the influence of TQM practices on organizational performance, 3) the influence of innovation on organizational performance. Besides this introductory part, the article consists of four chapters. Chapter 2 presents a literature review that covers the concepts related to the dimensions under study. Chapter 3 presents some considerations about causal relationships between TQM practices, innovation and organizational performance. Chapter 4 describes the conceptual model proposed in this paper. The article ends with Chapter 5, which presents the conclusions and prospects for future work.

## 2. Literature review

### 2.1 Total Quality Management

The Quality is an old concept, as proven by the elaborated planning and inspection schemes used in the construction of the pyramids of Egypt, or the marking system of clay pots used by craftsmen in the Middle Ages, which allowed them to easily detect defective parts (Saraiva et al. 2001). The

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development of quality concept appears typified in four phases. In the first phase, quality was essentially based on a simple system of inspection of product features or activities, based on measurement and test or assessment and comparison with the compliance requirements previously established. In the second phase, called quality control, inspection is complemented by an attitude of more preventive nature, based on methods of statistical quality control. The third phase, called quality assurance, focuses on the implementation of systems capable of ensuring that the manufacture and delivery of products meet customer expectations. In the fourth phase of quality evolution, TQM, the concept of continuous improvement finds a sharper application and the quality begins to relate to everything and everyone within the firm, no longer restricted to just one department or manufacturing processes (Saraiva et al. 2001; Pires 2006; Dale et. al, 2009).

TQM involves the application of quality management principles to all aspects of the organization, including customers and suppliers, and therefore integrates them into the key activity of the organization. The eight principles of quality management may be defined as: customer focus, leadership, people involvement, process approach, system approach to management, continuous improvement, decision making based on facts, mutually beneficial relationships with suppliers (Evans 2004; Dale et al. 2009). Therefore TQM focuses on improving organizational effectiveness and responsiveness to customer needs and aims to organizational excellence and customer satisfaction (Agus and Abdullah 2000, Kang 2002, Han et al. 2007). From the foregoing it may be argued that the strategy of TQM is based on the global involvement of all employees who are encouraged to be more flexible, interactive and participatory in organizational activities.

## **2.2 Innovation**

### *2.2.1 Defining innovation*

Innovation may be defined as the result of an interactive and nonlinear process between the firm and the environment (Silva 2003; Silva et al. 2005; Silva and Leitão 2007). It is an interactive process to result in internal collaboration among various departments of the organization, and also external collaboration with other firms, knowledge providers, financial institutions, training institutions and public administration (Kaufman and Tödting 2001). It is a nonlinear process to be stimulated by many actors and sources of information. According to the OECD Oslo Manual (2005), innovation may be typified in four distinct forms: product innovation, process innovation, marketing innovation, organizational innovation.

Product innovation corresponds to the introduction of a product or service that is new or significantly improved with respect to its characteristics or intended use. The innovation process refers to the implementation of a new or significantly improved production method or product delivery. Marketing innovation relates to the introduction of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing. Organisational innovation corresponds to the implementation of a new organizational method in business practices of the firm, labor organization or external relations (OECD 2005).

### *2.2.2 Levels of innovation*

Innovations may be arranged according to the change that they are associated with and the amplitude of their impact on economic systems. Radical innovations are related to discontinuous events or major changes at the level of applied knowledge. Innovations turn out to be extremely important in creating new products and expansion into new markets. Incremental innovations are characterized by improvement and continuous improvement. Innovations characterized as changes of the technological system correspond to large-scale technological changes, affecting several areas of new emerging sectors of the economy. Innovations associated with changes in the techno-economic paradigm correspond to technological changes at the macro-institutional level with scope and effect at the level of major changes in some sectors of the economy (Freeman 1994; Pombo 1995; Laranja et al. 1997).

### *2.2.3 Historical perspective on innovation*

Schumpeter (1934) was one of the first authors to emphasize the importance of innovation in the entrepreneurial process in organizations. The author believes that the central agent of innovation is the entrepreneur which modifies the conditions of the market (it is the innovative entrepreneur), as opposed to the routine manager, understood as a mere administrator. The first phase of the literature

of Schumpeter is associated with the positions taken in 1912 in his "Theory of Economic Development", where the author stresses the importance of the entrepreneur as an agent introducing innovation, linking the concept of innovation to the concept of "creative destruction" where the old methods and processes are replaced by new ones (Ripsas 1998; Hornsby et al. 2002; Rutherford 2007). The second phase starts in 1942 with the work "Capitalism, Socialism and Democracy" where the origins of innovation continue to be attributed to the entrepreneur who is within an organization. The individual entrepreneur is replaced by collective entrepreneur who becomes the main protagonist of the innovation process. The theories of Schumpeter influenced the research on innovation up to today. Silva (2003) states that the contribution of Schumpeter had repercussions in the two subsequent approaches, where the discussion about the nature and characteristics of the innovation process focused on the relative importance of components "market" and "science." Silva (2003) states that the contribution of Schumpeter had repercussions in the two subsequent approaches, where the discussion about the nature and characteristics of the innovation process focused on the relative importance of components "market" and "science".

#### *2.2.4 Linear models of innovation*

According to Godinho (2003), discussions about the nature of the innovation process focus mainly on the relative importance of the components market and science. From these discussions two trends emerge: 1) The approach called the technology-push (or science and technology push) which considers innovation as a result of scientific discoveries, 2) the market-pull approach (or demand-pull innovation) believes that the demand for goods and services expressed in the markets fosters innovation.

Subsequent empirical work on the topic of innovation revealed that the linear model approaches were simplifications of reality and did not reflect the different factors and the nature of the innovations highlighted in these previous studies (Nelson 1987). The innovation process can not be considered linear; no matter if the incentive for innovation comes from demand or from technology, but rather a complex interaction between consumers and potential new developments one.

#### *2.2.5 Interactive model of innovation*

The interactive chain-linked model of innovation presented by Kline and Rosenberg (1986) reflects the importance of feedback between the upstream and downstream stages of the linear model, showing interactions between science and technology through the various phases of the innovation process.

### **2.3 Organizational performance**

In the highly competitive world market, the performance measurement assumes a key role in the development strategy of organizations. According to Singh and Garg (2008), performance measurement may be defined as the process of quantifying the efficiency and effectiveness of the production system. The performance of an organization may be defined as the result / value obtained in its economic activity (sales volume), resulting from the strategy followed (Rumelt et al 1994). Franco et al. (2006) proposed different performance settings. They considered that the strategic performance is generic, synthetic and usually includes long periods (usually 5 years) and the whole organization. The tactical performance is less general and focuses on one area or specific organizational segment and did not cover such long periods (usually 1-3 years). The operational performance is more analytical, it has a short term horizon (up to 1 year) and focuses on activities, processes and operations. Matsuno et al. (2002) indicate variables of performance analysis such as market share, percentage of new product sales to total sales and return on investment. Robinson (2004) measures performance on three variables: economic performance, success of new products and relative market share. In the work developed by Han et al. (2007), the authors used the profit and market share to measure the performance of the organization. Metts (2007) measured the performance through three distinct categories: financial performance (market share, return, growth rate) operational performance (product quality, delivery, ease of production change) and organizational performance (customer satisfaction, employee satisfaction). From the foregoing, it appears that there are different ways of measuring organizational performance. Each investigator will take the most appropriate performance measures in accordance with the purpose and scope of the study that is undertaken.

### **3. Relationship between TQM, innovation, and organizational performance**

In this research TQM practices and innovation strategies are taken into account, so that organizations may develop as to improve their performance. It is important to consider the possible relationship between TQM practices and innovation and consequently the impact which TQM may have at the level of organizational performance when moderated by innovation.

#### **3.1 Relationship between TQM and organizational performance**

While some authors have questions about the importance of TQM practices in the, direct and immediate, improvement of organizational performance (Agus and Abdullah 2000; Han et al. 2007), others understand that the implementation of such practices can be instrumental in improving many aspects of the organization and, consequently, improve organizational performance (Easton and Jarrell 1998; Costa and Lorente 2004; Pinho 2007). Despite some reports of failures associated with the introduction of TQM practices, most empirical studies support the existence of a significant and direct relationship between TQM and organizational success (Prajogo and Sohal 2003, 2004). Costa and Lorente (2004) found that the implementation of TQM benefits the firm in many aspects such as product quality, customer service, fast response, competitiveness, customer satisfaction, employee satisfaction, employee motivation, the percentage of product without defect, and stock price. Pinho (2007) conducted a study on Portuguese Small and Medium Enterprises (SME) and concluded that there is a strong relationship between TQM and organizational performance. In the research developed by Beck and Walgenbach (2009) it appears that organizations are similarly rewarded for implementing quality management systems according to ISO 9000 and the authors argue that ISO certification not only increases the legitimacy, but also has important economic consequences.

