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## Measuring critical success factors of TQM implementation successfully – a systematic literature review

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In times of globalisation and international trade, the concept of total quality management (TQM) as a strategy to enhance organisational performance is growing in importance. To exploit the benefits provided by TQM, organisations must manage the complex implementation process successfully. Therefore, organisations need to measure critical success factors (CSFs) when introducing TQM. However, previous research has developed a plethora of measurement instruments and researchers do not agree on certain factors or on one single measurement instrument. A systematic literature review is conducted to structure and clarify the scattered research field. The analysis of 145 studies reveals that CSFs can be classified into 11 distinct dimensions. The article proposes a three-level framework and a holistic set of measurement instruments to help researchers and managers measure each critical dimension in a timely and comprehensive manner. A focus group consisting of six quality managers validated these results. The study concludes with further findings and future research. Deficiencies of current measurements are presented and the article discusses the finding that human related factors are regarded as highly relevant but have remained low on many researchers' and practitioners' agendas. Hence, this article is a major contribution to structure the complex research field of measuring CSFs of TQM implementation.

**Keywords:** total quality management; implementation; critical success factors

### 1. Introduction

Increasing global competition and more demanding customers force companies to seek continuous improvement, a greater degree of flexibility and enhanced quality. Under these external pressures, organisations in various industries consider quality and the management of quality as one of the key factors to achieve competitiveness. Therefore, most organisations employ quality practices such as statistical process control, Six Sigma or the ISO 9000 standards (Talib, Rahman, and Qureshi 2011). Among these quality practices, total quality management (TQM) has received attention from practitioners and scholars worldwide (Sila and Ebrahimpour 2003).

TQM is a holistic quality management approach that considers the entire value chain and emphasises human factors (Demirbag et al. 2006; Welikala and Sohal 2008). Only an effective TQM process systematically produces products with superior quality (Ng et al. 2014). In a competitive market, the resulting superior product quality determines the success and failure of a company (Demirbag et al. 2006). Organisations with excellent quality have higher operating incomes, revenues and stock performances (Beer 2003).

The success of every quality management concept depends on its successful implementation within the company. In practice, however, the implementation of TQM is a complex and difficult process and the advantages are not easily achieved (Rad 2006). Therefore, investigating critical factors that determine the success of TQM implementations is particularly important. Studies show that these factors have a positive influence on firm performance (for a detailed overview see Ebrahimi and Sadeghi 2014). Measuring critical success factors (CSF) is an essential precondition to control the implementation process and to increase the chances of success.

Previous research has suggested a plethora of possible measurement instruments for CSFs. However, finding and selecting adequate measurement instruments is a major challenge to companies because there is no consensus on certain factors or a holistic framework (Salaheldin 2009). The research field of CSFs and relating measurement instruments is wide and opaque. Thus, research that provides an overview and structures previous research is a necessary step to establish a common base for practice and academia.

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Despite minor variations in the importance of critical TQM success factors for several industries, different sectors generally understand the same factors as critical to success (e.g. Kumar, Garg, and Garg 2011). Hence, common critical excellence factors exist, which organisations can adopt regardless of their industry, type, size or location (Zairi and Alsughayir 2011). This paper identifies these few general dimensions and classifies them into a general framework. This research suggests a holistic measurement instrument, because available measurement instruments suffer from shortcomings like a lack of universal applicability (Singh and Smith 2006). For this purpose, the authors systematically analyse existing literature on measurement instruments. Through structuring and analysing previous empirical research, the authors find common superordinate factor dimensions and give implications on how to measure these dimensions successfully. In addition, the authors create a novel framework and validate the results using a focus group of quality management experts.

The paper is organised as follows. The next section presents the conceptual foundation by defining important concepts. Afterwards, the paper describes the methodology and the sample of the systematic literature review. The identified critical success dimensions are described in Section 4. Subsequently, the authors propose a comprehensive framework for CSFs, describe the steps undertaken to validate the framework and discuss implementation guidelines for managers. The paper concludes with further findings from the literature review that lead to future research opportunities and a concluding remark.

## 2. Conceptual background

### 2.1 Total quality management

More than one universally accepted definition for quality exists (Sila and Ebrahimpour 2003). Despite the variety of definitions, however, most of them have the following commonalities: (1) the fulfilment of requirements, in particular customer needs, (2) the focus on specific products, services or processes, (3) improved organisational performance and (4) the absence of errors. This study's understanding of the quality concept is not limited to products, but includes processes and other potentially important factors such as technical and personal resources.

Over the last decades, researchers extended the concept of quality to the entire organisation and made every individual within the organisation responsible for quality. Quality management evolved from a result-orientated quality control to an integrated company-wide approach (Mehra, Hoffman, and Sirias 2001). Researchers refer to this approach as TQM. The concept of TQM consists of three components. First, the term 'total' assumes that all individuals associated with an organisation contribute to quality management (employees, customers and suppliers). Second, 'quality' is the integral part of the corporate philosophy. Third, the term 'management' refers to the executive responsibility and relevance of managerial commitment (Ho 1997).

### 2.2 The term CSF

In order to benefit from TQM effectively, organisations require certain preconditions. These CSFs are best practices, enablers or keys, which drive a company's success (Baidoun 2003; Sila and Ebrahimpour 2005; Soltani, Lai, and Gharneh 2005). In this study, CSFs are conceptualised as initial inputs, which affect the adoption of quality management practices in a critical way (Baidoun 2003; Salaheldin 2009). A multitude of different CSFs exist that impact the success or failure of TQM implementation (Soltani, Lai, and Gharneh 2005; Salaheldin 2009). Some researchers use less than four of these CSFs to capture TQM practices and others more than 10 CSFs (Nair 2006; Wu and Zhang 2013).

### 2.3 Sources of CSFs for TQM implementation

In general, aspects of successful TQM implementation can be derived from four different theoretical areas: the work of quality leaders (gurus), formal award models, descriptive approaches and empirical research (Claver, Tari, and Molina 2003; Tari 2005). As shown in Figure 1, the research field on successful quality management implementation originates from the contribution of quality gurus in the 1980s. Almost at the same time, national governments launched award models for business excellence. Until the end of the 1990s, the vast majority of the literature on quality management consisted of case studies, descriptive and conceptual articles with few exceptions of empirical studies (Black and Porter 1995; Mehra, Hoffman, and Sirias 2001).

Sila and Ebrahimpour (2003) and Mehra, Hoffman, and Sirias (2001) conducted reviews and identified various CSFs. Since these literature reviews, empirical research and the discovery of new CSFs have further increased. Nowadays, researchers focus on empirical studies that include the principles of award models. For example, Lau, Zhao,

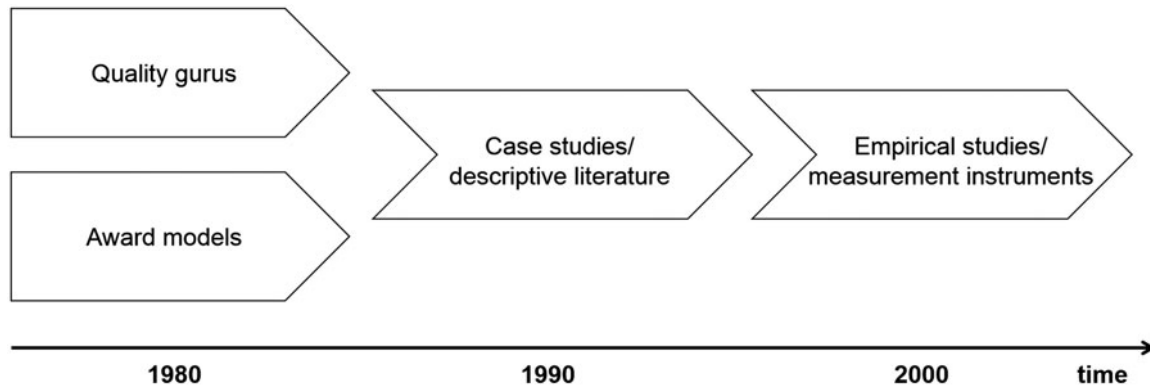


Figure 1. Illustration of the CSF literature development.

