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Links Between Organizational Culture and Six Sigma Practices

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Abstract

This study engages in the competing values framework to capture the underlying value of organizational culture. Survey data collected from 880 Iran manufacturing plants, the relationships between four culture types and three Six Sigma practices were examined via the structural equation modeling technique. The results show the differential effects of the culture types on the implementation of Six Sigma practices. The implications of the links between different cultures and different Six Sigma practices are discussed. The advantage of each culture type should help managers achieve effective implementation of Six Sigma practices from a whole perspective of quality management and culture.

Keywords: Six Sigma, Total Quality Management, Organizational Culture, Iran, Organizational Culture

Introduction

As companies such as Motorola, General Electric, Sony, and Johnson Controls claimed considerable financial benefits from their investments in Six Sigma, the adoption of Six Sigma showed an upward trend in industry (Desai, 2006). However, despite the claimed benefits from Six Sigma implementation, there are several reports of problems in the process of implementing them (Ahire and Ravichandran, 2001). Few researches relative to culture have been done to examine the implementation of Six Sigma, regardless of the recognized importance of organizational culture for Six Sigma adoption and deployment (Antony, 2004; Goffnett, 2004). Schroeder et al. (2008) in his finding have called for research investigating the question of internal fit in Six Sigma implementation, i.e., what types of organizations can success fully adopt Six Sigma and what changes in Culture and

structure may be required. This study investigates the influence of the organizational circumstances on individual quality management practices by examining the links between different culture types and different Six Sigma practices. In addition, this study includes three characteristic Six Sigma practices that are identified as essential in applying Six Sigma principles and methods, which addresses the lack of empirical research on Six Sigma and its implementation in the literature. The results of this study can provide an up-to-date view of the effect of culture on quality management and supply managers with more applicable information and guidance. Moreover, when examining the culture quality management relationship, this study conducts a comprehensive evaluation of different cultural characteristics. Most prior studies have focused on the effects of people and flexibility focused cultural characteristics on quality management, but “there has been little effort to synthesize what dimensions of culture have been studied to date or, more important, to identify which of these culture dimensions are more related to the implementation of change programs and subsequent improvements in important human and organizational outcomes” (Detert et al., 2000).

This study adopts the competing values framework (CVF) of culture to catch the underlying value orientations of an organization’s culture. This culture framework has been used to examine the relationship of different culture types and organizational practices. In this study, we analyze in detail how different culture types as defined in the CVF model affect the implementation of various Six Sigma practices in order to produce guidelines on how to better implement the Six Sigma practices in an organization according to its specific cultural environment.

Literature Review

In this research Six Sigma is a new approach to quality management (Su et al., 2006; Kumar et al., 2008). Six Sigma was began by Motorola Inc. in the 1980s and has been defined as “an organized and systematic method for strategic process improvement and new product and service development that relies on statistical methods and the scientific method to make dramatic reductions in customer defined defect rates” (Linderman et al., 2003). However, recent research suggests that Six Sigma introduces new and distinct concept and practices in to quality management. According to a theory based for the nature of Six Sigma, Schroeder et al. (2008) stated that although Six Sigma shares the tools and techniques with traditional quality management methods, it provides an organizational structure. Schroeder et al (2008) suggested that Six Sigma shows “an organized, parallel structure to reduce variation in organizational processes by using improvement experts, a structured method, and performance metrics with the aim of achieving strategic objectives”. In addition, Zu et al. (2008) empirically identified three characteristic practices essential for applying Six Sigma principles and methods, which are Six Sigma role structure, Six Sigma structured improvement procedure, and Six Sigma focus on metrics. Other researchers also supports the existence of these Six Sigma practices (Nonthaleerak and Hendry, 2008; Szeto and Tsang, 2005). Therefore, in this study we include the three Six Sigma practices in the analysis to provide a comprehensive evaluation of the cultural effect on contemporary quality management practices.

Organizational Culture

Organizational culture represents the regular way of values, opinions, and beliefs shared by members in an organization (Sigler and Pearson, 2000; Schein, 1985, 1992). Specifically, organizational culture is defined as “a regular way of beliefs discovered, or developed by a given group a sit learns to deal successfully with its problems of external adoption and internal integration that has worked well enough and, therefore, to be taught to new members as the correct way to

perceive, think, and feel in relation to those problems” (Schein, 1985). The values, beliefs, and underlying an organization’s culture ties its employees together and become the strategies through which the organization achieves its goals (Marcoulides and Heck, 1993). As the organization’s cultural values shape the character of an organization and enable the employees to define their understanding of reality, it drives the way things redone in the organization (Nahm et al., 2004), organizational culture stated as an explanatory variable that distinguishes one organization from another (Schein, 1985) and affects the way the organization operates and plays an important role in many aspect of the organization (McDermott and Stock, 1999). In order to evaluate an organization’s culture, in this study we adopt the CVF model developed by Quinn and Kimberly, 1984. The CVF explores the structures of organizational culture relating to compliance, motives, decision making, effectiveness, and organizational forms in the organization (Quinn and Kimberly, 1984).