#### **3.2 Relationship between innovation and organizational performance**

Several investigators (Miller 1983; Covin and Selvin 1989; Lyon et al. 2000; Coulthard 2007) note that entrepreneurial orientation (incorporating innovation dimension) improves the performance of the organization, being proved that innovation is an increasingly important factor for survival and expansion of firms facing an environment of increased competition and uncertainty (Gronhaug and Kaufman 1988). The main argument that innovation enables better performance stems from the fact that innovation enables organizations to respond more effectively to the challenges and dangers they face (Han et al. 1998). Damanpour (1996) recognizes that innovation includes the conduct of activities such as improving products, processes or procedures that aim to increase the value and performance of those products, processes or procedures. Also in the study by Pinho (2007), it appears that innovation, in terms of administrative processes, cutting edge technology and the ability to produce differentiated products, influences organizational performance.

#### **3.3 Relationship between TQM and innovation**

According to Zaire (1997), TQM may drive and make the organization more committed to creating a sustainable environment for innovation. Continuous improvement, participation in decision making, support from top management, teamwork and "open" culture of the organization are key elements common to TQM and innovation. Moreover, the implementation of TQM practices incorporates the key ingredients to the establishment and development of innovation (Prajogo and Sohal 2003, 2004). Empirical investigations which were conducted in the relationship between TQM and innovation have not reached consistent results. In the research undertaken by Pinho (2007) of Portuguese small and medium firms, a positive relationship between TQM and innovation has not been verified. The author states that the two dimensions relate to each other in complex ways, which is understandable in the context of small and medium firms where the study focused. Abrunhosa and Sá (2008), in an investigation into Portuguese footwear firms, found that not all the principles of TQM play a decisive role in innovation. The authors confirmed a positive relationship between communication, teamwork and support of top management and innovation activities. In an investigation that involved 93 firms from the manufacturing and services sectors of the autonomous region of Asturias, Vijande and González (2008) concluded that TQM by itself is able to promote innovation in the management of the organization. However, the effects of TQM on innovation in products and processes it is mediated by the culture of the firm which encourages innovation.

#### 4. Conceptual model proposal

From the literature review, there is some disagreement regarding the relationship between TQM and organizational performance. However, the number of researchers who found the existence of a positive relationship between TQM and the organization is larger; therefore it is legitimate to assume the possibility of a causal relation. Regarding the influence of innovation on organizational performance, the results presented by researchers are consistent, which supports the existence of a positive relationship between the two dimensions. Although there is no complete consensus regarding the relationship between TQM practices and innovation in the literature reviewed in this work, it is legitimate to consider that an organization that implements TQM practices creates the conditions for greater autonomy to its employees, greater risk assumption, greater pro-activity which will have repercussions at the level of the tendency of organization to support new ideas and creative processes, as well as new production and organizational methods. Given the above, is proposed in Figure 1, a conceptual model that encompasses a set of relationships between the three dimensions considered in this investigation.

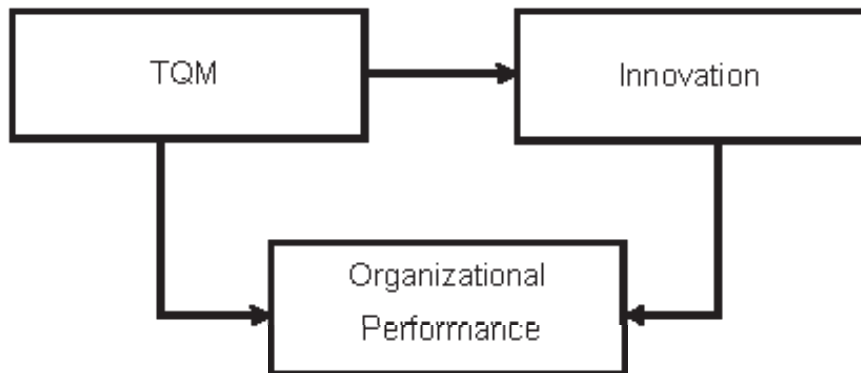


Figure 1: Conceptual model proposed

Each dimension of the conceptual model is associated with several variables usually considered in its measurement. TQM encompasses a broad range of important variables (Sila and Ebrahimpour 2002). Some authors choose to measure TQM through the criteria "means" from the European EFQM excellence model (Vijande and González 2008, 2009). The criteria means (leadership; people; strategy; partnerships & resources; and processes products & services) represent what the organization does.

According to the EFQM model, TQM is understood as behavior, activities and initiatives which are based on eight key concepts: results orientation; customer focus; leadership and constancy of purpose; management by processes and facts; people development and involvement; continuous learning, innovation and improvement; partnership development; corporate and social responsibility. These fundamental concepts incorporate the eight quality management principles; the variables commonly used in the measurement of TQM practices are inspired by both the fundamental concepts of the EFQM model as the principles of quality management (Han et al. 2007; Pinho 2007; Hung et al. 2010; Satish and Srinivasan 2010). Depending on the nature and objectives of the study, the authors consider the variables which best fit the research work. From the variables identified in several empirical studies (Han et al. 2007; Pinho 2007; Hung et al. 2010; Satish Srinivasan, 2010), eight were considered for this research: 1) Leadership, 2) Customer Focus, 3) Involvement and development of people, 4) Management by processes, 5) Continuous Improvement, 6) Relations with suppliers; 7) Measuring results; 8) Product Design.

Srinivasan and Satish (2010) consider five variables to measure innovation (research and development and technological innovation, product innovation, process innovation, organizational innovation, management innovation). Besides the 5 variables proposed by Srinivasan and Satish (2010), one more variable is considered, marketing innovation, which is associated with implementing a new marketing method (OECD 2005).

Regarding organizational performance, it is adopted to Metts typification (2007) which suggests that measuring the results of the organization by three variables: organizational effectiveness, financial performance and operational performance.

## **5. Conclusion and proposal for future work**

This study aimed at proposing a conceptual model identifying the relationship between TQM practices and innovation and impact of these two dimensions at the level of organizational performance. The literature review regarding the relation between TQM and innovation could differentiate the two approaches. In the first approach it appears that the practices of TQM work as support to innovation. In the second approach considers that the practices of TQM are considered deterrent of innovation. Despite some exceptions, most researchers noted a direct positive relationship between TQM practices and organizational performance. The results presented by researchers on the relationship between innovation and organizational performance are consistent so that the existence of a direct positive can be considered. Proposals suggested in this work should be confirmed through a qualitative study. Subsequently, it is proposed to collect data in order to testing causal relation between variables. The proposed conceptual model may prove useful to the extent that it suggests alternative ways of improving organizational performance.

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Conference Name	6th European Conference on Innovation and Entrepreneurship (ECIE 2011)
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There are some grammatical & other minor revisions recommended. For example:-  
 -Under 2.2.1 First sentence reads “In innovation may be defined” the “In” seems extra  
 -Under 2.2.2 A part of the first sentence reads “with and the amplitude and their impact on economic systems.” Needs revision  
 - Under 2.3 sentence #7 needs revision  
 - Under 5 opens with the word “with” which seems to be extra and so on ..

Finally section 2.2.2 is titled “Types of Innovation” while in the previous paragraph “types of innovations” were defined differently. It seems that the author/s meant Levels of Innovation under 2.2.2 otherwise the same concept is defined differently twice. I recommend the author/s to make a clearer distinction.

Should this paper be accepted for presentation at the conference?

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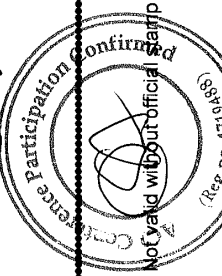
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*Exploring the Synergy between Total Quality Management and Innovation*

  
Heather Fulford, Programme Chair

  
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## Anexo III - Artigos aceites

- Fernandes, António, Lourenço, Luís and Silva, Maria José (2012), “Quality and Innovation: impacts of TQM principles adopted on innovation outputs, 4th World Conference P&OM/19th International Annual EurOMA Conference, 1-5 July, Amsterdam, Holland.
- Fernandes, António, Silva, Maria José and Lourenço, Luís (2012), “Innovation and Quality: impacts of innovation outputs on TQM principles adopted”, XVIII EICEOM International Conference on Industrial Engineering and Operations Management, 9-11 July, Guimarães, Portugal.