and Xiao (2004) and Xiang et al. (2010) base their studies on the Malcolm Baldrige National Quality Award, whereas Claver, Tari, and Molina (2003) as well as Tari, Molina, and Castejon (2007) refer to the model of the European Foundation for Quality Management. Empirical research employs measures to derive conclusions on factors influencing the success of TQM implementation. The multiple-item measurement instruments used in this research field provide guidance to practitioners for successful TQM implementation (e.g. by raising awareness of the importance of top management commitment) and help managers to evaluate the current quality management status (Saraph, Benson, and Schroeder 1989). In addition, valid and reliable measurement instruments are essential to conduct TQM research (Psomas and Fotopoulos 2010).

However, neither generally accepted measurement instruments for CSFs (Singh and Smith 2006) nor a generally accepted framework that guides the implementation process exists. Although reviews that analyse CSFs exist (Karuppusami and Gandhinathan 2006; Mehra, Hoffman, and Sirias 2001; Sila and Ebrahimpour 2002), problems remain. Most of these previous reviews have been published more than 10 years ago and contain up to 56 different factors.

The sheer amount of CSF research in general and the number of measurement instruments in particular that have accumulated over the last years generate two problem areas. First, researchers rely on a variety of outdated instruments, different instruments lead to limited comparability and results cannot be discussed in a larger context. Second, practitioners lose sight of the bigger picture of TQM implementation and only measure certain aspects of CSFs. Therefore, this systematic literature review summarises empirical studies with measurement instruments, groups CSFs for TQM implementation into a holistic framework with superordinate dimensions and tasks and suggests measurement instruments for each dimension of the framework. As suggested in the literature, the authors blend valid prior instruments rather than reinvent the wheel by developing a completely new instrument (Das, Paul, and Swierczek 2008; Singh and Smith 2006).

### 3. Methodology and sample

The authors conducted a structured review on empirical studies. This methodology allows the mapping and assessment of scientific literature and leads to a synthesis of findings, as well as managerial implications and further research opportunities (Tranfield, Denyer, and Smart 2003).

The systematic review follows the process proposed by Tranfield, Denyer, and Smart (2003). The authors identified potentially relevant research through a structured search based on a combination of the keywords 'TQM' or 'total quality management' and 'implementation', 'CSFs' as well as 'instrument' in the databases ScienceDirect, Business Source Complete and Emerald Management (see Figure 2). To ensure a high degree of comprehensiveness, the authors performed a forward and backward search of citations in articles, which were identified through the database searches.

An article had to fulfil three requirements to be included in the final sample. First, the article had to discuss TQM implementation and critical factors explicitly. Second, the article was based on a quantitative study that develops or applies an item-based measurement instrument to quantify CSFs. An item-based measurement instrument consists of different statements, which are rated on a scale (e.g. Likert scale) and measure a CSF. The protocol included studies that measure CSFs in the context of confirmatory factor analyses, structural equation modelling or regression analyses. Third, the article was situated in an industrial context. This sector is the most adequate for identifying TQM instruments, because manufacturing companies implement TQM more often and more successfully than other sectors (Huang and Lin 2002).

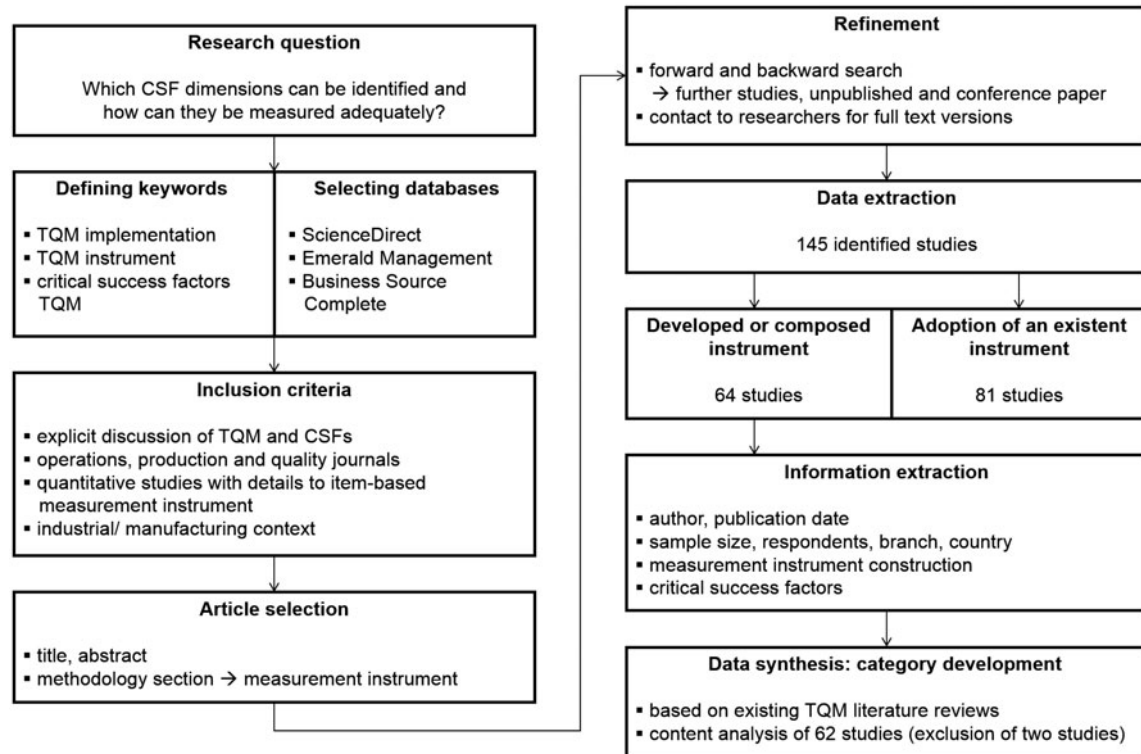


Figure 2. The structured review process.

Out of the 145 identified studies, 81 studies adopted an existing instrument. Accordingly, the sample contains 64 different unique measurement instruments.

Finally, this study synthesises the data using categorisation schemes of prior TQM literature reviews and a content analysis. The authors developed a coding system with the factors of the 64 selected studies following the deductive method proposed by Mayring (2000). The coding enables abstracting interrelated CSFs to broader dimensions. After the analysis, the authors decided to exclude two studies that summarise various dimensions in one factor for the frequency analysis, because these CSFs cannot be assigned to one single dimension.

Additionally, this study recommends instruments for measuring each dimension adequately. The authors choose the instruments from the 62 identified studies. The authors discussed each available instrument and selected instruments according to the fulfilment of the following four criteria. The measurement instrument has to be applicable in multiple industries, cover multiple CSFs within one dimension, be parsimonious and possess high reliability (i.e. Cronbach's  $\alpha > 0.7$ ).