Flexibility & Spontaneity

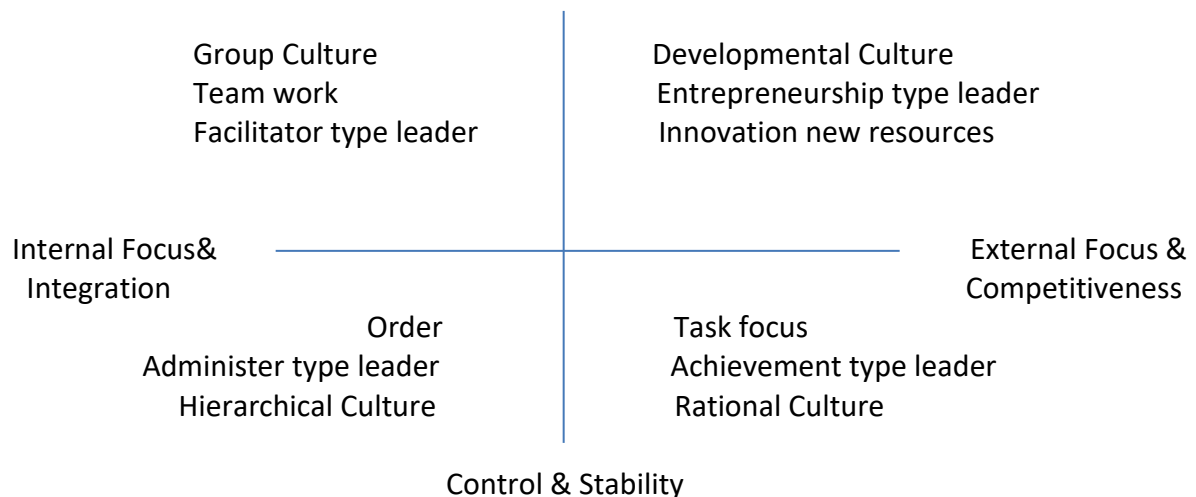


Figure 1. The competing values framework of organizational culture (Cameron and Freeman, 1991; Denison and Spreitzer, 1991).

The CVF (Figure 1) is create and shown two reflections at different value of orientations (Denison and Spreitzer, 1991; McDermott and Stock, 1999). The control-flexibility (vertical) of an organization focuses on change and stability. A focus on flexibility indicates the organization’s desire for flexibility, while a focus on control indicates an attractive desire to stay stable. The internal–external (Figure 1) (horizontal) refers to the organization’s focus on the internal organization and the external environment. An internal focus is that the organization emphasizes maintaining and improving the existing organization, whereas an external focus is that the organization focuses on participating, adapting and interacting with the external environment. The two internal–external combine to reflect four types of culture each representing different values about motivation, and strategic orientation in organizations. Group culture focuses on flexibility and internal maintenance, developmental culture highlights flexibility through growth, creativity, and adaptation to the external environment. Rational culture puts a focus on the external environment and hierarchical culture highlights stability and internal organization (Cameron and Freeman, 1991; McDermott and Stock, 1999).

An important assumption underlying the CVF is that the four quadrants are ideals (McDermott and Stock, 1999; Henri, 2006). Organizations rarely reflect only one culture type; rather each organization will show clearly a combination of different culture types, although it may be that one type is more important than the others (McDermott and Stock, 1999). The ratings on the four culture types may vary independently (Quinn and Spreitzer, 1991). Thus, when using the CVF to evaluate an organization's culture, researchers can examine the relationships between different culture types and different particular part of the construct(s). Several studies have adopted the CVF to explore the effect of organizational culture on various operations management practices (McDermott and Stock, 1999; Zammuto and O'Connor, 1992), performance measurement (Henri, 2006); and quality management (Prajogo and McDermott, 2005; Stock et al., 2007). In the current study, we examine the degree to which an organization emphasizes each of the four culture type's influences its implementation of different Six Sigma practices.

Organizational Culture and Quality Management

In the quality management literature, the importance of organization culture has been largely shown by the fact that many firms failed to achieve expected benefits because Six Sigma need change which an organization does its business (Rajamanoharan and Collier, 2006). Employees' perspective and behaviors are serious for implementing the changes required in implementing quality management programs (Van deWiele et al., 1993).

Organizational culture is recognized as having a limiting effect on the effectiveness of quality management implementation. The values and opinions of an organization's culture are able to shape its philosophy and policies of managing business, which in turn influence the development of quality management practices (Waldman, 1993). The emphasis of organizational culture is also clearly addressed in the Six Sigma literature, where culture is influencing the effectiveness of changes required for Six Sigma deployment in an organization. For example, Antony and Banuelas (2002) identified organizational culture as a key component that is essential for successful Six Sigma implementation. And, Breyfogle et al. (2001) suggested that organizations should evaluate their current culture with tools such as force field analysis to identify the forces that manage the organization toward Six Sigma implementation and those controlling a Six Sigma implementation. Managers should then make Strategic plans to intensify the drivers and overcome the controlling forces.

A majority of prior studies usually focused on the cultural characteristics related to people and flexibility, and neglect the prospective effect of the characteristics about control and standardization on quality management implementation. However, the quality management literature has shown that quality management is a multidimensional construct which covers multiple practices. Specifically, some practices are soft or infrastructure practices, such as workforce management, which highlights the organizational and people side of quality management and uses a variety of organizational development techniques to facilitate changes; on the other hand, the core practices are more related with the methodological and technical side of quality management and focus on using quality management tools and techniques to solve quality problems, including use of quality information (Evans and Lindsay, 1999; Flynn et al., 1995; Wilkinson, 1992). Significant distinctions between the various practices covered with Six Sigma, it is likely that cultural characteristics that support certain practices differ from those cultural characteristics that support other practices.

