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Quality management effectiveness in Asia: The influence of culture

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ABSTRACT

Globalization forces managers to utilize manufacturing capabilities from countries with different cultures than their own, particularly from Asia. Yet quality problems in China have raised concerns among managers and researchers as to how to assure product quality from Asian facilities. Implementing quality management practices may accomplish this, but such practices assume specific cultural values exist in certain Asian cultures. Using global manufacturing and cultural data, this study examines if cultural values in Asian and non-Asian countries moderate how effective quality management practices are at improving quality performance. Through the use of multilevel modeling, differences in quality management effectiveness are found among the East Asian cultures of China, South Korea, and Taiwan. Moreover, this study finds that specific cultural dimensions are statistically related to quality management effectiveness. The results of this study will assist managers in devising plans to assure higher quality from East Asian facilities and in predicting where problems may occur in other countries around the world.

1. Introduction

Quality problems in China – such as tainted milk products and excessive lead levels in toys – have raised interest in quality assurance from China and other East Asian countries (Chao and Leow, 2008; Teagarden and Hinrichs, 2009). Such problems raise the concern of supply chain managers about their suppliers' use of quality management (QM) practices (Kaynak and Hartley, 2008). Yet, how QM practices are implemented and if suppliers are committed to QM affects product quality (Ahire and Ravichandran, 2001; Flynn et al., 1995). Moreover, the commitment and use of QM are highly influenced by cultural values and context-specific effects (Chiang and Birtch, 2007; Lozeau et al., 2002; Zhao et al., 2004). Because many QM practices were developed in Japan (Deming, 1986), a culture distinct from other East Asian countries (Lowe, 1998; Onishi and Bliss, 2006), QM may not be as effective in these other countries because of different cultural values (Juan Jose et al., 2007). Therefore, implementing QM in China and other East Asian countries may not correct quality problems as expected. But do East Asian countries have different cultural influences on QM effectiveness, which is defined as QM's effect on quality performance? Moreover, does QM effectiveness differ between East Asian and Western cultures? In general, are there specific aspects of country culture affecting the ability of QM practices to improve product quality? This study seeks answers to these questions by studying differences among East Asian and other cultures.

A culture is defined as "shared motives, values, beliefs, identities, and interpretations or meanings of significant events that result from common experiences of members of collectives that are transmitted across generations" (House and Javidan, 2004, p. 15). A country's culture is multidimensional, and since the late 1970s a large body of literature has expanded the set of cultural value dimensions. Although there are other cultural dimensions studies (Schwartz, 1999), the most used dimensions in QM studies are based on Hofstede (1980), who studied 50 countries along four cultural dimensions: power distance, uncertainty avoidance, individualism, and masculinity.[2] Extending Hofstede, the GLOBE project (House et al., 2004) studied 62 countries along nine cultural dimensions: power distance, uncertainty avoidance, humane orientation, institutional collectivism, in-group collectivism, assertiveness, future orientation, performance orientation, and gender egalitarianism. Although, the GLOBE dimensions (shown in Table 1) provide a business-relevant set of dimensions, they may not be exhaustive or relevant to studying QM.

Following a call from literature (Zhao et al., 2007), this study uses the GLOBE project. The GLOBE cultural value scores from three

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[2] A fifth dimension was later added labeled "long-term orientation".

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Table 1
GLOBE dimensions included in the study[a].