# Quality and innovation: impacts of TQM principles adopted on innovation outputs

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## Abstract

The relationship between Total Quality Management (TQM) and innovation has been studied by several research projects. However, there is some disagreement in the literature with many researchers suggesting that the impact of TQM on innovation depends both on the TQM dimensions taken into consideration and on the type of innovation. Therefore, this paper aims to identify just which features of TQM prove determinant to the innovation outputs of organizations. Our findings support the importance of the TQM principles as drivers of innovation outputs. Hence, the adoption of certain organizational principles is susceptible to boosting the development of innovation.

**Keywords:** Quality, Innovation, TQM

## Introduction

Despite the relationship between the implementation of the principles underlying total quality management (TQM) and innovation having been subject to analysis by various research works, there is no consensus in their results on the TQM influence over organizational innovation activities. Whilst according to some research findings (Prajogo and Sohal, 2003, 2004 a,b; Abrunhosa and Sá, 2008; Vijande and González, 2008; Prajogo and Hong, 2008), only some specific TQM principles foster innovative activities, others (Singh and Smith, 2004; Pinho, 2007) maintain adopting these principles may not only limit but even hinder the development of such activities.

The objective of this research project is to study the impact of TQM variables on the variables underpinning innovation performance. After this brief introduction, the article is made up of four main sections. In the first, there is a short review of the literature on the TQM impact on innovation before we set out a conceptual model. The second section puts forward the research methodology applied in the study. The third section details the

statistical findings before we discuss our results. In the fourth and final section, we present our research conclusions and make suggestions for future research.

### Literature Review

Diverse studies have approached the impact of TQM on innovation (Prajogo and Sohal, 2001, 2003, 2004 a,b, 2006 a,b; Singh and Smith, 2004; Hoang et al., 2006; Pinho, 2007; Abrunhosa and Sá, 2008; Prajogo and Hong, 2008, Vijande and González, 2008; Perdomo-Ortiz et al., 2009 a,b). The lack of consensus in their results and the conclusions reached by these researchers reflects two schools of thinking (Prajogo and Sohal, 2003; Mushtaq et al., 2011). One school, more positive in approach, suggests that the implementation of TQM principles reflects in the incorporation of factors fundamental to establishing and nurturing innovation favorable activities (Prajogo and Sohal, 2003, 2004 a,b). The more negative vision derives from the fact there is no clear evidence that statistically proves the positive effects of adopting TQM principles on the organization's innovation levels (Singh and Smith, 2004). The research carried out by Pinho (2007) at Portuguese small and medium sized companies did not find any positive relationship between TQM and innovation. Meanwhile, Vijande and González (2008) conclude that TQM is, in itself, able to enhance organizational innovation activities. Abrunhosa and Sá (2008) find that not all TQM principles play determinant roles in innovation. The different arguments set out by researchers in turn reflect the multidimensional natures of both TQM and innovation. Different TQM principles may generate different impacts on innovation (Perdomo-Ortiz et al., 2009 a,b; Prajogo and Sohal, 2001, 2004 a,b).

While the TQM concept has already been debated by many authors, there is neither any instrument for measuring and for evaluating its incidence and scope nor even any agreement over just which variables make up the concept (Sila and Ebrahimpour, 2002). In accordance with the TQM concept adopted by Han et al. (2007), Pinho (2007), Hung et al. (2010) and Satish and Srinivasan (2010), and which incorporates the quality management principles identified by the ISO 9000 norm, we deploy the eight concepts presented in descriptive summary form in table 1.

*Table 1 – TQM Associated Concepts*

<i>Leadership</i>	<i>Associated with the commitment of senior management to a culture of quality management</i>
<i>Customer Focus</i>	<i>Associated with the way the organisation determines client requirements, needs, expectations and preferences</i>
<i>Involvement and Development of People</i>	<i>Associated with how organisations involve employees, foster their participation and performance in organisational activities</i>
<i>Process Management</i>	<i>Associated with how organisations identify, manage and develop their processes</i>
<i>Continuous Improvement</i>	<i>Associated with reviewing organisational processes with the objective of ensuring continuous improvement</i>
<i>Suppliers Relationship</i>	<i>Associated with the organisation's supplier relationships</i>
<i>Results Analysis</i>	<i>Associated with however organisations select, gather and analyse quality management related data</i>
<i>Product Design</i>	<i>Associated with the utilisation of quality based tools and techniques in the design and development of products</i>

Satish Satish and Srinivasan (2010) measure innovation activities according to five

concepts: research and development (R&D) and technological innovation; product innovation; process innovation; organizational innovation; and, management innovation. This research project additionally takes marketing innovation (OECD, 2005) into consideration. A brief description of each of the six concepts is contained in table 2.

*Table 2 – Innovation Performance Associated Concepts*

<i>R&amp;D and Technological Innovation</i>	<i>Associated with founding and running a technological research and development department</i>
<i>Product Innovation</i>	<i>Associated with the introduction of new or significantly improved goods and services</i>
<i>Process Innovation</i>	<i>Associated with the implementation of new or significantly improved production or product delivery methods</i>
<i>Organizational Innovation</i>	<i>Associated with the implementation of new organisational methods</i>
<i>Management Innovation</i>	<i>Associated with the implementation of new management methods</i>
<i>Marketing Innovation</i>	<i>Associated with the implementation of new marketing methods</i>

*Research hypotheses and proposed conceptual model*

Various researchers refer to how senior management leadership wields a positive impact on innovation activities (Feng et al., 2006; Perdomo-Ortiz et al., 2006) while Hung et al. (2010) identify senior management support as a critical factor to the success of organizational innovation. Accordingly, we arrive at our first research hypothesis:

**H1:** Leadership has impact on the innovation performance of organizations

The client focus approach conceives of organizations producing products and services undergoing constant adaptation to market trends and developments. This approach may however result in short term management perspectives, overlooking the importance of wider reaching research and a proactive posture. From an optimistic perspective, the client focus principle assumes further and additional information is built up on current and future needs and able to anticipate demand levels (Hung et al., 2010; Han et al., 1998). Satish and Srinivasan (2010) point out that a strong focus on customers has impacts on process innovation. Therefore, we posit our second research hypothesis:

**H2:** The level of customer focus has impact on the innovation performance of organizations

The involvement and development of human resources, associated with the delegation of responsibilities and the commitment to quality is reflected in levels of employee autonomy and motivation and hence potentially favourable to many aspects of innovation (Prajogo and Sohal, 2003; Feng et al., 2006; Perdomo-Ortiz et al., 2006; Satish and Srinivasan, 2010). This is correspondingly reflected in our third research hypothesis.

**H3:** Involvement and development of people has impact on the innovation performance of organizations

Perdomo- Ortiz et al. (2006) analyse the process management variable bound up with standardisation and concluded such plays a crucial role in the destructive innovation actually taking place. Satish and Srinivasan (2010) find in favour of process management impacting on both product innovation and process innovation. We are thereby in a position to propose our fourth research hypothesis:

**H4:** Process management has impact on the innovation performance of organizations

A Continuous improvement requires some standardization of processes and activities that may hinder and slow innovation related activities to the extent that the prevailing

level of organizational conformity means employees are unwilling to risk changing specific routines (Prajogo and Sohal, 2001). Concerns about fully taking advantage of material resources and total equipment utilization inherent to the continuous improvement approach may drive shortages in the resources essential to innovation processes (Nijhof et al., 2002). In contrast, that all organizational human resources are involved in setting targets for improving their performance, favours creative thinking and pro-learning and cooperative attitudes among members of staff and resulting in greater involvement in innovation related activities (Hung et al., 2010; McAdam, 2004). Hence, we reach our fifth research hypothesis:

**H5:** Continuous improvement has impact on the innovation performance of organizations

Supplier relationships represent an important source of new ideas to the extent that they provide raw materials and their subsidiaries are specialists in these products and stimulate the utilization of "novelty" in their sectors. Equipment suppliers, new technologies and services, in addition to consultants, are among the potential sources of ideas for new organizational working and activity management methodologies (Saraiva and Orey, 1999). Therefore, our sixth research hypothesis inquires whether:

**H6:** Suppliers relationships has impact on organizational innovation performance

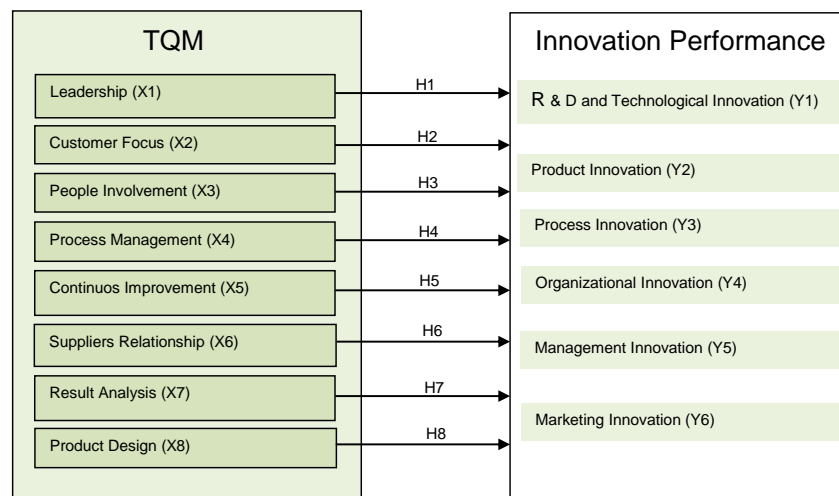
The measurement of TQM related results may bring benefits to various different facets of the organisation and including its ongoing innovation activities. The TQM systems and tools may prove highly effective in enabling the effective management of innovation programs (Keathley and Owens, 2010). Hence, we correspondingly formulate our seventh research hypothesis:

**H7:** Results analysis has impact on the innovation performance of organizations

The incorporation of quality tools and techniques into product design may have a positive impact in terms of innovation related activities. Perdomo-Ortiz et al. (2006) conclude that this type of action has a direct and positive relationship with innovation. This establishes the theoretical framework for our eighth and final research hypothesis:

**H8:** Product design has impact on the innovation performance of organizations

In figure 1, we set out the conceptual model designed to evaluate the impact of each TQM associated concept on those associated with innovation performance.



*Figure 1 – Proposed conceptual model*

## **Methodology**

### *Sample and Data Collection*

The research project analyzed information gathered from a total of 218 organizations engaged in a diverse range of sectors and activities and all certified according to the ISO 9001:2008. That the sample is made up of certified organizations guarantees a certain interest level in the theme of quality management as well as familiarity with the concepts incorporated into the questionnaire sent them (Curry and Kadasah, 2002). The invitation to participate was delivered by e-mail (with a link to the electronic questionnaire) to the senior management of each company. This methodological approach ensured the questionnaire was completed by the CEO or company leader thereby guaranteeing the internal validity of the study to the extent of the knowledge held by these individuals on TQM practices and innovation ongoing throughout their organizations (Taylor and Wright, 2003). Given this is a closed type questionnaire, for each indicator, the respondent indicated his/her level of agreement with the affirmation from a range of ten alternatives (from 1 – totally disagree to 10 – totally agree). The questionnaire was subjected to a pre-test undertaken by some senior managers with certain improvements made resulting from their interpretations of the questionnaire content.

### *Operational data handling and validation of variables*

As previously detailed in figure 1, we take eight TQM concepts as independent variables (variables X1 to X8) and six innovation performance concepts as dependent variables (variables Y1 to Y6).

The variables were subject to reliability and validity tests through recourse to SPSS software. We measured reliability (measuring the level of consistency and robustness of the indicators associated with each variable) with Cronbach's Alfa. The lowest result returned was equal to 0.767, higher than the minimum reference level of 0.70 (Hair et al., 2006) and thus confirming the model's reliability and robustness. This validity underpins the measurement of a set of indicators precisely portraying the associated variable (Hair et al., 2006). Various authors (González-Alvarez and Nieto-Antolín, 2007; Abrunhosa and Sá, 2008) recommend analysis of the main factors in order to ascertain whether they and their respective indicators are in conformity with the literature review and the assumptions taken into account while drafting the questionnaire. Compliance with the reference value (a minimum of 0.500) relative to the Kaiser–Meyer–Olkin (KMO) test (Hair et al., 2006) ensures the factorial analysis is appropriate for data processing. We concluded that only one factor at a time should be considered for the set of indicators associated with each variable. In every case, the Eigenvalue result exceeded the reference value (minimum of 1) suggested by Hair et al. (2006). In addition, all extracted factors returned variance rates equal to or greater than 66%, and thus above the set reference value of 60% (Hair et al., 2006). As regards the factor loadings, with the exception of the indicator for the variable human resource involvement and development, withdrawn after the first iteration, all indicators were deemed relevant for the respective factors given they met the reference value (over 0.70) proposed by Hair et al. (2006). We also calculated the component scores for the various factors and applied the multiple linear regression technique for evaluating the impact of each TQM variable on each innovation performance variable.

## Data analysis and discussion of results

### *Multiple linear regression data analysis*

Multiple linear regression assumes there is a linear relationship between a variable Y (the dependent variable) and k independent variables. This analytical method is appropriate to determining the impact of two or more independent variables on a dependent variable (Hair et al., 2006).

In order to determine the impact of the eight TQM variables on the six innovation performance variables, we constructed six multiple linear regression models in accordance with the equation (1):

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + e_1 \quad (1)$$

Nevertheless, prior to obtaining the models, we first need to verify compliance with the assumptions specified in the linear regression models in order to ensure that the validity of the latter may be confirmed. The first assumption stems from the independence of the observations guaranteed in this case given that the sample was made up of 218 questionnaires completed by 218 different organizations. The second assumption relates to the homoscedasticity of the residuals. These residuals should display homogeneous variance around an average null value with the value of residuals constant across the observation interval. This assumption was verified through observation of the residual graphs for the six models and finding constant variance in the residuals and thus the appropriate homoscedasticity (Hair et al., 2008). The third assumption refers to the normal residual distribution. Observation of the normal graphical distribution of residuals led to the conclusion that the errors are normally distributed across the six models. The values fall over the course of the diagonal without either substantial or systematic deviations, which indicates a normal distribution of errors (Hair et al., 2008). The fourth assumption relates to the existence of multicollinearity, which was subject to evaluation by two statistical processes: Tolerance and Variance Inflation Factor (VIF). Tolerance measures the quantity of variance in an independent variable that is not explained by other independent variables. Where the other variables explain significant amounts of variance in one independent variable in particular then there are multicollinearity problems in effect. The value of the tolerance reference is commonly set at 0.10 and hence tolerance scores returned lower than 0.10 indicate multicollinearity problems. The VIF is the inverse of tolerance and with a maximum acceptable value of 10 (Hair et al., 2008). The independent variables VIF values ranged from a minimum of 1.547 to a maximum of 3.574, thereby confirming the absence of multicollinearity.

Multiple linear regression analysis made recourse to SPSS software incorporating the stepwise methodology. The analytical estimates for the six models are set out in table 3. Based on the adjusted R<sup>2</sup> results, we conclude that the six models are reasonably adjusted to their data. Observation of the column deriving from ANOVA sig. analysis results in, and for all of the models, the rejection of the null hypothesis, H<sub>0</sub>: β=0, and therefore confirms, with a 99% level of confidence, that the respective dependent variable is linearly related to the independent variables.

Table 3 – Linear regression estimates

Modelo	R	R <sup>2</sup>	R <sup>2</sup> ajustado	Anova sig.
1	0.369	0.136	0.124	0.000
2	0.547	0.299	0.286	0.000
3	0.435	0.189	0.178	0.000
4	0.563	0.317	0.304	0.000
5	0.524	0.275	0.265	0.000
6	0.400	0.160	0.148	0.000

*Results and discussion*

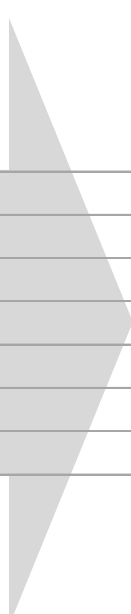
The linear regression coefficients for the six models and their respective significance levels are detailed in Table 4.