The multidimensional relationship between organizational culture and quality management has been identified by some researchers (Cameron and Quinn, 1999). This study expanding prior

research (Cameron and Quinn, 1999; Prajogo and McDermott, 2005) by considering Six Sigma practices. Furthermore, we develop and propose a set of hypotheses between cultural types and Six Sigma practices so that the results will provide a detailed description of the culture–quality management relationship.

Hypothesis Development

In this section, we discuss the hypotheses about the relationships between four culture types of CVF and five Six Sigma practices. A major firm of this research highlighting the group culture is the development of human prospective, teamwork as a means to better decisions and overall output (Denison and Spreitzer, 1991). These values are suited with the implementation of human resource-related practices in Six Sigma, such as workforce management and Six Sigma role structure. An important assumption is that employees should be properly motivated to improve their work because most people are really motivated to do a good job when working in an environment without fear and push (Detert et al., 2000; Hackman and Wageman, 1995). The importance group culture's on sticking together, morale and the long-term benefit of human resources development are consistent with and should facilitate the process of establishing the organizational environment supporting employee learning, collaboration, and involvement for the effective implementation of quality initiatives (Detert et al., 2000; Naor et al., 2008). Successful implementation of Six Sigma in an organization demands creating teamwork within cross functions providing employees with appropriate training, involving them in decision-making, rewarding them for quality performance, developing Six Sigma to lead the organizational improvement efforts, and establishing the communications to create awareness of organizational goals for quality improvement (Choi, 1995; Daft, 1998; Flynn et al., 1994; Kaynak, 2003; Lee and Choi, 2006; Pande et al., 2002). The above discussion suggests:

H1. The importance of an organization's on the group culture will be positively related with the level of workforce management.

H2. The importance of an organization's on the group culture will be positively related with the level of Six Sigma role structure.

The group culture, with its focus on participation and empowerment, “helps to equalize people by giving everyone a voice in the product design and process management, as well as responsibility for the results” (Naor et al., 2008). Knowing that their ideas and thoughts will be valued by management, employees then will be more willing to make efforts in identifying and solving problems and taking more responsibilities in improvement projects (Antony and Banuelas, 2002; Motwani et al., 2004; Naor et al., 2008). The teamwork, communication and empowerment promoted by the group culture are also expected to facilitate the implementation of tools and techniques in Six Sigma for problem solving. The technique-focused practices, such as quality information, as well as the use of metrics and structured improvement procedure in Six Sigma, require the timely sharing of quality data throughout the ranks of the organization to make it available to all employees, cooperation between departments through teamwork to exchange ideas, joint efforts of management and employees in process management activities of preventive maintenance, quality problem recognition and solving, and mistake proof procedures, and effective measurement of process and product performance and project coordination (Kaynak, 2003; Lee and Choi, 2006; Schroeder et al., 2008). Therefore on the above discussion, we propose that:

H3. The importance of an organization's on the group culture will be positively related with the level of quality information, product/service design and process management.

H4. An organization's emphasis on the group culture will be positively related with the level of Six Sigma focus on metrics and structured improvement procedure.

Developmental Culture

The developmental culture is distinguished by a dynamic, entrepreneurial, and creative work place and its effective leadership is visionary, innovative and risk-oriented (Cameron and Quinn, 1999). The entrepreneurial leadership is reasoned with the principal of using Six Sigma role structure to lead the organization's quality Improvement initiative through projects. Communicate with the champion and the leadership council, provide expert advice to improvement teams and help teams promote their successes (Pande et al., 2002).

Within the managerial structure of Six Sigma, champions set a rationale and goal for improvement projects that arrange with business priorities and are responsible to the Six Sigma leadership council for the success of their projects. These specialists take more significant individual responsibility in selecting the improvement projects that have potential to bring in significant improvements in quality performance as well as financial and market benefits, and planning the progress of the projects, and justifying the project outcomes (Breyfogle et al., 2001; Lee and Choi, 2006). To search for new processes, the Six Sigma specialists are committed to experimentation and innovation and they have to change in order to transfer the new ideas into ongoing operations (Pande et al., 2002). The highlighting of organizations developmental culture support adapted and innovation activities that may lead to product and service advantage and profitability (Cameron and Quinn, 1999). In these innovative organizations, there is a push for constant, continuous improvement and doing things better, thus they encourage the behavior of constantly studying the processes and products for improvement (Detert et al., 2000).

In the developmental culture, people form teams around tasks, which disband as soon as the task is completed, and they reconfigure themselves when new tasks arise, and thus power flows from task team to task team depending on what problem is being addressed at the time (Cameron and Quinn, 1999). These organizations tend to encourage the development of leaders who are motivated to initiate new improvement projects and provide a necessary resources and responsibilities to carry out the projects. So this type of focus increases the allocation of organizational resources for employee training so as to improve their knowledge and skills to meet the changing requirements of customers (Yeung et al., 1991). Resources for training are serious for the Six Sigma role structure in developing the improvement expertise (Linderman et al., 2003). This approach happens with the way Six Sigma teams work. Six Sigma teams are formed along the process they are trying to improve and are disbanded after the process improvement is implemented (Schroeder et al., 2008). Both leaders and team members have to adapt new opportunities. The importance of the developmental culture on adaptation ability and individuality is expected to smooth the configuration process of teams (Cameron and Quinn, 1999). Therefore, the above discussion suggests that:

H5. The importance of an organization's on the developmental culture will be positively related with the level of Six Sigma role structure.