#### 4. Results of the literature review

The analysis revealed that previous research investigated CSFs of TQM implementation in various contexts (e.g. different countries, industries, company sizes, respondents and sample sizes). However, almost none of the articles deal with the same set of factors. The continuous rise of research related to the success of TQM implementation further increases the number of different CSFs identified in the literature. Although many authors assume common dimensions of CSFs (e.g. nearly all studies included a form of 'top management commitment' or 'process management'), no topical study investigates the existence of such broader dimensions that could lead to a holistic framework. This study fills this research gap by identifying 11 central CSF dimensions. In addition, this study contributes a comprehensive framework that classifies the previously identified dimensions (see Table 1 and Figure 3).

The review extracts a total of 511 factors out of 62 studies. Table 1 provides an overview of TQM implementation dimensions including important examples of CSFs for each dimension.

Besides these most important factors, some authors also mention the CSFs innovation and resources. This study does not classify these two factors in a separate dimension, because innovation often represents a performance parameter – or

Table 1. Analysis of quantitative studies.

No.	CSF dimension	Examples of CSF within each dimension	# of times dimension quoted	Rank	# of times CSF quoted	Rank
(1)	HRM/recognition/teamwork	Employee involvement (Ahire, Golhar, and Waller 1996), employee empowerment (Ahire, Golhar, and Waller 1996), recognition & reward (Zhang, Waszink, and Wijngaard 2000), teamwork (Kumar, Garg, and Garg 2011)	55	1	83	2
(2)	Top management commitment and leadership	Top management support (Flynn, Schroeder, and Sakakibara 1995), executive commitment (Powell 1995), leadership (Valmohammadi 2011)	53	2	63	3
(3)	Process management	Tools and techniques (Valmohammadi 2011), continuous improvement (Claver, Tari, and Molina 2003), process design (Zhang, Waszink, and Wijngaard 2000)	53	2	105	1
(4)	Customer focus and satisfaction	Customer and market focus (Lau, Zhao, and Xiao (2004)), customer satisfaction (Black and Porter 1995), customer relationship (Zu, Robbins, and Fredendall 2010)	49	4	56	4
(5)	Supplier partnership	Cooperation with suppliers (Claver, Tari, and Molina 2003), supplier quality management (Ahire, Golhar, and Waller 1996), supplier relationship (Flynn, Schroeder, and Sakakibara 1995)	42	5	46	5
(6)	Training and learning	Learning (Claver, Tari, and Molina 2003), knowledge (Adam et al. 1997), education & training (Das, Paul, and Swierczek 2008)	35	6	40	6
(7)	Information/analysis/data	Quality data and reporting (Demirbag et al. 2006), internal quality information usage (Jayaram, Ahire, and Dreyfus 2010)	35	7	38	8
(8)	Strategic quality planning	Quality policy (Demirbag et al. 2006), quality planning (Tari, Molina, and Castejon 2007), vision & plan statement (Zhang, Waszink, and Wijngaard 2000)	34	8	40	7
(9)	Culture and communication	Trust (Jayaram, Ahire, and Dreyfus 2010), cultural change (Antony et al. 2004)	13	9	22	9
(10)	Benchmarking	Competitors (Singh and Smith 2006), benchmarking (Powell 1995)	8	10	8	10
(11)	Social and environmental responsibility	Wider community (Singh and Smith 2006), quality citizenship (Rao, Solis, and Raghunathan 1999)	6	11	6	11
	Innovation	Product innovation (Das, Paul, and Swierczek 2008)	3	12	3	12
	Resources	Resources (Yusof and Aspinwall 2000)	1	13	1	13

at least a mediator or moderator of the relationship between the CSFs and performance – and consequently results as a dependent variable from the successful implementation of the CSFs (e.g. Akgün et al. 2014; Kim, Kumar, and Kumar 2012; Sadikoglu and Zehir 2010; Wiengarten et al. 2013). Resources are a part of other factors (e.g. top management is responsible for providing resources) and form no distinct dimension.

Both the analysis on the basis of the several CSFs and by the dimensions in general show that process management, HRM/recognition/teamwork as well as top management commitment and leadership are the most commonly measured aspects.

The next sub-sections are structured as follows. First, the authors describe each dimension briefly, discuss each dimension's theoretical relevance and provide empirical evidence of each dimension's impact on performance (i.e. statistically significant influences of the CSFs on certain outcome variables). Table 2 displays the summary of the empirical evidence by providing an overview of studies that confirm significant effects of CSFs on performance. Second, the authors suggest instruments for measuring each dimension.

#### 4.1 Human resource management/recognition/teamwork

In this context, human resource management focuses on employee participation. Through active involvement, employees acquire new knowledge, recognise errors faster and solve problems more efficiently. The resulting understanding of the

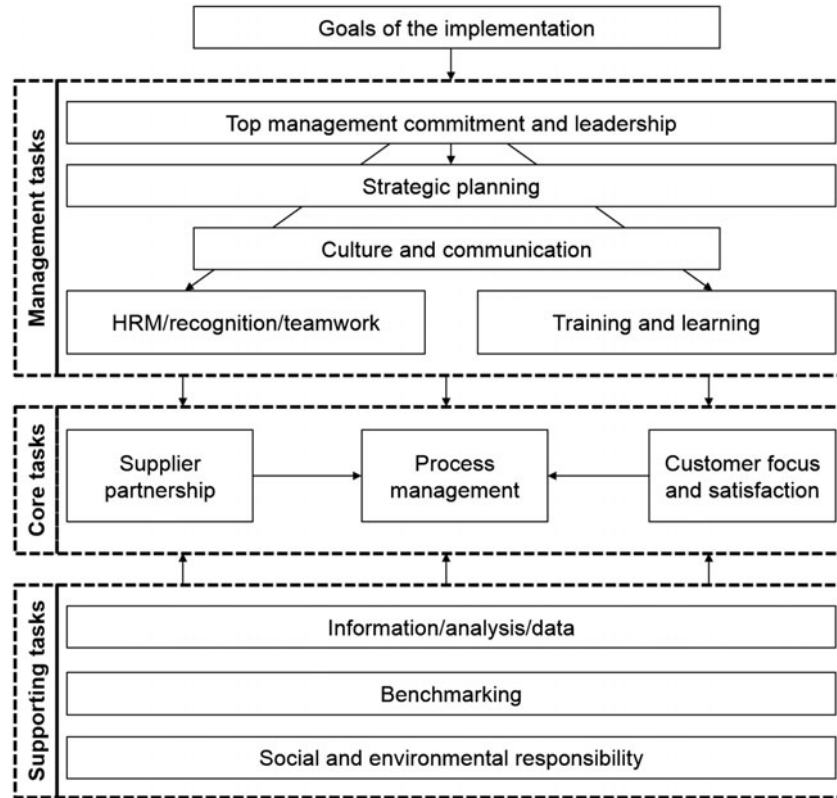


Figure 3. Critical success factors of TQM implementation framework.

importance of quality leads to intensified commitment to TQM. This change in attitude makes employees feel as a part of the organisation and enables the creation of a company-wide quality culture (Zhang, Waszink, and Wijngaard 2000). Participation furthermore encourages employees to suggest ideas for continuous quality improvement (Welikala and Sohal 2008). Organisations should implement a formal reward system to stimulate employee involvement (Rao, Solis, and Raghunathan 1999).

Another important aspect of human resource management is employee empowerment. Responsibility fosters the talent of employees and their motivation to actively participate. In addition, empowerment fosters the bottom-up identification of quality problems. Employees can quickly respond to potential errors, if they have the authority to do so (Mehra, Hoffman, and Sirias 2001; Vouzas and Psychogios 2007). Finally, empowerment reduces the need for supervisors and minimises related costs (Ahire, Golhar, and Waller 1996).