Cultural Dimension	Description
Future Orientation (FO)	The extent to which individuals engage in future-oriented behaviors such as delaying gratification. planning, and investing in the future
Institutional Collectivism (IC)	The degree to which a collective's institutional practices encourage and reward collective distribution of resources and collective action.
Humane Orientation (HO)	The degree to which a collective encourages and rewards individuals for being fair, altruistic, generous, caring, and kind to others.
Uncertainty Avoidance (UA)	The extent to which a collective relies on social norms, rules, and procedures to alleviate unpredictability of future events.
Assertiveness (AS)	The degree to which individuals are assertive, confrontational, and aggressive in their relationships with others
Power Distance (PD)	The degree to which members of a collective expect power to be stratified and concentrated at higher levels.
In-Group Collectivism (GC)	The degree to which individuals express pride. loyalty, and cohesiveness in their organizations or families
Performance Orientation (PO)	The degree to which a collective encourages and rewards group members for performance improvement and excellence

[a] The one dimension not included in this study is Gender Egalitarianism (i.e. the degree to which a collective minimizes gender inequality) because QM does not specify gender roles and is not affected by gender (Aksu, 2003).

closely related East Asian countries – China, Korea and Taiwan – as well as non-Asian countries are used to examine which cultural dimensions impact QM effectiveness. Thus, this study tests whether the GLOBE dimensions predict QM effectiveness. Most likely, not all cultural dimensions affect QM. Finding a narrower set of relevant cultural dimensions will enable managers to (1) predict what countries are culturally amenable to QM; (2) focus on fewer dimensions when selecting suppliers; and (3) concentrate efforts on a specific dimension to improve how QM is implemented and used. By knowing which GLOBE dimensions influence QM effectiveness, managers can improve the product quality received from their East Asian facilities and suppliers.

This study uses a culture-as-moderator perspective (Gelfand et al., 2007) that has not been statistically investigated for QM practices, but has explained the effectiveness of other management practices in Asia and elsewhere (Elenkov and Manev, 2005; McDermott and Stock, 1999; Newman and Nollen, 1996; Yang et al., 2007). At first, it may seem that cultural values cause quality practices to be adopted. However, there are some shortcomings to this viewpoint. Company management may invest in quality programs as part of a strategic plan (Sousa and Voss, 2001). Quality practices, like six-sigma, may be adopted because of a management fad (Shah et al., 2008). And, contractual requirements may stipulate that specific quality practices, such as ISO 9000, be implemented (Sroufe and Curkovic, 2008). For these reasons, QM practices will be adopted to satisfy institutional requirements (Boiral, 2003; Dimaggio and Powell, 1983) but may be ineffective at delivering quality performance (Choi and Eboch, 1998). A moderation perspective recognizes there are non-cultural reasons for QM adoption, while also recognizing that certain cultural traits help organizations coordinate quality efforts more effectively (Flynn and Saladin, 2006). Therefore, this paper differs from past research by viewing country culture as influencing how QM is implemented and used, and thereby moderating the relationship between QM and quality performance.

Some culture literature suggests there are two manifestations of culture: values and behaviors[3] (Hitlin and Piliavin, 2004; Segall et al., 1998). Cultural values differ from cultural behaviors because cultural values are what a society feels is important and what should be (Rokeach, 1973), while cultural behaviors are a society's observable practices and activities (House and Javidan, 2004). The QM literature suggests that cultural values are more important to consider than behaviors because values drive attitudes and behaviors (Detert et al., 2000). In fact, Detert et al. (2003) found specific cultural values to underlie QM, referring to these as QM values. These authors state that when an organization's cultural values are incongruent with QM values, then quality initiatives will not be as successful. Although Detert et al. (2000) focuses on organizational culture, country culture strongly affects organizational culture (House et al., 2004). Because of the importance of cultural values, this study uses the congruence between GLOBE's country cultural value dimensions and Detert et al.'s QM values to predict QM effectiveness in the East Asian countries of China, Korea, and Taiwan. These East Asian cultures are affected by their historical roots from the teaching and works of Confucius. Because the GLOBE study refers to these countries as "Confucian Asian" countries (Gupta and Hanges, 2004), such terminology is used in this paper.