Table 4 – Multiple linear regression analytical model estimates

Model	Dependent Variables	Independent Variables	B stan.	Sig.
1	R&D and technological innovation (Y1)	Process Management (X4)	-0.323	0.006
		Continuous Improvement (X5)	0.370	0.002
		Product Design (X8)	0.278	0.001
2	Product Innovation (Y2)	Customer Focus (X2)	0.246	0.019
		Continuous Improvement (X5)	0.310	0.002
		Suppliers Relationship (X6)	-0.300	0.002
3	Process Innovation (Y3)	Product Design (X8)	0.298	0.000
		Continuous Improvement (X5)	0.396	0.000
		Suppliers Relationship (X6)	-0.279	0.004
4	Organisational Innovation (Y4)	Product Design (X8)	0.282	0.001
		Leadership (X1)	0.330	0.000
		Continuous Improvement (X5)	0.300	0.006
5	Management Innovation (Y5)	ResultsAnalysis (X7)	-0.171	0.070
		Product Design (X8)	0.145	0.042
		Leadership (X1)	0.314	0.001
6	Marketing Innovation (Y6)	Customer Focus (X2)	-0.195	0.054
		Continuous Improvement (X5)	0.391	0.000
		Process Management (X4)	-0.276	0.016
6	Marketing Innovation (Y6)	Continuous Improvement (X5)	0.384	0.001
		Product Design (X8)	0.278	0.001

Analysis of table 4 finds that only hypothesis H3 is not supported by the data. Thus, there is no statistical evidence that the involvement and development of human resources impacts on the innovation performances of organizations. Despite this result differing from that expected, it is in keeping with the research findings of Singh and Smith (2004). The H1, H2, H4, H5, H6, H7 and H8 hypotheses are statistically supported by the data and hence we may state that leadership, a focus on clients, process management, continuous improvement, relationships with suppliers, the measurement of results and product design all record a significant impact on organizational innovation performance levels. In accordance with other research projects (Perdomo-Ortiz et al., 2009 a,b; Prajogo and Sohal, 2001, 2004), we conclude that each TQM principle has a different impact depending on which innovation performance variable is under consideration. In figure 2, we symbolically portray the impact, whether positive (+) or negative (-), of each

TQM variable for each innovation performance variable.



	<i>R&amp;D and Technological Innovation</i>	<i>Product Innovation</i>	<i>Process Innovation</i>	<i>Organisational Innovation</i>	<i>Management Innovation</i>	<i>Marketing Innovation</i>
<i>Leadership</i>				+	+	
<i>Customer Focus</i>		+			-	
<i>Process Management</i>	-					-
<i>Continuous Improvement</i>	+	+	+	+	+	+
<i>Relationship with Suppliers</i>		-	-			
<i>Measurement of Results</i>				-		
<i>Product Design</i>	+	+	+	+		+

Figure 2 – Impact of TQM variables on innovation performance variables

Our findings confirm the positive impact of senior management involvement in both organizational innovation and management innovation, which is in harmony with the empirical studies of various authors (Feng et al., 2006; Perdomo-Ortiz et al., 2006; Hung et al., 2010). As regards the focus on clients, our results back the original idea that the adoption of this TQM principle enhances the propensity of the organization to engage in product innovation (Hung et al., 2010; Han et al., 1998). However, client focus proves to have a negative impact on management innovation. This facet of TQM seems to imply short term management, highly deterministic and within the framework of which broader market research and proactive positioning fall off the organizational radar. Contrary to expectations, process management is restricted to innovation activities related to R&D and technological innovation as well as marketing innovation. That the empirical data applied in this research deriving from organizations certified according to the ISO 9001:2008 norm may explain this result. The implementation of a quality management system in accordance with this norm obliges the specification of the processes necessary to the quality management system and their application throughout the organization. This approach may have, to a certain extent, overlooked certain specific fields perceived as of lesser importance to the quality management system implementation process. The research results favor the idea continuous improvement fosters all the innovation activities ongoing at organizations and is in keeping with the findings of works by Hung et al. (2010) and by McAdam (2004). The results also suggest that relationships with suppliers limit product and process innovation thereby running counter to the literature review that pointed to a positive impact of supplier relationships on the innovative activities of organizations (and specifically in terms of product and process). One

possible explanation for these results derives from how supplier relationships subject the organization to changes in their products and processes with the objective of better adapting the integration of the goods and services provided by the supplier. In this context, relationships with suppliers may dissuade “isolated” innovation from taking place at each organization in particular. Furthermore, contrary to expectations, the measurement of results emerges as a factor blocking organizational innovation activities. The measurement of results and the desire to attain completely determined goals may force the organization into tightly binding action procedures that discourage the development of innovation activities at the organization. With the exception of management innovation, the utilization of product design tools and techniques positively impacts on all the innovation performance variables.

### **Conclusion**

The results obtained generically support the findings featured in the literature and do substantiate the conclusion that the different TQM principles generate different impacts on organization innovation performance. Thus, we need prudence in identifying the outputs of innovation that should be strengthened in keeping with prioritizing the implementation of the appropriate TQM principles. Should this not happen, we may end up obtaining results very contrary to those sought after. We should furthermore understand that innovation processes are influenced by a multiplicity of factors and to the extent of which some are actually exogenous to the organizations themselves. The study contains some limitations. The empirical data refers to organizations from different sectors of activity and hence the generalization of the results obtained may not be specifically applicable at the sector level. The gathering of data focused on the perceptions held by senior management and this may not reflect the complete organizational reality. As regards future research, it would be interesting to break the sample down into different groups and analyze any eventual differences in the impact of TQM principles on innovation variables. The existence of shared and common features to TQM and innovation suggests the idea that the commitment of an organization to innovation may reflect in a corresponding interest in development and implementing TQM. In this context, there is also relevance in analyzing the impact of innovation outputs on the adoption of TQM principles.

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Kind regards on behalf of the conference organizing committee.  
Dirk Pieter van Donk, Sander de Leeuw



# Innovation and Quality: impacts of innovation outputs on TQM principles adopted<sup>1</sup>

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## Abstract

Innovation and total quality management (TQM) are regarded as key competitive factors and the impact of TQM on innovation has been studied by several authors. Many of them suggest that the impact of TQM on innovation depends both on the TQM dimensions considered and on the type of innovation. The existence of common elements to TQM and innovation raises the idea that the organization's commitment to innovation can have some impact on the establishment and development of TQM. In this context, it becomes relevant to investigate whether or not the systematic and sustained development of innovative activities fosters the adoption and implementation of TQM principles. The main objective of this paper is to explore the impact of innovation's outputs on TQM. The conceptual model proposed considers 6 innovation's outputs (research, development and technological innovation; product innovation; process innovation; organizational innovation; management innovation; marketing innovation) as factors that can have impact on 8 TQM's variables (leadership; customer focus; involvement and development of people; management by processes; continuous improvement; relations with suppliers; measuring results; product design). This study is based on empirical data collected through a questionnaire answered by 218 ISO 9001:2008 certified organizations. Findings suggest that different innovation types have dissimilar impacts on TQM dimensions.

**Keywords:** innovation; quality; TQM.

## 1 Introduction

The importance of total quality management (TQM) as a determinant factor in the innovative performance of the organizations has been addressed in the research studies of many authors (Prajogo and Sohal, 2001, 2003, 2004 a,b; Sá and Abrunhosa, 2007; Abrunhosa and Sá, 2008; Martínez-Costa and Martínez-Lorente, 2008; Prajogo and Hong, 2008; Perdomo-Ortiz et al., 2009 a,b). Different elements of the TQM will, however, have different impacts on innovation. The influence of TQM in innovation depends on the TQM principles, as well as on the type of innovation (Perdomo-Ortiz et al., 2009 a,b; Prajogo and Sohal, 2001, 2004 a,b). The existence of common key elements of innovation and TQM, suggested by Prajogo and Sohal (2003, 2004 a,b), raises the idea that emphasis on innovation may translate the organization's TQM interest. This study is focused within this context and the following research question can be identified: What type of impact does each innovation output have on the adoption of TQM principles?

The main objective of this paper is to study the impact of innovation outputs in the adoption of TQM principles. Data was collected through a questionnaire answered by 218 ISO 9001:2008 certified organizations.

Besides this first introductory section, the paper is composed by four chapters. In chapter 2 there is a brief literature review, where a reflection concerning the impact of innovation in the TQM is made and where a

conceptual model is proposed. Chapter 3 presents the methodological approach of this study. Chapter 4 contemplates data analysis, results and discussion. Chapter 5 presents conclusions and future work.

## **2 Literature Review**

The literature review shows that innovation has a substantial impact on the organizational performance, but there are many research gaps. This study contemplates the Oslo Manual (OECD, 2005) that typifies innovation in 4 different ways: product innovation; process innovation; marketing innovation; organizational innovation.

Alongside, TQM is considered a management philosophy that contemplates the application and integration of 8 quality management principles within the organization (Dale et al., 2009). It refers to a management approach that aims towards organizational excellence (Han et al., 2007) having in consideration all the interactions between the elements of the organization and focusing on efficiency improvement and the capacity to attend customer needs (Fernandes et al., 2010).

Next, several theoretical bases which support the hypotheses are presented. Although the literature review presents a substantial of innovation on TQM, there are evidences showing that the impact of a certain type of innovation in the quality management principles is far from being answered.