Rational Culture

Six Sigma use the compensation policies including motivations for group performance, quality-based motivations and compensation based on breadth of skills (Flynn et al., 1995; Henderson and Evans, 2000). Particularly, Six Sigma role structure directly links the motivation compensation of performance to the achievement of Six Sigma goals and rewards the champions based on the

outcomes of their improvement projects that they are accountable for (Henderson and Evans, 2000). Such motivations and rewards delivered by management are used to increase employee participation in continuous improvement and to increase employees' ownership in their jobs and quality improvement activities (Ahire et al., 1996; Naor et al., 2008). These performance-contingent compensation policies are compatible with the strategies characterizing the rational culture, which regard motivations as an integral tool used to motivate the work force to follow better performance and achieve organizational goals (Naor et al., 2008). This suggests that:

H6. The importance of an organization's on the rational culture will be positively related with the level of workforce management.

H7. The importance of an organization's on the rational culture will be positively related with the level of Six Sigma role structure.

The rational culture promotes a result-oriented workplace where the major task of management is to manage the organization toward productivity and profits (Cameron and Quinn, 1999). In a rational culture environment highlighting direction, and task fulfillment, effective planning is observed as an importance measure of performance (Denison and Spreitzer, 1991), thus employees are acceptable towards the principles of organizing quality improvement activities following the Six Sigma structured procedure such as careful planning of the projects, attaining predetermined objectives step by step and instrumental management styles of team leaders, which will compose the process of adopting and using this structured method.

The focus on goal accomplishment and direction fits with the notion of applying Six Sigma structured improvement procedure and Six Sigma metrics to ensure that continuous improvement activities can accomplish significant results. Six Sigma projects are planned and implemented in a structured manner (e.g., in the format of define-measure-analyze-improve-control (DMAIC) in process improvement or define-measure-analyze-design-verify (DMADV) in product design). The decision about which project is initiated is based on strategic importance rather than utility (Schroeder et al., 2008). A project's prospective benefits, both in quality improvement and financial returns, have to be clearly defined (Breyfogle et al., 2001; Pande et al., 2002). The guide lines along the DMAIC or DMADV procedures are clearly described and clear instructions are given to team members in terms of tools to use and tasks to fulfill (Choo et al., 2007; Linderman et al., 2006). The progress of the projects is then closely tracked and recorded to evaluate whether the planned tasks are completed and the anticipated outcomes are achieved (Breyfogle et al., 2001; Pande et al., 2002). Therefore, we propose that:

H8. The importance of an organization's on the rational culture will be positively related with the level of Six Sigma structured improvement procedure.

As the rational culture encourages the activity and accomplishment of defined objectives oriented toward profitability and competitiveness, it is expected to facilitate the use of Six Sigma metrics in quality improvement. First, Six Sigma metrics are customer-oriented and financially limited with the objective of competitive advantage, which happens with the external focus of rational culture on achievements such as productivity and profits. The customer-oriented metrics are to understand the true customer need, especially the identification of critical-to-quality (CTQ) characteristics, to set project improvement goals and to direct improvement efforts; the financial metrics are to ensure that Six Sigma improvement efforts have measurable financial returns (Schroeder et al., 2008). Analysis and evaluation of improvements based on metrics provides a link between organizational strategy and operational action (Sinclair and Zairi, 1995). Second, a variety of quantitative metrics are used in Six Sigma to evaluate quality performance of products, services and

processes, to identify improvement opportunities, and to define clearly, challenging goals for improvement projects (Linderman et al., 2003; Schroeder et al., 2008). When team members are motivated by the opinion that their performance toward the organizational goals will be rewarded, they will declare more efforts to ensure that each project activity contributes to the common endpoint and extend their capabilities to new ambitious boundaries (Denison and Spreitzer, 1991; Linderman et al., 2003; Naor et al., 2008; Zammuto and Krakower, 1991). It has been shown that when it's used with Six Sigma improvement method and tools, clear goals help to encourage more improvement efforts and increase the improvement of Six Sigma projects (Linderman et al., 2006). Using those Six Sigma metrics in project selection and evaluation helps to improvement efforts with observable benefits in customer satisfaction and financial profits. It is suggested that:

H9. The importance of an organization's on the rational culture will be positively related with the level of Six Sigma focus on metrics.

Hierarchical Culture

Organizations emphasizing the hierarchical culture are distinguished by a development and structured place to work where procedures govern what people do (Cameron and Quinn, 1999). In such organizations, employees will feel comfortable about complying with the conventional steps of the Six Sigma structured procedure and they will be willing to follow the inflexible steps and use the prescribed tools. Schroeder et al. (2008) suggest that from the perspective of the organizational theory, this is a met routine for changing established routines or for inventing new routines, with an assumption that problem solving can follow reliable steps.

The opinion underlying the hierarchical culture is that individuals will follow organizational strategies when roles are formally stated and apply through rules and regulations (Quinn and Kimberly, 1984). The hierarchical culture tends to use strategies of clear rules, close control, and clear lines of decision-making authority, and procedures, are valued as the keys to success (Cameron and Freeman, 1991; Cameron and Quinn, 1999; Denison and Spreitzer, 1991). In sum the Six Sigma structured improvement procedure requires teams to use the formalized problem-solving approach to plan and conduct a project with clear steps, instruction and tools prescribed at each step of the procedure. Thus, the concern for reliability, uniformity and formality of rules and procedures inherent in the hierarchical culture is expected to facilitate organizations to put Six Sigma structured improvement procedure in effect. It is then proposed that:

H10. The importance of an organization's on the rational culture will be positively related with the level of Six Sigma structured improvement procedure.