Put succinctly, this study views country cultural as primarily influencing *how* QM practices are implemented and used, not *if* they are used. Although a Confucian Asian firm may have significantly invested in QM, these practices may not be effective because of the moderating cultural values. The remainder of the paper is organized as follows: (1) It hypothesizes the general benefit of QM and then compares GLOBE dimensions to QM values to hypothesize cultural moderating effects. (2) It uses the GLOBE scores of China, Korea, and Taiwan to hypothesize differences among Confucian Asian cultures and Western culture. (3) It presents a description of the sample and statistical model. (4) It discusses the results along with managerial implications.

2. Literature and hypothesis development

This section presents each hypothesis while reviewing the relevant literature, beginning with the expected overall impact of QM. It then focuses on the specific cultural interactions with QM. Fig. 1 presents the overall model, with the extent of investment in QM practices directly influencing competitive product quality performance. In between are the Confucian Asian countries and the cultural dimensions. The cultural dimensions moderate how quality practices affect quality performance—that is, they moderate QM effectiveness. The graphical representation in Fig. 1 follows

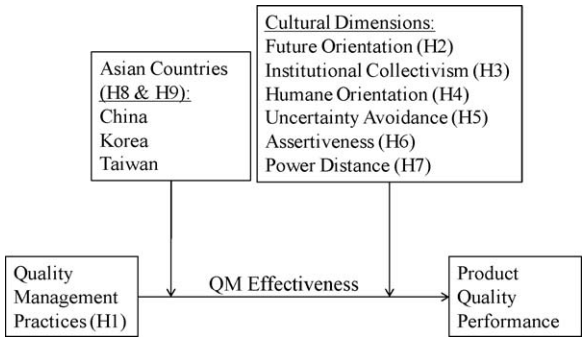

Fig. 1. Research framework.

[3] The GLOBE study refers to behaviors as "practices." Because this study makes frequent reference to "QM practices" the term cultural "behaviors" are used.

Lozeau et al.'s (2002) observation that organizations may invest in QM practices for institutional reasons, but the organizational context may assist or may thwart the true intent of QM. The composite influence of a country's cultural values does not directly affect quality performance, but instead creates an environment for which QM will be more or less effective.

2.1. Quality management practices' affect on quality performance

The purpose of quality management practices are to improve product quality, defined as the ability to meet customer needs and be free from deficiencies, like errors and rework (Juran and Godfrey, 1998). Product quality is the result of manufacturing resources – people, processes, materials, and equipment – oriented to varying degrees for achieving customer satisfaction and low deficiencies (Ahire and Dreyfus, 2000). Specific QM practices are designed to better orient the manufacturing resources to improve quality through higher process control (e.g. SPC), better documentation (e.g. ISO 9000), more cooperation and involvement (e.g. TQM), and deeper improvement efforts (e.g. six-sigma). The consensus of results from empirical studies is that quality management practices effectively improve product quality and overall performance (Nair, 2006; Naveh and Erez, 2004; Rungtusanatham, 2001; Schroeder et al., 2005). This study examines the effect of these practices to determine the impact of quality practices on quality performance. Therefore, it is hypothesized that

Hypothesis H_a1. Quality management practices are positively related to product quality performance.

2.2. Cultural dimensions affect quality management effectiveness

The importance of organizational culture to QM practices is well-documented in the literature. Mead (1985) first reports the importance of culture to quality management, finding that quality tools caused new interactions among employees that are enhanced by a more cooperative culture. Later, Bright and Cooper (1993) describe how quality management assumes an organizational culture that views employee conflict as dysfunctional, that sees management as a rational process, and that shares the desire for high quality. Bates et al. (1995) show a significant correlation between QM strategies and organizational culture. Further, Powell (1995) argues that tacit cultural elements of QM drive success. Additional empirical studies support Powell's claim that organizational culture is an important determinant of QM success (Miron et al., 2004; Naor et al., 2008; Taveira et al., 2003).