Effective people management should also promote teamwork. Cooperating employees share required information, work more flexible, develop mutual trust among each other and improve the problem-solving process by quickly producing results (Welikala and Sohal 2008; Vouzas and Psychogios 2007).

Researchers, such as Rahman and Bullock (2005) or Samson and Terziovski (1999), confirm the relevance of people management by linking it to firm performance. The measurement instrument by Lau, Zhao, and Xiao (2004) includes teamwork, empowerment, reward systems and training aspects. Valmohammadi (2011) covers participation and employee satisfaction. To get a broad perspective, organisations should use both instruments.

#### 4.2 Top management commitment and leadership

TQM is a management philosophy and therefore the initiation of quality activities stems from the leadership level. Top management commitment and leadership refer to factors that measure the involvement and support for quality of individuals on higher levels of an organisation's hierarchy. Top management has to form a sound foundation of clear values and policies and provide corresponding resources (Grover, Agrawal, and Khan 2006). Management is able to change the working climate in favour of quality acceptance and signal employees the importance of TQM introduction (Das, Paul, and Swierczek 2008; Mehra, Hoffman, and Sirias 2001).

Table 2. Examples of empirical effects of CSFs on performance.

Dimension	Study	CSF (independent variable)	Performance (dependent variable)	Significance
Human resource management/ recognition/teamwork	Samson and Terziovski (1999)	People management	Organisational performance	Multiple regression analysis with significant beta coefficient of 0.259
	Rahman and Bullock (2005)	Workforce commitment	Customer satisfaction, employee morale, productivity, defects, delivery in full, warranty cost, cost of quality	Regression analysis with significant standardised beta coefficients between 0.14 and 0.51
	Nair (2006)	People management	Financial performance, operational performance	Meta-analysis with corrected correlations of 0.253 and 0.434
Top management commitment and leadership	Samson and Terziovski (1999)	Leadership	Organisational performance	Multiple regression analysis with significant beta coefficient of 0.158
	Lakhal, Pasin, and Limam (2006)	Top management commitment and support	Operational performance, financial performance, product quality	Path analysis with significant indirect effects between 0.30 and 0.42
	Nair (2006)	Management leadership	Financial performance, customer service, product quality	Meta-analysis with corrected correlations of 0.278 and 0.547
Process management	Kaynak (2003)	Process management	Quality performance	Path analysis with significant effect of 0.12
	Lakhal, Pasin, and Limam (2006)	Quality system improvement	Product quality	Path analysis with significant direct effect of 0.34
	Nair (2006)	Process management	Financial performance, customer service	Meta-analysis with corrected correlations of 0.267 and 0.419
Customer focus and satisfaction	Samson and Terziovski (1999)	Customer focus	Organisational performance	Multiple regression analysis with significant beta coefficient of 0.12
	Rahman and Bullock (2005)	Customer focus	Customer satisfaction, employee morale, productivity, delivery in full	Regression analysis with significant standardised beta coefficients between 0.20 and 0.21
	Lakhal, Pasin, and Limam (2006)	Customer focus	Financial performance, operational performance	Path analysis with significant total effects of 0.18 and 0.44
Supplier partnership	Kaynak (2003)	Supplier quality management	Inventory management performance	Path analysis with significant effect of 0.35
	Rahman and Bullock (2005)	Cooperative supplier relations	Customer satisfaction, employee morale, productivity, delivery in full	Regression analysis with significant standardised beta coefficients between 0.15 and 0.28
	Nair (2006)	Supplier quality management	Operational performance	Meta-analysis with corrected correlation of 0.391
Training and learning	Solis, Raghu-Nathan, and Rao (2000)	Employee training	Quality performance	Significant correlations of 0.50 and 0.64 in two of three samples
	Rahman and Bullock (2005)	Personal training	Delivery in full	Regression analysis with significant standardised beta coefficients of 0.15
	Lakhal, Pasin, and Limam (2006)	Employee training/ employee participation	Operational performance	Path analysis with significant total effects of 0.80 and 0.91
Information/analysis/ data	Choi and Eboch (1998)	Information and analysis	Plant performance, customer satisfaction	Significant correlations between 0.13 and 0.41
	Lakhal, Pasin, and Limam (2006)	Information and analysis	Financial performance, product quality, operational performance	Path analysis with significant direct effects between 0.34 and 0.57

(Continued)

Table 2. (Continued)

Dimension	Study	CSF (independent variable)	Performance (dependent variable)	Significance
Strategic quality planning	Nair (2006)	Quality data analysis	Customer service	Meta-analysis analysis with corrected correlation of 0.41
	Choi and Eboch (1998)	Strategic quality planning	Customer satisfaction	Significant correlations between 0.27 and 0.43
	Solis, Raghu-Nathan, and Rao (2000)	Strategic quality planning	Quality performance	Significant correlations between 0.45 and 0.67 in three samples
Culture and communication	Sun (2000)	Strategy	External performances, internal performances	Significant correlations between 0.29 and 0.52 in two samples
	Powell (1995)	Adopting the philosophy	TQM performance, total performance	Significant correlations of 0.29 and 0.32
	Terziovski, Power, and Sohal (2003)	Quality culture	Improved business performance	Significant hierarchical regression model with change in $R^2$ of 0.095
Benchmarking	Valmohammadi (2011)	Communication and quality information system	Organisational performance	Significant regression analysis with $R^2$ of 0.073
	Sun (2000)	Benchmarking	External performances, internal performances	Significant correlations between 0.25 and 0.39 in two samples
	Agus and Hassan (2011)	Benchmarking	Production performance, customer related performance	Significant correlations between 0.513 and 0.564
Social and environmental responsibility	Solis, Raghu-Nathan, and Rao (2000)	Quality citizenship	Quality performance	Significant correlations of 0.44 and 0.62 in two of three samples
	Sun (2000)	Citizenship	Internal performances	Significant correlations of 0.41 and 0.42 in two samples
	Parast and Adams (2012)	Quality citizenship	Internal quality results	Path analysis with significant estimate

The results of several studies with different methodologies suggest that management commitment and leadership is the most crucial factor for TQM implementation (e.g. Chin et al. 2002; Lakhal, Pasin, and Limam 2006; Yusof and Aspinwall 2000). In addition, meta-analysis results show that management leadership positively impacts performance indicators (Nair 2006). For measuring this dimension, two instruments are appropriate. Zhang, Waszink, and Wijngaard (2000) consider the encouragement of employees, the provision of resources and the long-term orientation by management. Brah, Tee, and Rao (2002) focus on culture of change, commitment and goal orientation. Depending on the organisational context and objectives, managers can choose either the philosophy-orientated instrument by Brah, Tee, and Rao (2002) or the action-orientated instrument by Zhang, Waszink, and Wijngaard (2000) or combine both instruments.

### 4.3 Process management

The literature agrees on a process-orientated instead of a result-orientated management approach (Mehra, Hoffman, and Sirias 2001). Organisations should manage processes to function without operating errors (Zhang, Waszink, and Wijngaard 2000). The relevance of process management bases on the assumption that organisations are systems of interlinked processes and that process improvement determines performance improvement (Deming 1986; Samson and Terziovski 1999). In order to achieve better product and service quality, organisations should identify key processes and improve them continuously (Zhang, Waszink, and Wijngaard 2000). To achieve process control and continuous improvement, researchers suggest statistical methods as effective tools (Das, Paul, and Swierczek 2008; Zhang, Waszink, and Wijngaard 2000).

Process redesign and re-engineering can lead to dramatic performance improvements (Hammer and Champy 1993; Samson and Terziovski 1999). Process management is often positively correlated to performance indicators (Nair 2006).