### **2.1 Innovation as a determinant of TQM**

Innovation and quality are basic elements to the functioning of organizations and simultaneously focusing on both dimensions can be an enormous advantage for both. Quality can stimulate the innovation in the sense that it supplies adequate tools that become more efficient and guided towards customer satisfaction. Innovation is assumed as a vital process of success and organization improvement, there is no point in facing quality without an important part of innovation (Saraiva and Orey, 1999). The continuous improvement, the participation in the decision process, the support of top management, team work and "the open" culture of the organization, are common components of innovation and TQM (Prajogo and Sohal, 2003, 2004 a,b). Organizations focus on the systematic and sustainable development of innovative activities which can promote the adoption of TQM principles that have been efficient in the reply of organizations to the great and permanent challenge called innovation.

It is known that the performance of organizations is associated to its innovative capacity. Innovative organizations can be twice more cost effective than non innovative organizations (Akgun et al., 2007; Gilmore, 2009). Mossey et al. (2002) point out two conditions organizations should necessarily consider, without which, focus on innovation may become totally efficient: efficient communication to all the organization of decision taking; development of long run strategic plans. These two aspects suggest that focusing on innovation implies the involvement of top management as a driving and dynamic factor of the innovation process.

The capacity of the organization to access certain markets and attract customers can be strengthened by innovation. Discovering new ways to execute tasks makes collaborators more productive and involved in their activities (Lafley and Charan, 2008) and, innovative companies when compared to less innovative companies, show greater rates of productivity (Rogers, 1998). This suggests that the results of innovation will be able to exert some impact on management practices of the organization which lead to the possibility that focusing on innovation can stimulate TQM. In accordance to Lafley and Charan (2008), although the development of products is the most common type of innovation, there are other typologies that can show great importance for the organization: innovation in process organization; innovation in logistic activities; marketing innovation; innovation of the business model. Due to the multidimensional nature of innovation, it is important to think about the concepts associated to innovation outputs and the concepts associated to TQM.

Satish e Srinivasan (2010) measured the innovative activity of the organization through 5 concepts: R&D and technological innovation; product innovation; process innovation; organizational innovation;

management innovation. This study, additionally considers marketing innovation (OECD, 2005). "Innovation outputs" are seen as demonstrations of innovative activities, carried out by the organizations, in the context of the innovation typologies proposed in the Oslo Manual (OECD, 2005). A summary description of the 6 concepts is presented in table 1.

Table 1: Concepts associated to the Innovation outputs

Research and development (R&D) and technological innovation	Associated to the creation and existence of an inquiry department and technological development
Product Innovation	Associated to the introduction of a new service or good or which has been significantly improved
Process Innovation	Associated to the implementation of a new or significantly improved production method or product delivery
Organizational Innovation	Associated to the implementation of a new organizational method
Management Innovation	Associated to the implementation of a new management method
Marketing Innovation	Associated to the implementation of a new marketing method

Han et al. (2007), Pine (2007), Hung et al. (2010) and Satish and Srinivasan (2009, 2010) associate TQM to several concepts that incorporate the principles of quality management identified by norm ISO 9000. Of those concepts used by the authors and associated to TQM, 8 are considered in this study and summarily described in table 2.

Table 2: Concepts associates to TQM

Leadership	Associated to the commitment of top management with the culture of management through quality
Customer Focus	Associated to the way the organization determines the requirements, the needs, the expectations and the preferences of the customers
Involvement and Development of the People	Associated to the way the organization involves its collaborators and it foments its participation and persistence in the activities of the organization
Process Management	Associated to the way the organization identifies, generates and develops its processes
Continuous Improvement	Associated to the revision of the organization processes having as main aim their continuous improvement
Suppliers Relationship	Associated to the way the organization relates with its suppliers
Result Analysis	Associated to the way the organization selects, collects and analyses given data related to quality management
Product Design	Associated to the use of tools and quality techniques in the conception and development of products

## 2.2 Research hypotheses and proposal of the conceptual model

Robinson and Stubberud (2011) carried out a survey concerning the effect of innovation in 3233 Norwegian companies showing 9 important effects: Increased range of goods and services; Improved quality in goods or services; Entered new markets or increased market share; Improved flexibility of production or service provision; Met regulation requirements; Increased capacity of production or service provision; Reduced labor costs per unit output; Reduced environmental impacts or improved health and safety; Reduced materials and energy per unit output. These effects of innovation can be easily incorporated in the effects companies want to reach with the TQM philosophy and suggest TQM as an organization's answer to the innovation focus.

The existence of an R&D department is very expensive for the organizations, in the sense that minimum resources are required and sometimes these organizations do not have them (Ramer et al., 2009). Financing these activities becomes particularly difficult due to the high risk associated to innovation activities. Due to these new limitations, organizations are not involved in research activities and

development of new technologies, they do, however, invest in activities that are less expensive. They all place great emphasis in the management processes of innovation, exploring its innovative potential through the use of suitable management techniques where, for example, the use of external knowledge is included. In a study developed with Australian companies Gilmore (2009), showed that the external contribution provides an increase of 70% of the innovation level. The constraints associated to research activities, development and technological innovation can stimulate the TQM approach that supports the organization in overcoming obstacles and achieving goals. Based on what was said above, the first hypothesis of this study is formulated:

**H1:** Focusing on innovation, at R&D and Technological Innovation level has impact in the adoption of TQM principles by the organization.

The installed competition world-wide compels to the development of new or significantly improved products. Quality techniques such as the Failure Mode and Effects Analysis (FMEA), the QFD – Quality Function Development, the Design of Experiences, the Taguchi methods, can be decisive in achieving innovative products. On the other hand, basic quality tools and Brainstorming can stimulate the creativity of the team and contribute towards product innovation. The application of Benchmarking techniques can play an excellent role in product innovation when allowing the comparison with better practices inside or outside the organization. The second hypothesis of this study is formulated by the above:

**H2:** Focusing on innovation, at the level of Product Innovation, has an impact on the adoption of TQM principles by the organization.

The introduction of new or significantly improved processes can basically create two types of effect: reduction of the unitary cost of production and increase of the productive quality process (Lafley and Charan, 2008). Managing a process implies the establishment of boundaries, attributing responsibilities and establishing performance indicators. Process innovation thus seems to foment management practices at the level of people's involvement, continuous improvement, processes management and customer focus. Face to the displayed, the third hypothesis of this study is formulated by the above:

**H3:** Focusing on innovation, at the level of Process Innovation, has impact on the adoption of TQM principles by the organization.

Innovation management encloses a wide set of tools and techniques and comprises all the activities related to the innovation process of the organization. The aim is to maximize the results and it includes enabling measures at the level of the internal processes and connections with the exterior (Ramer et al., 2009). Internally, the cooperation between departments can be improved and strengthened and methodologies that foment the creation of new ideas can be created. Externally, the existence of relations with customers, suppliers and organizations in general, is very important in identifying innovation inputs and sharing of knowledge, where the notion of open innovation (Chesbrough, 2003) has directed the attention of the organizations for connections with the exterior. Ramer et al. (2009) consider 4 areas of management innovation through which the organizations can improve their innovative performance: Human resource management - the increase of incentives can promote the participation in innovative activities; Team work - sharing knowledge and mutual trust can benefit innovation; Searching for external sources – identification of innovation inputs from customers, suppliers, competitors, university and other organizations; Co-operation - creation of partnerships and external sources of knowledge that allow the sharing of costs and risks associated to innovative activities. The fourth hypothesis of this study is formulated by the above:

**H4:** Focusing on innovation, at the level of Organizational Innovation, has impact on the adoption of TQM principles by the organization.

Besides the introduction of new organizational methods, the organization can implement new methods of management (administrative computerization; motivation systems; new departments) or introduce new systems of knowledge management. Similarly to what happens at the level of the organizational management, the fifth research hypothesis is suggested:

**H5:** Focusing on innovation, at the level of Management Innovation, has an impact on the adoption of TQM principles by the organization.

An example of marketing innovation is the increasing use of the Internet for expansion of marketing channels. This innovative aspect can facilitate the management of the organization focusing on TQM philosophy where certain aspects such as customer focus, continuous improvement and mutually beneficial relations with suppliers seem to become strengthened. The sixth research hypothesis is thus suggested:

**H6:** Focusing on innovation, at the level of Marketing Innovation, has an impact on the adoption of TQM principles by the organization.

In figure 1 is presented the proposed conceptual model is which aims at evaluating the eventual facilitating or inhibiting effect that each concept associated to innovation outputs may have in the concepts associated to TQM.