Methodology of Research

In this research we survey to investigate Six Sigma implementation and organizational culture in the Iran manufacturing industry. New measures were developed to evaluate the three Six Sigma practices by reviewing the practitioner publications (Bhote, 2003; Breyfogle et al., 2001; George, 2003; Pande et al., 2002) and the academic research (Choo et al., 2004; Linderman et al., 2003; Schroeder, 2000). Items were measured on four-point Likert scales with "strongly disagree (1)" and "strongly agree (4)." Organizational culture was measured the instrument which contains 8 Likert-scale items, 2 for each culture type (Quinn and Spreitzer, 1991). This culture instrument was designed to evaluate the degree to which an organization emphasizes each of the four culture types in the CVF, and thus is appropriate for examining the relationships between culture types and individual Six Sigma practices simultaneously. Kalliath et al. (1999), by using confirmatory fact or analysis (CFA),

verified that this instrument has excellent validity and reliability estimates. The measurement items of culture were evaluated by the four-point Likert scale with one for not valued at all and four for highly valued, to evaluate the degree to which an organization value the relevant cultural characteristics. To improve the measurement scales, the required instrument was first reviewed by operations management, organizational behavior, and strategic management. Then, the questionnaire was pre-tested by five quality managers who had more than 5 years of experience in implementing quality management in manufacturing plants.

The survey instrument was managed as a web-based format to 2600 Iran manufacturing plants that were selected. Four rounds of emails with a link to the web survey were sent to the target sample (Dillman's; 2000), and responses were received from a total of 880 plants resulting in an overall 33% response rate. The respondents included those in the position of operations manager, quality manager, director of quality, continuous improvement manager, Six Sigma master. The sample represents a diversity of industries and sizes. A majority of the plants came from industries in transportation equipment's (35%); electrical equipment's (13%); fabricate metal product (6%); and metal product manufacturing (14%). To evaluate the potential of non-response bias, this study tested the difference of the available variables between the early and late respondents (Armstrong and Overton, 1977).

The final sample was split in to two, depending on the dates they were received. The early group include of 640 replies which were received before the fourth mail, while the late group included 240 replies received after the fourth email. The w2 tests realized no statistically significant differences (at 95% significance level) on the demographic variables including the numbers of employees and the types and length of quality management training the respondents received. The t-tests indicated no significant differences between the means of two groups in terms of the Six Sigma practices and organizational culture.

Analysis and Results

A second response was obtained from 142 plants that responded to the survey. The second response rate was then evaluated to determine the "inter change ability" of responses within the same group, that is, it evaluates whether one group member's response is basically identical to another group member's response with regard to the constructs of organizational culture and Six Sigma practices. The within-group of second response index $r_{wg(j)}$ was used to evaluate second response rate. A mean $r_{wg(j)}$ of 0.70 or above is usually accepted as a satisfactory value indicating second response rate (James et al., 1993) and the $r_{wg(j)}$ value of each factor was greater than 0.70, (Table1).

Table1. Descriptive statistics and tests of second responses, unidimensionality, and reliability

Factor	Mean	S.D	$r_{wg(i)}$	Average AD	Unidimensionality (CFI)	Composite reliability	
						Cronbach's alpha	Weighted
Work force management	4.98	1.38	0.83	0.62	0.94	0.88	0.90
Quality information	4.55	1.22	0.82	0.95	0.98	0.92	0.94
Six Sigma rule structure	3.40	1.93	0.85	0.74	0.95	0.92	0.97
Six Sigma structured procedure	4.62	1.81	0.90	0.54	0.99	0.95	0.95
Six Sigma focus on matrices	4.90	1.53	0.83	0.56	0.93	0.93	0.95
Group culture	4.90	1.39	0.77	0.65	0.99	0.95	0.95
Developmental culture	4.89	1.31	0.80	0.60	0.96	0.91	0.92
Rational culture	5.36	1.12	0.87	0.65	0.94	0.90	0.91
Hierarchical culture	4.91	1.08	0.81	0.58	0.99	0.82	0.91

In addition, the other second response rate measure, the average deviation (AD) index was calculated to evaluate the average within group deviation. According to Burke and Dunlap (2002), the upper limit of AD for the four-point scale like those used in this study is 1.20. The average AD values range from 0.50 to 0.97 (Table1), lower than the upper limit, further corroborating between the respondents. Given the satisfactory second response rate and the absence of differences between the plants returning one response against those returning two responses in terms of the constructs measured, the same pattern can be assumed to exist in the whole sample. These findings strongly support reliability of the measures as the results appear to reflect plants' attributes (Henri, 2006). The dual responses were then averaged for the following analyses. We also used Harmon's one-factor test (Podsakoff et al., 2003) to threat of common methods variance (CMV) in the self-reported, single-respondent data set. This test assumes that if a significant amount of CMV is present, either a single factor will appear from the unrotated factor analysis or one general factor will account for the majority of the covariance in the independent and dependent variables. The results of Harmon's single-factor test indicated that five factors were extracted from the whole set of variables, and when the 3 Six Sigma factors were each factor analyzed with the culture factors. Although the above tests do not remove the possibility of CMV, the results indicate that single-respondent; self-report does not appear to be a major problem in this study.