Practitioners can evaluate process management with the measurement instrument developed by Jayaram, Ahire, and Dreyfus (2010). This construct refers to process control as well as improvement. However, current measurement instruments of process management solely focus on manufacturing operations. Researchers mainly relate to efficient manufacturing processes when discussing this CSF. Practitioners should not solely focus on production but also on internal operations and information processes.

#### **4.4 Customer focus and satisfaction**

Customer orientation relates to the goal of identifying and meeting current and emerging customer needs (Nair 2006). Organisations need to establish an open relationship with customers to obtain information on their desires and to receive feedback on how to meet these requirements in the best possible way (Das, Paul, and Swierczek 2008; Flynn, Schroeder, and Sakakibara 1995; Zhang, Waszink, and Wijngaard 2000). Consumer opinions can enhance the product and service quality and therefore should be included in each stage of the product development process (Das, Paul, and Swierczek 2008; Singh and Smith 2004). Due to the fact that customer satisfaction affects the success or failure of a company, an organisation should be able to respond quickly to changing consumer demands (Das, Paul, and Swierczek 2008; Mehra, Hoffman, and Sirias 2001).

Nair (2006) underlines the importance of this construct by demonstrating evidence of a strong relationship between customer focus and firm performance. Moreover, customer focus receives particular attention as a CSF, because by definition TQM is a customer-orientated practice (Mehra, Hoffman, and Sirias 2001). Companies can examine the presence of this factor with the help of the measurement instrument by Samson and Terziovski (1999) or Zhang, Waszink, and Wijngaard (2000). Both instruments include complaint management and the measurement of customer satisfaction. Samson and Terziovski (1999) additionally consider consumer requirements and the involvement of customers. Zhang, Waszink, and Wijngaard (2000) include the prioritisation of customer focus and market research.

#### **4.5 Supplier partnership**

Supply quality is an essential aspect of TQM, because vendor parts often represent a major source of quality problems (Zhang, Waszink, and Wijngaard 2000). Poor quality leads to extra costs and can damage the image of a product or an entire company. Long-term relationships between the organisation and selected suppliers reduce quality control costs and ensure lasting provision of components with the required quality (Das, Paul, and Swierczek 2008; Zhang, Waszink, and Wijngaard 2000).

Different studies support the notion that supplier partnership is critical for TQM implementation success and confirm a significant relationship between cooperative supplier relations and performance measures for manufacturing firms (Kaynak 2003; Rahman and Bullock 2005; Valmohammadi 2011). For measuring the current state of supplier cooperation, practitioners can use the instrument of Zu, Robbins, and Fredendall (2010). This instrument measures long-term relationships, a small number of high quality suppliers, the active involvement and evaluation of suppliers and the provision of assistance to suppliers.

#### **4.6 Training and learning**

Training in quality concepts and tools is a precondition for employee involvement and empowerment. Maintaining a high quality level requires capable employees. Trained employees better understand quality-related issues and their role within the quality management approach. Thus, only employees equipped with knowledge and abilities can make constructive contributions to quality (Ahire, Golhar, and Waller 1996; Rao, Solis, and Raghunathan 1999). Managers should therefore view training expenses as investment rather than costs (Das, Paul, and Swierczek 2008).

Solis, Raghu-Nathan, and Rao (2000) prove a strong correlation between quality performance and employee training. Rahman and Bullock (2005) demonstrate a direct effect of personnel training on delivery in full. The authors advise firms to measure people development by the instrument of Zhang, Waszink, and Wijngaard (2000). This measurement instrument emphasises available resources for education, awareness learning and consideration of employees as valuable long-term resources.

#### **4.7 Information/analysis/data**

The information system represents a key part of the quality management infrastructure. To maintain and continuously improve quality, organisations require a persistent flow of reliable information (Rao, Solis, and Raghunathan 1999). The

collection of appropriate data is essential to monitor the current quality status. Organisations cannot evaluate the quality of products and services correctly, if they cannot measure the status before and after improvement activities (Jayaram, Ahire, and Dreyfus 2010). In addition, not only the availability of information is important to organisations, but also the adequate usage by management and employees (Rao, Solis, and Raghunathan 1999).

Lakhal, Pasin, and Limam (2006) confirm the relevance of data-based factual decision-making by pointing out that information and analysis have a significant direct effect on various performance measures. Choi and Eboch (1998) also show in their study that information and analysis and plant performance are correlated positively. The authors recommend measuring the construct with the instrument of Lakhal, Pasin, and Limam (2006). This instrument measures whether organisations collect data and transmit information to employees as well as use data to identify areas of improvement.

#### **4.8 Strategic quality planning**

TQM is an organisational strategy that requires long-term management orientation. Companies have to integrate quality in the organisational strategy to achieve consistent and lasting excellence (Lee, Rho, and Lee 2003). The quality plan determines the vision for the company's future and keeps employees on track (Solis, Raghu-Nathan, and Rao 2000). Without strategic quality plans, organisations cannot establish clear objectives and priorities regarding customer and market orientation. Consequently, organisations may not identify target fields for improvement activities and fail to allocate resources to the required areas (Rao, Solis, and Raghunathan 1999).

Solis, Raghu-Nathan, and Rao (2000) confirm the crucial relation between strategic quality planning and quality performance empirically. The instrument by Tari, Molina, and Castejon (2007) provides a valuable tool for measuring the implementation of strategic planning. The items measure the formal inclusion of customer and market requirements in strategic planning processes, the setting of objectives and the comparison of actual and target results.

#### **4.9 Culture and communication**

Supportive attitude and quality orientation by employees determine the acceptance or rejection of the required organisational change for implementation. Strong quality orientation accelerates the spread of the quality philosophy through the organisation (Maletič, Maletič, and Gomišček 2014). Likewise, lack of quality culture can obstruct problem-solving across the organisation and consequently, hinder continuous improvement (Welikala and Sohal 2008). Organisations often ignore this factor despite its remarkable importance (Antony et al. 2004). Effective communication holds together the pieces of the total quality process and is important for the success of the quality initiative (Baidoun 2003; Kanji and Asher 1993). When management explains quality goals and policies to employees, they encourage their commitment to the TQM programme (Welikala and Sohal 2008). Thus, communication of TQM principles and establishing quality awareness are closely linked.

Powell (1995) demonstrates that adopting the quality philosophy is significantly correlated to firm performance in the long run. Valmohammadi (2011) proves that communication positively impacts organisational performance. Practitioners can use the instrument by Antony et al. (2004) to measure the constructs of communication in the company and cultural change separately. The communication factor emphasises the coordination between departments and the cultural change construct focuses on employee's awareness of the quality concept.

#### **4.10 Benchmarking**

Benchmarking describes the analysis of best practices of leading competitors in the same branch or organisations in other branches using similar processes (Ahire, Golhar, and Waller 1996; Das, Paul, and Swierczek 2008). Benchmarking enables organisations to enhance their performance by learning from external sources (Rao, Solis, and Raghunathan 1999). Additionally, the aim of the formal evaluation is to provide a starting point for the understanding of quality issues and the identification of areas to improve (Zhang, Waszink, and Wijngaard 2000). Thus, benchmarking can significantly affect the improvement of key business processes and consequently, increase the quality level. Without benchmarking, organisations do not know their relative performance and they probably fail to design processes more effectively (Rao, Solis, and Raghunathan 1999).

Sun (2000) finds a significant correlation between benchmarking and business results. The authors suggest that practitioners use the measurement instrument by Das, Paul, and Swierczek (2008). This instrument considers whether organisations use benchmarking and whether benchmarking effectively helps to improve processes and products.