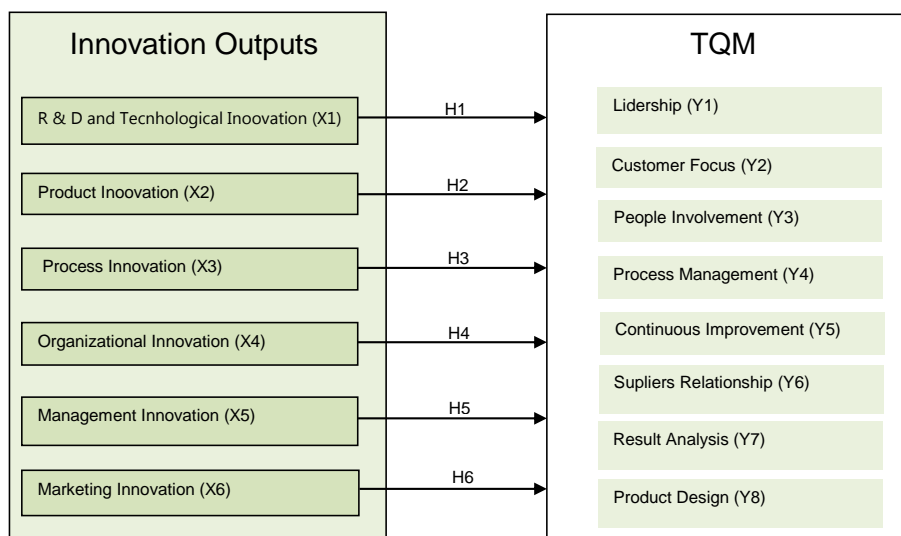


Figure 1: Proposed conceptual model

### 3 Methodology

#### 3.1 Sample and data gathering

The study was developed from the information collected at 218 certified organizations. Certified organizations were considered to guarantee some organizational knowledge and interest on quality management as well as familiarity with the concepts used in the questionnaire sent to the organizations (Curry and Kadasah, 2002). The sample was constituted by organizations from several activity sectors and the invitation for participation in the research was made through an email sent to the general email address of organizations. In the body of the email there was a link to access an electronic questionnaire which was a basic instrument of information gathering. This methodological approach allows top management of the organization to answer the questionnaire and guaranties that there was internal validity in the study, in the sense that it allows an extensive knowledge of TQM and innovation in the entire organization (Taylor and Wright, 2003).

With the questionnaire it was possible to collect information concerning the perception of top management in each organization in what refers to different aspects related to adoption of TQM principles and innovation. Since it is a Likert type questionnaire, the respondent selected, for each item/indicator, his level of agreement with a statement, among 10 possible alternatives (of 1 – In total disagreement to 10 – In total agreement). The questionnaire was submitted to some top managers for a pre-test. This procedure allowed some improvements related to interpretation of statements.

### 3.2 Operationalization and validation of variavels

The literature review focuses on the possibility that innovation outputs have an important role in the adoption of TQM. In such a way that it explores the impact innovation outputs might have in the adoption of TQM. As it was presented, previously in Figure 1, th 6 innovation outputs are represented through the independent variables (variables X1 to X6) and the 8 concepts associated to TQM represented through the dependent variables (variables Y1 to Y8).

The variables were submitted to reliability and validity tests. The reliability was measured through the Cronbach alpha, obtained with SPSS software. The lowest value obtained was 0.767, greater than the minimum value of reference, 0.70 (Hair et al., 2006), therefore considering it a reliable measuring instrument.

The validity makes it possible to measure whether the set of items/indicators represent, with precision, the associated variable (Hair et al., 2006). Some authors (González-Alvarez and Nieto-Antolín, 2007; Abrunhosa and Sá, 2008) recommend an analysis of the main factors in order to find out if the factors and the respective items/indicators are in compliance with the literature review and the assumptions considered in the elaboration of the questionnaire. The fulfilment of the reference value (minimum of 0.500) regarding the Kaiser-Meyer-Olkin test (KMO) (Hair et al., 2006) made it possible to consider factor analysis adequate for data treatment. Based on the factor analysis one concludes that only a factor should be considered for a set of items/indicators associated with each variable. In all cases, the Eigenvalue value (total variance explained by factor) obtained was superior to 1 (Hair et al., 2006). Additionally all the extracted factors represented more than 66% of the variance, this value was, in many cases, superior to 80%. The variance explained from the extracted factors must be at least equal to 60% (Hair et al., 2006). According to what has been presented, variables can be considered unidimensional. In what refers to factorial loadings, with exception to an indicator regarding the variable Involvement and Development of People, removed in the first iteration, all items/indicators were considered relevant for the respective factors, in the sense that they fulfil the reference value (higher than 0.70), suggested by Hair et al. (2006).

## 4 Analysis of data and discussion of results

### 4.1 Multiple linear regression in data analysis

In the multiple linear regression it is assumed that there is a linear relationship between a variable Y (the dependent variable) and at least one of k-1 independent variable. It is an adequate method of analysis when the objective is to determine the impact of two or more independent variables in a dependent variable (Hair et al., 2006). In the sense of determining the impact of 6 variables associated to innovation outputs in the 8 TQM variables, 8 multiple linear regression models were created in accordance to the following equation 1:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \varepsilon \quad (1)$$

However, before performing the regression analysis and obtaining the models it is necessary to verify the fulfillment of the assumptions. The first assumption is related with the independence of the observations which was guaranteed by the fact that the sample was comprised of 218 questionnaires and answered by 218 different organizations. The second assumption refers to the homoscedasticity of the residuals. The residuals must have a homogeneous variance around an average null value, where its value should remain constant in every range of observation. This assumption was verified through the observation of residual graphs, where, for the 8 models, a constant variance of residues was verified and therefore its homoscedasticity (Hair et al., 2006). The third assumption refers to the normal distribution of residuals. The observation of the normal probability plot made it possible to conclude, for the 8 models, that errors are normally distributed, in the sense that the values fall along the diagonal line without substantial or systematic deviations, indicating a normal error distribution (Hair et al., 2006). The fourth assumption is related to the existence of multicollinearity, which was evaluated through the Tolerance and of Variance

Inflation Factor (VIF). Tolerance measures the amount of variance that is not explained by other independent variables. If others variables explain large part of the variance of a particular independent variable is a sign that there is multicollinearity. The reference value for tolerance is typically 0.10, where values inferior to 0.10 indicate multicollinearity problems. The VIF is the inverse of tolerance and has a maximum acceptable value of 0.10 (Hair et al., 2006). The observed VIF values for independent variables are between the minimum value of 1.524 and maximum of 3.410, confirming the absence of multicollinearity.

Multiple linear regression analysis was performed through SPSS software using the stepwise method. Analysis estimates for the 8 regression models can be found in table 3.

Table 3: Estimates of the linear regression

Model	R	R <sup>2</sup>	R <sup>2</sup> adjusted	Anova sig.
1	0.547	0.299	0.292	0.000
2	0.493	0.243	0.236	0.000
3	0.544	0.296	0.283	0.000
4	0.517	0.267	0.253	0.000
5	0.592	0.350	0.341	0.000
6	0.374	0.140	0.132	0.000
7	0.427	0.182	0.171	0.000
8	0.492	0.242	0.232	0.000

From the values of R<sup>2</sup> adjusted, one concludes that the 8 models have reasonable adjustment to the data. Based on the values of ANOVA sig. it is possible to reject hypothesis, H0: β=0, for all models. Therefore it safe to state that there is a linear relationship between the dependent variable and, at least, one of the independent variables.

## 4.2 Discussion and Results

The coefficients of the 8 linear regression models and respective levels of significance are presented in Table 4. Only H3 is not sustained by the data. It was not statistically proved that focusing on innovation, at the level of new or significantly improved processes, has an impact on the adoption of TQM principles. Lafley and Charan (2008) suggest the reduction of the unitary cost of production and the increase of quality in the productive process are the two main effects of the innovation process. The results of this study are, partially, in accordance with this perspective, and support the idea that process innovation does not have an impact on the management philosophy of the organization. The H1, H2, H4, H5 and H6 are supported by the empirical data making it possible to state that R&D and technological innovation, product innovation, organizational innovation, management innovation and marketing innovation have significant impact on the adoption of TQM. These results are generically in accordance with the literature review. It is however, important to refer that similarly to what happens with the impact of TQM principles in innovation activities (Perdomo-Ortiz et al., 2009 b; Prajogo and Sohal, 2001, 2004 a,b), the impact of each innovation output in TQM depends on the variable of the considered TQM.