Tests of Unidimensionality, Reliability, and Validity

The measurement items were evaluated for unidimensionality, reliability, convergent and discriminant validity. We evaluate unidimensionality first because it increases the chances of specifications (Gerbing and Anderson, 1988), and the analysis of reliability and construct validity is based on the assumption of unidimensionality (Al-Hawari et al., 2005; Nunnally and Bernstein, 1994). The unidimensionality of each construct by using CFA was tested. The software EQS 6.1 was used throughout the study to test the CFA models and the structural model. All the CFA models had a

comparative fit index (CFI) of value higher than 0.90, indicating a sufficient model fit and thus satisfactory unidimensionality of the scales (Al-Hawari et al., 2005) (Table 1).

Construct reliability was estimated with the internal consistency method using Cronbach's alpha. In Table 1, the Cronbach's values of each scale in this study range from 0.80 to 0.96. In addition, complex reliability of weighted was calculated for each scale, since the weighted index provides a realistic reliability assessment for latent factors measured by multiple items because it considers that the items may not equally load on to the factor (Bacon et al., 1995), as opposed to Cronbach's alpha, which assumes unit weights for the items and may under estimate the true construct reliability (Bollen, 1989). As shown in Table 1, the scales had a complex reliability estimate above 0.75, suggesting high construct reliability (Nahm et al., 2004). Testing the structural model, CFA was performed on the entire set of measurement items simultaneously (Anderson and Gerbing, 1988; Byrne, 1998). The measurement model was evaluated by examining the goodness-of-fit indices, factor loadings, standardized remains, and modification indices.

During the process of evaluating the measurement model, several items were deleted based on the criteria such as large standardized remains, modification indices, or factor loadings less than 0.50 (Byrne, 1998; Kaynak, 2003; Nahm et al., 2004). Unidimensionality and complex reliability of the scales were re-evaluated and showed satisfactory results. Therefore, the goodness-of-fit of the measurement model was evaluated using multiple model fit indices, including the ratio of χ^2 , comparative fit index (CFI), non-normed fit index (NNFI), standardized root mean square remains (SRMR) and root mean square error of approximation (RMSEA) (Kline, 2004). Based on the criteria for evaluation of model fit suggested by the literature (Byrne, 1998; Hu and Bentler, 1999), the final measurement model had a sufficient model-to-data fit: χ^2 per degree. Based on the measurement model, intersect and discriminant validity of the constructs was evaluated. A construct's intersect validity is recognized if the items are significantly related to the factor (Nunnally and Bernstein, 1994).

Also, a standardized factor loading of 0.50 or higher, ideally 0.70 or higher, provides strong evidence of intersect validity (Hair et al., 2005). In this study, all the items have significant factor loadings, i.e., t-values are greater than 1.96 at the significance level of 0.05 (Al-Hawari et al., 2005), and most items have factor loadings greater than 0.70, suggesting adequate intersect validity. Discriminant validity was tested by comparing the χ^2 values between the constrained model that sets the correlation of any two factor sat one and the unconstrained model that estimates the correlation (Anderson and Gerbing, 1988). A series of χ^2 difference tests were performed for the five six sigma factors and four culture factors with the significance a level adjusted to 0.0005 (0.05/91) by dividing by the number of tests performed (Kaynak and Hartley, 2006).

Table2. Test results of discriminant validity

Factors	1	2	3	4	5	6	7	8	
Work force management	0.60 156.42								
Quality information	0.56 195.05	0.47 236.67	–						
Six Sigma rule structure	0.44 674.71	0.45 397.01	0.33 1032.16	–					
Six Sigma structured procedure	0.62 515.16	0.63 290.54	0.52 674.01	0.59 250.16	–				
Six Sigma focus on matrices	0.65 441.75	0.41 246.69	0.64 268.86	0.71 190.57	0.73 871.00	–			
Group culture	0.67 456.4	0.37 251.8	0.59 194.2	0.66 248.5	0.47 684.7	0.70 567.1	–		
Developmental culture	0.60 390.0	0.34 252.5	0.49 229.2	0.53 324.8	0.46 501.9	0.61 206.5	0.87 125.2	–	
Rational culture	0.66 340.8	0.39 256.0	0.47 298.0	0.53 226.0	0.63 363.3	0.63 271.8	0.66 253.6	0.80 271.8	–
Hierarchical culture	0.34 324.8	0.45 239.1	0.50 229.4	0.48 240.9	0.56 432.7	0.81 195.4	0.55 196.8	0.56 427.6	0.81 128.2

As shown in Table 2, the w2 difference tests between all pairs of factors are significant (a significantly lower w2 value for the unconstrained model), indicating strong discriminant validity (Hair et al., 2005). Additionally, in Table 2, the correlations between the factors are all lower than their reliability estimates, providing further evidence of discriminant validity (Crocker and Algina, 1986; Ghiselli et al., 1981). The SEM technique was utilized to test the proposed relationships between four culture types and 3 Six Sigma practices. The structural model shows acceptable model fit: w2 per degree.