Table 3. Analysis of quantitative studies.

CSFs	Corresponding measurement instruments
HRM/recognition/teamwork	Lau, Zhao, and Xiao (2004), Valmohammadi (2011)
Top management commitment and leadership	Zhang, Waszink, and Wijngaard (2000), Brah, Tee, and Rao (2002)
Process management	Jayaram, Ahire, and Dreyfus (2010)
Customer focus and satisfaction	Samson and Terziovski (1999), Zhang, Waszink, and Wijngaard (2000)
Supplier partnership	Zu, Robbins, and Fredendall (2010)
Training and learning	Zhang, Waszink, and Wijngaard (2000)
Information/analysis/data	Lakhal, Pasin, and Limam (2006)
Strategic quality planning	Tari, Molina, and Castejon (2007)
Culture and communication	Antony et al. (2004)
Benchmarking	Das, Paul, and Swierczek (2008)
Social and environmental responsibility	Rao, Solis, and Raghunathan (1999)

#### 4.11 Social and environmental responsibility

According to Sila and Ebrahimpour (2002), this dimension includes the organisation's responsibility for good public citizenship and the protection of the environment and people's health as well as resource conservation. The organisation's task is to provide leadership and support to publicly important issues (Rao, Solis, and Raghunathan 1999). Initiatives such as sustainable development and responsible care gain importance to companies. However, altruism does not drive the emphasis of public responsibility but rather the creation of a beneficial image leading to increased sales or company performance. Consequently, companies may lose out to others, if they fail to emphasis quality citizenship (Solis, Raghu-Nathan, and Rao 2000).

Sila and Ebrahimpour (2002) criticise that despite the factor's importance only few studies extract it as a separate construct. Solis, Raghu-Nathan, and Rao (2000) demonstrate the construct's importance by measuring a significant relationship between quality citizenship and quality performance. Quality managers can use the measurement instrument by Rao, Solis, and Raghunathan (1999) to determine the extent of quality citizenship in the company. This measurement instrument does not only consider environmental issues, but also topics of public health and safety.

#### 4.12 Summary

Organisations can use the recommended measurement instruments to investigate their current state of CSFs regarding TQM implementation. The authors suggest using a five or seven-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. Table 3 gives a summary of the CFSs and the recommended measurement instruments. The Appendix 1 displays the holistic redrafted instrument with items from an 'our company' perspective.

## 5. Discussion

### 5.1 Framework

Further abstraction by the authors from the 11 dimensions to some more general tasks results in a three-level framework (see Figure 3). Arrows inside each level indicate processes and arrows between the levels indicate influences on other levels. Reducing the plethora of CSFs into one framework with three levels (i.e. tasks) and 11 dimensions helps researchers and practitioners to assess the problem in a timely and comprehensive manner. The framework's subdivision relates to the general classification of processes into management tasks, core tasks and supporting (infrastructure) tasks. Supporting tasks create a supportive environment for operative core tasks, which in turn deliver output. Management tasks affect core tasks and include strategic aspects of implementation planning and control (Flynn, Schroeder, and Sakakibara 1995; Isaksson 2006; Lakhal, Pasin, and Limam 2006). In this paper, we extend the management dimension to human resource tasks and group the CSFs into the core and supporting tasks differently to previous authors (e.g. Lakhal, Pasin, and Limam 2006; Sousa and Voss 2002).

The direction of the arrows between the CSFs is based on results of previous empirical studies, theoretical considerations and the results of a focus group. For instance, for management tasks, Sila and Ebrahimpour (2005) find that leadership strongly influences strategic planning. In addition, top management is responsible for employee management and training of employees as well. Tari, Molina, and Castejon (2007) demonstrate that 'leadership' significantly influences

‘human resource management’ and ‘learning’. Top management as well as employees determine the culture and communication within the company. Therefore, a multitude of factors influences the dimension ‘culture and communication’.

Concerning the core tasks, Tari, Molina, and Castejon (2007) prove that ‘supplier management’ and ‘customer focus’ affect ‘process management’. Management tasks and supporting tasks affect these core tasks. For example, ‘leadership’ influences ‘process management’ (Sila and Ebrahimpour 2005) and ‘information and analysis’ serve as foundations for further CSFs such as customer focus (Xiang et al. 2010) or ‘supplier management’ (Sila and Ebrahimpour 2005).

## 5.2 Focus group

To expand and validate the framework, the authors conducted a focus group with quality managers in Germany. Initially, the authors pre-tested the content and procedures of the focus group in a face-to-face interview with a quality manager who did not participate in the focus group. Afterwards, six quality managers from different industrial companies participated in a three-hour discussion (Table 4).

The focus group proceeded as follows. First, the experts freely discussed important factors that are required for successful TQM implementation. Second, the authors presented the framework and the quality managers evaluated its correctness and applicability, discussed the hierarchy of the dimensions and made proposals to implement the measurement instruments. All quality managers confirmed the basic structure of the framework. However, the experts suggested some alterations and supplements, which companies should take into account when introducing TQM.

First, the discussion of the framework with quality experts resulted in the additional dimension ‘goals of the implementation’. This preceding step is necessary to determine the objectives of the TQM implementation. Companies should first clarify their current quality problems and reflect, if the implementation of TQM is the right way to solve these problems. Only if the company understands why it requires TQM, the implementation can be successful.

Second, risk is an important variable that influences the success of the TQM implementation. Therefore, strategic planning as well as process management have to consider risks that accompany the implementation.

Third, ‘culture and communication’ does not only refer to the companies culture and mode of communication; this dimension has to include culture as a holistic construct (e.g. as in the culture dimensions theory, Hofstede 1984) as well.

Fourth, some supporting tasks are becoming more important and also develop a strategic component. For example, the dimension ‘Information/analysis/data’ will not only support core tasks; this dimension is becoming an important management task. Information security and availability is essential for TQM implementation. Without the proper functionality of the information system, the information flow is interrupted and TQM implementation becomes impossible.

Table 4. Companies and relating quality managers included in the focus group.

Industry sector	Expert position	Work experience in quality management	Company location in Germany	Revenue	Number of employees
Semiconductor	Manager Quality	>15 years	Dresden (Silicon Saxony)	>1.000 mil. €	>3.500
Automobile safety systems	Quality Engineer	<5 years	Döbeln (Saxony)	>100 mil. €	>250
Automation systems	Senior Product Manager/Quality Management Representative	>10 years	Dresden (Silicon Saxony)	>10 mil. €	≈100
Plastic electronics	Director Quality	>20 years	Dresden (Silicon Saxony)	>10 mil. €	>150
Organic electronics	Quality Manager	≈5 years	Dresden (Silicon Saxony)	>10 mil. €	≈150
Surface technology	Quality Manager	>25 years	Berlin (Silicon Saxony)	>100 mil. €* >10 mil. €*	>800*
Aviation industry	Quality Engineer**	>5 years	Dresden	>10 mil. €* >10 mil. €*	≈350*

\*No separate data for the location available. Data refer to the entire company.

\*\*Interview pre-test.

Finally, all quality managers agreed on management tasks as the most important tasks, although the quality managers rather operate within the core tasks (e.g. process management). Despite the suggested modifications (e.g. regarding 'information/data/analysis' as a management task as well), the experts had no objections concerning the hierarchy of the framework in general. Nevertheless, validating the hierarchy empirically goes beyond the scope of the focus group and requires quantitative methods.

The quality managers also discussed how companies should implement TQM and the relating CSFs with the help of the framework. The next section includes some of these proposals.