Table 4: Estimates of the multiple linear regression models

Model	Dependent Variable	Independent Variables	B Standard	Sig.
1	Leadership (Y1)	Organizational Innovation (X4)	0.348	0.000
		Management Innovation(X5)	0.252	0.001
2	Customer Focus (Y2)	Product Innovation (X2)	0.311	0.000
		Organizational Innovation (X4)	0.256	0.000
3	People Involvement (Y3)	R& D and Technological Innovation (X1)	-0.143	0.046
		Product Innovation (X2)	0.260	0.000
		Organizational Innovation (X4)	0.256	0.003
		Management Innovation(X5)	0.233	0.002

		R& D and Technological Innovation (X1)	-0.177	0.016
4	Process Management (Y4)	Product Innovation (X2)	0.314	0.000
		Organizational Innovation (X4)	0.275	0.002
		Management Innovation(X5)	0.138	0.076
		Product Innovation (X2)	0.272	0.000
5	Continuous Improvement (Y5)	Organizational Innovation (X4)	0.199	0.012
		Management Innovation(X5)	0.258	0.000
		Product Innovation (X2)	0.137	0.063
6	Suppliers Relationships (Y6)	Organizational Innovation (X4)	0.286	0.000
		Product Innovation (X2)	0.185	0.011
		Organizational Innovation (X4)	0.157	0.078
7	Results Analysis (Y7)	Management Innovation(X5)	0.184	0.025
		Product Innovation (X2)	0.312	0.000
		Organizational Innovation (X4)	0.151	0.054
8	Product Design (Y8)	Marketing Innovation (X6)	0.133	0.075

Table 5 symbolically presents, the positive (+) or negative (-) impact, of each innovation output in each TQM variable.

Table 5: impacts of innovation outputs in TQM variables

		GQT								
		Leadership	Customer Focus	People Involvement	Process Management	Continuous Improvement	Suppliers Relationships	Results Analysis	Product Design	
Innovation Outputs	R & D and Technological Innovation			-	-					
	Product Innovation		+	+	+	+	+	+	+	
	Organizational Innovation	+	+	+	+	+	+	+	+	
	Management Innovation	+		+	+	+		+		
	Marketing Innovation									+

From analyzing table 5 we can verify a negative impact of R&D and technological innovation regarding the involvement and development of people in the management process. Positive results regarding the innovative activity seem to contribute to some disinvestment at the level of involvement and development of people and the process approach. This result is, in a way, in accordance with the literature since the organization managed to overcome the constraints associated to R&D activities, technological innovation and it does not feel so obliged to seek alternative ways of innovation. Thus, some lack of interest in adopting of TQM principles may be verified. The results support the initial idea that improving performance, at the level of product innovation, organizational innovation and management innovation, will promote the adoption of TQM principles. The results show that innovation outputs of marketing

innovation promote the adoption of methodologies related to product design; suggesting that focusing on the organization, at the level of innovation in packing products, in communication techniques with the customer, in distribution methodologies and price policies, will have an impact on the level of product design activities, such as the periodic revision of its characteristics considering the demands of clients and suppliers.

## 5 Conclusion and proposal of future work

The obtained results support the general literature suggestions. The most important difference of this study, when compared with other studies identified in the literature reviewed, is the simultaneous inclusion of innovation outputs along with TQM principles, assuming an integrative perspective either of the various demonstrations of innovative activities or the aspects of TQM. To the exception of the innovation process, all the other innovation outputs, considered in this research, have a positive impact in the adoption of TQM principles. In academic terms, this study represents an important contribution by bringing together innovation and TQM, more specifically by analyzing the impact of innovation outputs on the adoption of TQM principles. The purpose was to expand a little more the knowledge on these areas of the economic and social sciences and actively contribute to their development. On the other hand, in practical terms, by analyzing the impact of innovation outputs on the adoption of TQM principles, we seek to obtain information and knowledge useful for the organizations surveyed. As a result they may achieve profitable increases in organizational performance, with obvious benefits not only internally, at all levels, but also externally to all persons and institutions that relate to these organizations. The research presents some limitations. The empirical data refer to organizations of different activity sectors and for which, the generalization of the obtained results may not apply to certain activity sectors. Data gathering considers the perception of top managers that may not correspond completely to the feeling of the entire organization. Regarding future research, it could be interesting to divide the sample in different groups and analyze eventual impact differences in innovation outputs when adopting TQM principles. Dividing the sample could be made, for example, in accordance with the activity sector or with the dimension of the organization. Because there is a possibility of each innovation output being able to influence and be influenced by others outputs, and the same happens with variables associated to TQM, an evaluation of the cross impacts among variables associated with outputs of the innovation and variables associated with TQM is suggested.

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**ICIEOM 2012 notification for paper 109 - ACCEPT subject to minor revisions**

ICIEOM 2012 [icieom2012@easychair.org]

Enviado: sexta-feira, 30 de Março de 2012 23:42

Para: António Fernandes

Dear António Fernandes,

We hereby send you the notification of acceptance, subject to minor revisions, of your paper "109 - Innovation and Quality: impacts of innovation outputs on TQM principles adopted", and invite you to send your final paper till April 15.

Please use the template for the final paper, as provided on our website, and pay special attention to the reviewers' comments.

Soon, you will receive additional information to make your registration in the conference.

If you have any questions, do not hesitate to contact us.

Best regards,  
Rui M. Lima  
(ICIEOM2012 Organization)

----- REVIEW 3 -----

PAPER: 109

TITLE: Innovation and Quality: impacts of innovation outputs on TQM principles adopted

AUTHORS: António Fernandes, Maria Jose Silva and Luis Lourenço

OVERALL RATING: 3 (Accept the paper and ask the author(s) to consider the reviewer recommendations.)

a. Originality The paper presents a technique, method or concept not known or not used before. This work is not similar to others previously reported. (1 to 5 - one being associated to the lowest evaluation and five to the highest one):: 2 (2)

b. Novelty - The paper does not necessarily develop new techniques or generate new knowledge, but it applies, or combines, them in a fresh and novel way or shed some new light on their applicability in a certain domain. 1 (lower) to 5 (highest): 2 (2)

c. Relevance - Importance, usefulness, and/or applicability of the results (ideas, methods and/or techniques) described in the paper. 1 (lower) to 5 (highest): 2 (2)

d. Quality Scientific, technical, and/or methodological soundness of the paper. 1 (lower) to 5 (highest): 3 (3)

e. Appropriateness Suitability, agreeableness, compatibility, congruity, and adequacy of the paper to the areas and topics of the conference. 1 (lower) to 5 (highest): 3 (3)

f. Presentation - Adequate organization of the paper and the language used in it, as to make its content clear, easily readable and understandable. Clarity in what has been achieved by the author of the article. Template applied correctly.: 3 (3)

This paper deals with the impact of innovation in the adoption of TQM principles. As the authors said the relationship between TQM and innovation has been studied by several authors in the literature. This study assumes that every ISO 9001:2008 certified company has adopted TQM philosophy. They also considered the "types of innovation" as the output of the innovation. These are the weak issues and hypotheses to be highlighted in the paper. At the end of the day, the authors stated that the results support the general literature suggestions. So what is the difference of this study? What is the actual contribution of this study? The conclusion section suffers from loose generalizations and needs improvement. I think the authors should explain their actual contribution explicitly and discuss

their assumptions throughly in their paper.

----- REVIEW 4 -----

PAPER: 109

TITLE: Innovation and Quality: impacts of innovation outputs on TQM principles adopted

AUTHORS: António Fernandes, Maria Jose Silva and Luís Lourenço

OVERALL RATING: 4 (Accept the paper with no conditions.)

- a. Originality The paper presents a technique, method or concept not known or not used before. This work is not similar to others previously reported. (1 to 5 - one being associated to the lowest evaluation and five to the highest one):: 3 (3)
- b. Novelty - The paper does not necessarily develop new techniques or generate new knowledge, but it applies, or combines, them in a fresh and novel way or shed some new light on their applicability in a certain domain. 1 (lower) to 5 (highest): 3 (3)
- c. Relevance - Importance, usefulness, and/or applicability of the results (ideas, methods and/or techniques) described in the paper. 1 (lower) to 5 (highest): 4 (4)
- d. Quality Scientific, technical, and/or methodological soundness of the paper. 1 (lower) to 5 (highest): 4 (4)
- e. Appropriateness Suitability, agreeableness, compatibility, congruity, and adequacy of the paper to the areas and topics of the conference. 1 (lower) to 5 (highest): 4 (4)
- f. Presentation - Adequate organization of the paper and the language used in it, as to make its content clear, easily readable and understandable. Clarity in what has been achieved by the author of the article. Template applied correctly.: 4 (4)

This is a good empirical study on the impact of innovation from adopting TQM principles. The paper is generally well-written.

The discussion and analysis could be improved by relating to more recent literature. Journals such as Total Quality Management and Business Excellence have many related papers.