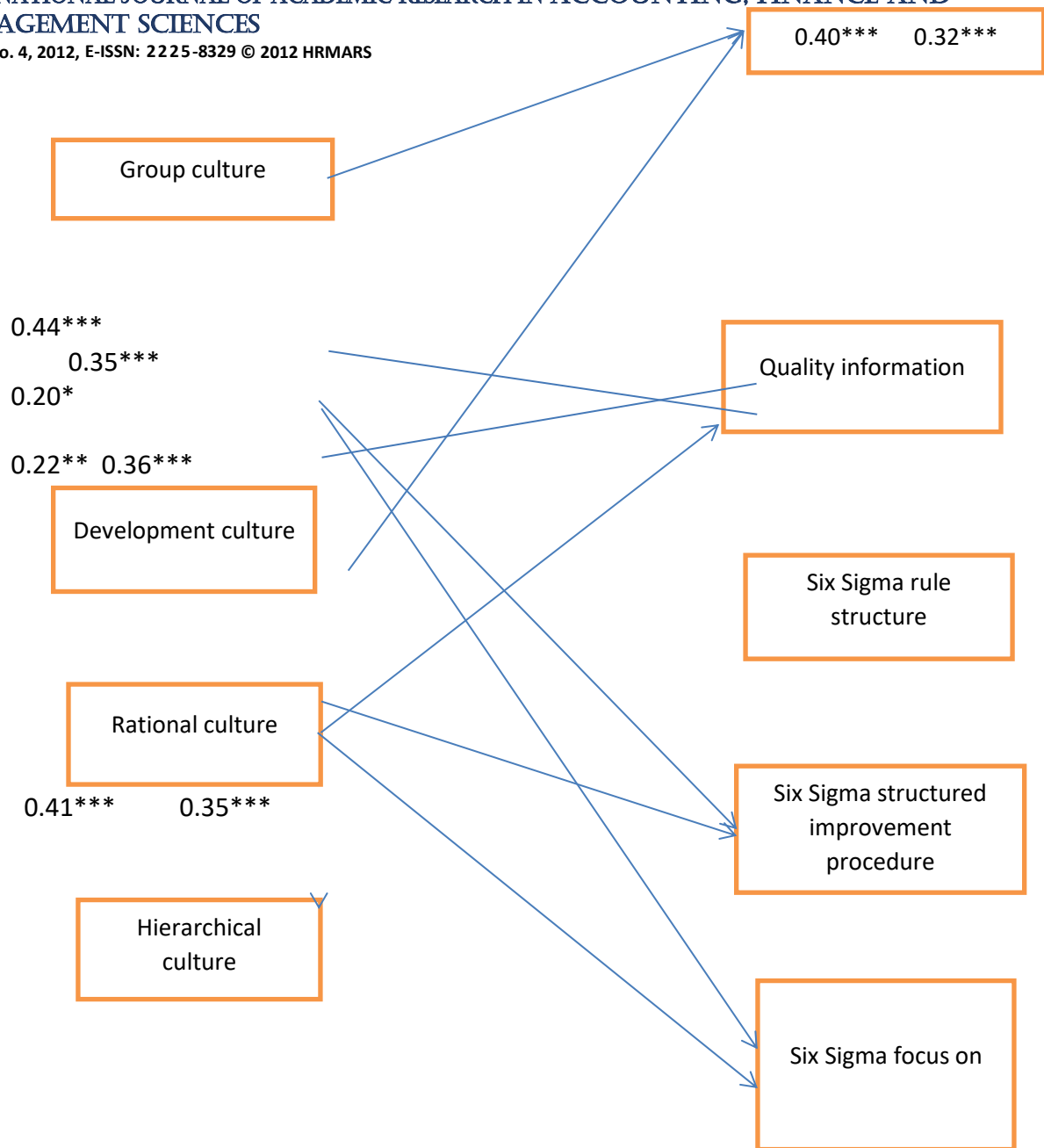


Figure 2. Structural model of organizational culture and Six Sigma practices

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

As shown in Figure 2, most links between the culture types and Six Sigma practices are supported. It is found that the hierarchical culture has no significant effect on the practices that it was expected to affect. However, three culture types—group, developmental, and rational cultures are found to have significant positive effects on different quality management practices though a few links are not supported.

Results and Discussion

In this study we disclose that different culture types influence different Six Sigma practices. The rational culture is found to have a significant effect on three of the five Six Sigma practices. This

finding confirms the importance of group culture for quality management as suggested in prior studies (Naor et al., 2008; Prajogo and McDermott, 2005). Effective implementation of Six Sigma practices requires an organizational environment that encourages communication and employee involvement to make possible changes and provides resources for continuous improvement (Beer, 2003; Bhote, 2003; Breyfogle et al., 2001; Flynn et al., 1995; Kaynak, 2003). By developing a group culture, organizations promote participation, trust, and relate to human development as their core value.

In this supportive environment, employees are not only encouraged to participate in continuous improvement teams and are rewarded for their contribution to better quality, but also receive the training and education to be successful in their jobs. As the developmental culture illustrates the understanding for flexibility by the tendency to shift power from task team to task team depending on what problem is being addressed at the time (Cameron and Quinn, 1999), it may be easier to organize Six Sigma teams based on tasks (Schroeder et al., 2008). The hierarchical culture has no significant links to either process management or Six Sigma structured improvement procedure as proposed (Yeung et al. 1991; and Quinn and Spreitzer, 1991).

Similarly, the results of this study suggest that compared with other three CVF culture types, the hierarchical culture is the least influential for implementing Six Sigma practices. We also look in to what culture type (s) is suitable for each practice. The results of this study show that each Six Sigma practice is compatible with one or two culture types. The rational culture is found to have a significant effect on the five Six Sigma practices. The highlight of rational culture productivity and achievement, clearly defined objectives for external competitiveness, which is consistent with Six Sigma practices. Gathering and using quality information can also provide the strategic advantage in the external markets that are the focus within a rational culture. The results show that the developmental culture is significantly related to the implementation of Six Sigma role structure. The individuality valued within this culture supports the approach of Six Sigma that provides training on an as-needed basis and differentiated by task and as signs different roles and responsibilities to the Six Sigma specialists based on their expertise (Linderman et al., 2003).