### 5.3 Implementation

Proposing corresponding measurement instruments assists both managers and researchers to understand CSFs of TQM implementation. Managers can use the measurement instruments in a survey, which they distribute among their employees in order to evaluate the current status of TQM implementation and the level alignment with CSFs. In this way, the company can reveal CSFs that are insufficiently implemented and need improvement.

The framework supports structuring and interpreting the results of the survey. With the help of the proposed classification, managers will be able to understand which CSFs are interrelated and which CSFs are preconditions for the implementation of other CSFs. For example, 'top management commitment and leadership' is one of the most important CSFs. If companies do not implement this CSF properly, succeeding CSFs like 'training and learning' will also lack proper implementation.

In addition, it can be used as a communication tool that raises awareness of potential pitfalls of TQM implementation. This is particularly important because learning is required to take advantage of TQM (Douglas and Judge 2001).

To successfully implement TQM practices, organisations need to perform multiple loops of feedback and install control routines (Douglas and Judge 2001). First, the presented items and constructs are a possible starting point to create these control measures and procedures. The authors suggest that these measures are used in a comprehensive way and that firms apply all 11 dimensions. Second, firms should not use the measurement tool only once but rather integrate it permanently into the road map to business excellence and monitor changes (Zairi and Alsughayir 2011). The quality managers of the focus group confirmed the importance of continuity and small steps instead of great leaps. For the purpose of continuity, constant training and involvement of employees are crucial (e.g. in form of working groups).

The experts particularly emphasised four important preconditions that firms should address. First, companies should clarify the objectives of the TQM implementation and improvement. Second, companies need to assure and communicate active and constant management engagement for the TQM initiative. Third, the focus group revealed that culture is crucial for successful TQM implementation. In practice, this means that companies have to carve the framework for a supportive open culture that sets quality in the centre of attention. Fourth, companies need to understand that the dimension 'strategic planning' also comprehends risk management and that 'information/analysis/data' is partly a management task as well.

Additionally, the experts of the focus group advise companies to regard the implementation from different perspectives. Top managers, quality managers, employees as well as customers and suppliers have to understand the purpose of the TQM implementation. Therefore, top management has to translate the goals and the implementation process into the language of each stakeholder. When explaining TQM implementation, top management should abstain from a very complex and theoretical perspective and rather emphasise simplicity and practicability.

This study suggests a universally applicable measurement tool. However, organisations should not view the framework as a to-do-list but rather check for the necessity of contextual adjustments (Zairi and Alsughayir 2011). Customising quality management practices can even be more beneficial than implementing standardised approaches (Zhang, Linderman, and Schroeder 2012). Managers need to realise synergy effects between the factors. The CSFs are mutually dependent and influence each other (Hellsten and Klefsjö 2000). For example, top management commitment fosters employee involvement, influences the quality culture and determines strategic planning (Flynn, Schroeder, and Sakakibara 1995; Nair 2006).

### 5.4 Further findings and future research

Although the field of TQM implementation offers a wide range of research opportunities, this study focuses on suggesting research in the following two areas. First, the authors describe deficiencies of current measurements and suggest ways to reduce these deficiencies. Second, the authors argue that the current focus on measuring hard factors more often than soft, human and behavioural factors creates false results and incentives.

A deficiency in currently used measurement instruments is that many items may not fit to present contexts. Researchers rely on these measurement instruments because of their consistent reliability. However, when the contexts change but the measures remain the same, validity will be questionable (Singh and Smith 2006). Hence, researchers should adapt existing instruments to current contexts and test whether these newly developed instruments exhibit sufficient reliability and validity. This study is a first step towards this research goal. The items that compose the new instrument are more topical. Nevertheless, future research has to empirically verify whether this instrument fulfils validity criteria and the framework is reliable and valid in a broader context as well.

Additionally, the literature review reveals that researchers should perform studies in more distinctive contexts to guarantee broad applicability (e.g. a greater variety of different cultural contexts). In addition, different and unique industries such as health care and education deserve more research attention because of their importance for economies and the lack of studies on TQM implementation in these industries (for a notable exception see Douglas and Judge 2001). Moreover, implementing performance measurement systems (e.g. measurement instruments for CSFs) in large firms require different practices than the implementation in small and medium-sized enterprises (SMEs) (Taylor and Taylor 2014). This study only investigates large firms and consequently, future research should address the implementation of CSF measurement instruments in SMEs as well.

The literature review on CSFs shows that studies ascribe a greater role to soft elements (behavioural elements of management and human aspects) during the implementation process than to hard ones (technical aspects such as process control tools and techniques) (Abdullah, Uli, and Tari 2008; Calvo-Mora et al. 2013; Talib, Rahman, and Qureshi 2011). Soft elements have a number of vital meanings. For instance, they can have an indirect effect by creating a supportive environment for process protocols and techniques or they can directly influence performance (Rahman and Bullock 2005). Managers can easily quantify the hard elements' achievements to quality results, whereas the soft side is more problematic to measure (Vouzaz and Psychogios 2007). However, visible variables have a smaller impact on performance compared to the hidden human aspects (Grover, Agrawal, and Khan 2006), because hidden CSFs are more difficult to imitate (Sousa and Voss 2002).

Future research on TQM success should focus on investigating these aspects. Regarding this structured review, 208 of the identified 511 CSFs (41.0%) in the literature review belong to the group of human factors (44.7% in relation to the dimensions respectively). These factors include the following dimensions: top management commitment and leadership, HRM/recognition/teamwork, training and learning as well as culture and communication. Figure 4 displays the relation between human CSFs to the total of CSFs investigated in the 62 studies of the literature review. For example, (Xiang et al. 2010) measure six CSFs, but only two of them are human related CSFs, resulting in a ratio of 0.33. According to the importance of human factors, this quota should be higher in future studies. In addition, the relation between human and total factors did not increase over time and remains constant (see Figure 4). Despite exceptions, most researchers utilise more non-human than human factors within their questionnaires (i.e. the ratio of human factors to total factors is smaller than 0.50). Thus, the research literature contains a contradiction. The findings of the literature review as well as the focus group emphasise management tasks and the importance of human factors, but researchers have not yet adopted these findings in quantitative surveys.

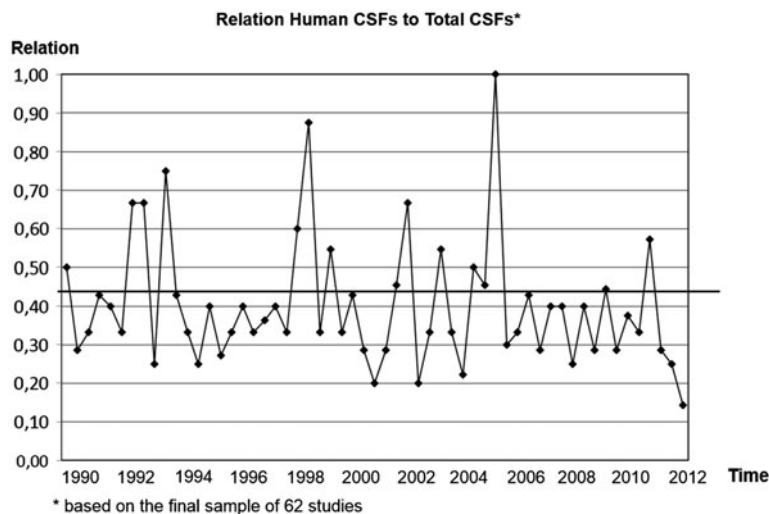


Figure 4. The relation between human factors and other factors over time.