Creating close contacts with customers is aimed to provide managers and employees a better understanding of customer needs and expectations in order to evaluate current quality level, control quality conformance, and set goals for future improvement (Flynn et al., 1994; Hackman and Wageman, 1995). This objective is more suited with the rational culture's values of control and probability achievement than the group culture's values of cooperation or the developmental culture's focus on innovation. On the other hand, to select significant effect of group culture on supplier relationship indicates the importance of trust and commitment for supplier management. As suggested in the supply chain management literature, effective supply chain collaboration requires adaptation to a collaborative culture that require external and internal trust, mutuality of benefits information exchange, and communication (Barratt, 2004). The finding of significance of group culture for supplier relationship in this study highlights the importance of the external trust toward suppliers and internal cooperation with employees for ensuring continuous, effective supplier collaboration.

The results suggest that human-focused practices in Six Sigma are supported by different culture types, indicating their slightly different focuses. In this study, this practice is found to be supported by the group and rational cultures whose core values are consistent with the application of the organizational development techniques such as investment in employee training and education, employee involvement and participation, and the performance based policy of rewards

and compensation. On the other hand, the Six Sigma role structure practice is considered as a leadership development mechanism (Schroeder et al., 2005) which develops a group of quality leaders in the organization's continuous improvement efforts with the responsibilities of taking the initiative to identify improvement projects of promising outcomes as well as leading the project performance to realize the target goals. These leadership skills are expected to be nurtured in the environment that values innovative and entrepreneurial-behaviors and achievement of goals. Similarly, the two technique-focused practices in Six Sigma—Six Sigma structured improvement procedure and Six Sigma focus on metrics—are found to be supported by both the group and rational cultures.

These results indicate the importance of rational culture for managing the use of quality management tools and techniques for achieving higher quality level in organizations. This finding is analogous to the dual focus of operations management in today's industry, which stresses control and flexibility happening at the same time (Douglas and Judge, 2001). As recognized in the literature (Cameron and Freeman, 1991; Quinn and Spreitzer, 1991; Smart and St. John, 1996; Wilkins and Ouchi, 1983; Yeung et al., 1991), the unique advantage of different culture types for organizational performance indicates that emphasis on one single culture type is not the best for the overall organizational effectiveness.

The results of this study suggest that in order to obtain full benefits from implementing multiple Six Sigma practices, it is important to develop not only flexibility and people oriented culture values (i.e., the group culture and the developmental culture) but also control-and external-oriented values (i.e. The rational culture). Organizations need to support and engage their employees in quality improvement activities and to emphasize productivity and achievement of goals as a result (Cameron and Quinn, 1999). Shea and Howell (1998), suggested that successful quality management implementation requires accompany to provide employees with the freedom, autonomy, and range of skills to engage in creative and effective continuous improvement activities, while at the same time encouraging the use of a systematic standardized problem-solving approach to use quality tools to control its systems and processes. This study disclose the differential effects of culture Types on the implementation of Six Sigma practices.

Conclusions

In this research few studies have systematically examined the relationships between different culture types and individual practices. This study extended previous studies of culture and quality management relationship through a comprehensive assessment of the links between different culture types and Six Sigma practices in the analysis which helps to advance our knowledge of the influence of organizational culture on contemporary quality management practices.

This study has important implications for management practices. Based on the results of this study, different culture types affect different practices. Before adopting Six Sigma initiatives, managers need to be aware of the cultural values emphasized in their organization so that the multiple Six Sigma practices can be effectively implemented in the organization. The theoretical constructs and measurement scale developed in this study may support future researchers who wish at the same time to measure Six Sigma and address their distinctions in relationships with other variables. The findings of this study provide the managers some guidelines to design their policies or adjust their systems to adopt different Six Sigma practices. Managers would be sensible to evaluate their company's current cultural values and develop necessary action plans to create a supportive cultural environment to ensure that multiple Six Sigma practices will be successfully implemented.

This study treats the common method variance problem because a majority of the self-reported perceptual data used in this study was collected from single respondent. We collected dual responses from 142 plants, and the analysis of that data showed satisfactory second responses rater. Also, the Harmon's one-factor test results of the single-response data indicate that common method favoritism does not appear to be a major problem, though we acknowledge that the statistical analyses do not completely remove the chances of this problem.

This study focuses on examining the relationships between culture types and quality management practices. However, few organizations are trait by only one culture type; rather they have a culture profile consisting of different culture types. Also, the implications of this research suggest the necessity of creating a comprehensive culture environment that may reflect multiple and competing types (e.g., the group culture and the rational culture).

Future research must investigate the viability of effectively achieving balance among different culture types in one organization and to provide an understanding of the complexities of maintaining the balance. Moreover, there are two possible directions about the relationship between organizational culture and quality management. On one hand, quality management implementation may change an organization's culture; on the other hand, quality management must fit to the existing culture to succeed (Lewis, 1996).

This research assumed the first relationship, as Prajogo and McDermott (2005) and Zeitz et al. (1997) did, that organizational culture influences the quality management implementation. When an organization starts to adopt a quality management program, whether and how its existing culture can support this quality management program is important. However, we acknowledge that with continuously implementing the quality management program, employees' beliefs and outlook may be changed as a result of using the quality improvement principles and practices in their jobs, which may lead to changes in the organization's culture. Therefore more research is needed to investigate how an organization's culture profile influences the pattern of Six Sigma implementation as well as the resulting effect on organizational performance.

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