## 6. Conclusion and limitations

This study's purpose was to analyse the numerous available measurement instruments for CSFs of TQM implementation, create dimensions that represent the literature on CSF measurement and suggest measurement instruments that researchers and practitioners can use. In addition, the authors developed a comprehensive three-level framework, expanded and validated the framework in a focus group and discussed further findings of the literature review. Hence, this article makes an important contribution by structuring the complex research field and by providing advice for TQM implementation as well as for further research.

However, the results must be qualified in several ways. First, the authors did not systematically analyse studies concerning the relationship between CSFs and performance outcomes. There are other studies (e.g. Abdullah, Uli, and Tari 2008; Nair 2006; Sadikoglu and Zehir 2010) available for this research question. However, further research could also use our classification as a basis for conducting a meta-analysis concerning the effect of CSF dimensions and performance outcomes. Second, although the authors used strict criteria to select the final measurement instruments, there is no objective way for selecting the 'right' instrument. Other instruments could also be applicable. Third, the comprehensive framework has not been tested quantitatively. The quality managers of the focus group had no objections against the hierarchy of the framework, but future research needs to assess whether our assumptions hold. However, the authors are convinced that the 11 dimensions, the framework and the suggested measurement instrument will help research to create a common platform for future studies and assist managers in a more successful TQM implementation.

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## Appendix 1

Table A1. Measurement instruments (Likert Scale anchored with 'strongly disagree' and 'strongly agree').

### (1) *HRM/recognition/teamwork*

Adapted from Lau, Zhao, and Xiao (2004)

- (1) Our company empowers employees.
- (2) Our company has a transparent and effective appraisal system for recognising and rewarding employees for their efforts.
- (3) Our company stresses teamwork and team spirit.
- (4) Our management motivates employees and fully develops their potential.
- (5) Our company trains employees in quality concepts, taking care of their needs and developing their competencies.
- (6) Our company provides training for employees to improve their competency.
- (7) Our company provides a safe and healthy work environment.
- (8) Our company provides special training for employees to serve our customers well.

Adapted from Valmohammadi (2011)

- (1) Our company provides a participative environment for employees.
- (2) Our company motivates, supports and encourages employees.
- (3) Our company creates awareness among employees on quality.
- (4) Our company measures effectiveness of training and its impact on employees.
- (5) Our company measures employee satisfaction.
- (6) Our company supplies feedback to employee satisfaction.
- (7) Our company facilitates teamwork to solve problems.

### (2) *Top management commitment and leadership*

Adapted from Zhang, Waszink, and Wijngaard (2000)

- (1) Our top management actively participates in quality management and improvement process.
- (2) Our top management learns quality-related concepts and skills.
- (3) Our top management strongly encourages employee involvement in quality management and improvement activities.
- (4) Our top management empowers employees to solve quality problems.
- (5) Our top management arranges adequate resources for employee education and training.
- (6) Our top management discusses many quality-related issues in top management meetings.
- (7) Our top management focuses on product quality rather than yields.
- (8) Our top management pursues long-term business success.

Adapted from Brah, Tee, and Rao (2002)

- (1) Our management actively encourages change and implements a culture of trust, involvement and commitment in moving towards 'Best Practice'.
- (2) Ideas from work teams are actively used in assisting management.
- (3) Our managers clearly identify quality goals for employees to achieve.
- (4) People in our company are consistently rewarded for good suggestions and quality improvement.
- (5) Our management views quality as more important than cost and schedules objectives.

### (3) *Process management*

Adopted from Jayaram, Ahire, and Dreyfus (2010)

- (1) Our company identifies causes of scrap and rework.
- (2) Our company takes immediately corrective actions when a quality problem is identified.
- (3) Our company improves systematically key processes to achieve better product quality and performance.
- (4) Our company controls manufacturing processes using defect prevention tools.
- (5) Our company regularly monitors improvement in quality of products and processes.

### (4) *Customer focus and satisfaction*

Adapted from Samson and Terziovski (1999)

- (1) Our company knows our external customers' current and future requirements (both in terms of volume and product characteristics).
- (2) These customer requirements are effectively disseminated and understood throughout the workforce.
- (3) In designing new products and services our company uses the requirements of domestic customers.
- (4) Our company has an effective process for resolving external customers' complaints.
- (5) Customer complaints are used as a method to initiate improvements in our company's current processes.
- (6) Our company systematically and regularly measures external customer satisfaction.

Zhang, Waszink, and Wijngaard (2000)

- (1) Our company collects extensive complaint information from customers.
- (2) Quality-related customer complaints are treated with top priority.
- (3) Our company conducts a customer satisfaction survey every year.
- (4) Our company always conducts market research in order to collect suggestions for improving our products.
- (5) Our company provides warranty on our sold products to customers.
- (6) Our company has been customer focused for a long time.

(Continued)

Table A1. (Continued)

*(5) Supplier partnership*

Adapted from Zu, Robbins, and Fredendall (2010)

- (1) Our company strives to establish long-term relationships with suppliers.
- (2) Our company relies on a small number of high quality suppliers.
- (3) Our suppliers are actively involved in our product design/redesign process.
- (4) Our suppliers are evaluated according to quality, delivery performance and price, in that order.
- (5) Our company has a thorough supplier rating system.
- (6) Our suppliers are involved in our quality training.
- (7) Our company provides technical assistance to our suppliers.

*(6) Training and learning*

Adapted from Zhang, Waszink, and Wijngaard (2000)

- (1) Our company encourages employees to accept education and training in our company.
- (2) Resources are available for employee education and training in our company.
- (3) Most employees in our company are trained on how to use quality management methods (tools).
- (4) Our company gives quality awareness education to employees.
- (5) Our company gives specific work-skills training to all employees.
- (6) Our company regards employees as valuable, long-term resources worthy of receiving education and training throughout their career.

*(7) Information/analysis/data*

Adapted from Lakhal, Pasin, and Limam (2006)

- (1) Our company presents and transmits important information to employees.
- (2) Our company collects and analyses data related to its activities.
- (3) Our company harnesses information to improve its key processes, products and services.
- (4) Our company has precise data about the competition used to identify areas of improvement.

*(8) Strategic quality planning*

Adapted from Tari, Molina, and Castejon (2007)

- (1) Our company bases the development and implementation of strategies and plans on data concerning customers' requirements and the firm's capabilities.
- (2) Our management sets objectives for managers.
- (3) Our management sets objectives for all employees.
- (4) Our management communicates its strategy and objectives to the whole staff.
- (5) Our management involves the employees in the setting of its objectives and plans.
- (6) Results are evaluated by comparing them to planned results, in order to make improvements.

*(9) Culture and communication*

Adapted from Antony et al. (2004)

- (1) Continuous quality improvement is part of all employees' responsibility rather than of the quality department alone.
- (2) Our company attaches importance to start employee coaching with the concept of quality rather than the policy.
- (3) All employees are ready and willing to be trained and educated with new concept on quality.
- (4) Our company establishes long-term goals related to quality.
- (5) Our company develops a company-wide culture of quality.

*(10) Benchmarking*

Adapted from Das, Paul, and Swierczek (2008)

- (1) Our company is engaged in extensive benchmarking of competitors' products that are similar to our primary product.
- (2) Our company has engaged in extensive benchmarking of other companies' business processes in other industries.
- (3) Benchmarking has helped improve our product.
- (4) The quality system in our company is continuously improving.

*(11) Social and environmental responsibility*

Adapted from Rao, Solis, and Raghunathan (1999)

- (1) Our company considers public health issues as a company responsibility.
- (2) Our company considers public safety issues as a company responsibility.
- (3) Our company considers environmental issues as a company responsibility.
- (4) Our company extends its quality commitment to the external community.