The importance of country culture to QM is less documented in the literature, but a significant number of studies exist. Specifically, Lagrosen (2002) uses case studies across four European countries to find that country cultures differ in their interpretation of quality, their QM implementation problems, and their methods to overcome quality problems. The study finds, for instance, that low power distance cultures emphasize training personnel while high power distance cultures highlight leadership. Later, in a survey-based study of one large Swedish multinational company, Lagrosen (2003) finds that across 30 countries statistically significant correlations exist among a set of QM values[4] and Hoftstede's (1997) culture dimensions. More recently, Flynn and Saladin (2006) test the relationship among Hoftstede's cultural dimensions and the Baldridge Award criteria (2004). They find the presence of QM to be especially correlated with collectivism and masculinity. These studies show that country culture is also important to successful QM efforts.

This paper differs from past research in some important aspects. The above studies view country culture as influencing the *existence* of QM practices, rather than the *effectiveness* of QM practices. Even though Lagrosen's (2002) study finds that country culture influences both *if* and *how* QM practices are implemented, the latter influence lacks empirical investigation. However, case studies by Lozeau et al. (2002) find that organizations incompatible with QM's underlying structure will "corrupt" the practice, detrimentally molding it to maintain social processes and diverting it from quality improvement. Although country culture is not explicitly considered, Lozeua et al. provide a basis to explain culture's influence on QM. Thus, this paper uses Lozeau et al. to explain, and then empirically investigate, how culture moderates QM effectiveness. Furthermore, the above studies predominantly use Hoftstede's results, which have been challenged on their reliability and validity (McSweeney, 2002). By contrast, this study uses the GLOBE cultural dimensions, extending the above literature using a culture-as-moderator approach and testing hypotheses of how cultural value dimensions impact QM effectiveness. Moreover, this study tests the ability of GLOBE's cultural scores to predict QM effectiveness among Confucian Asian and Western cultures. In these ways, this paper contributes to understanding the cultural aspects that are crucial for successful QM.

Individual preferences and operating decisions influence whether QM is accepted or corrupted in an organization (Lozeau et al., 2002). Generally, individual behavior is directed towards desired outcomes and away from undesired outcomes (Higgins, 1997). An individual's personal attributes – such as personality and cultural values – interact with one's work situation – such as operational tasks and procedures – to motivate behavior (Wallace et al., 2009). For instance, employees valuing individual reward and responsibility will be motivated to solve problems alone rather than in a group. Thus, cultural predispositions influence whether employees perceive quality practices to be in their best interest. Individuals will promote practices with outcomes desired within their culture, while preventing culturally undesired outcomes through practice corruption.

To predict how GLOBE's cultural dimensions influence QM effectiveness, this study recognizes that QM is founded on underlying organizational values, in part because QM evolved from Japan (Deming, 1986). Detert et al. (2000) argued for and later found evidence (Detert et al., 2003) supporting the existence of specific QM values within eight general types of cultural values (see Table 2). The eight general value types are (1) the basis of truth and rationality; (2) the nature of time and time horizon; (3) motivation; (4) stability versus change, innovation, and personal growth; (5) orientation to work, task, and coworkers; (6) isolation versus collaboration and cooperation; (7) control, coordination, and responsibility; and (8) orientation and focus—internal or external. The corresponding QM values are as follows: (Q1) decisions should to rely on factual information; (Q2) improvements should require long-term orientations; (Q3) quality problems should be understood as caused by systems not people; (Q4) continuous improvement should be never ending; (Q5) stakeholder needs should be satisfied through internal change; (Q6) cooperation should exist with all parties; (Q7) decision-making should be shared; and (Q8) financial results should follow from customer satisfaction. Collectively, these cultural values underlie QM. It should be noted that Dean and Bowen (1994) and others (Anderson et al., 1994; Kujala and Lillrank, 2004) argue that successful QM is primarily based on continuous improvement (Q4), cooperative teamwork (Q6), and a customer focus (Q8). These are considered the most important values and therefore particular attention is paid to these for developing hypotheses.

[4] Customer orientation, leadership commitment, full participation, business process focus, continuous improvement, and measurement focus.

Table 2
Values related to QM[a].

Cultural Value	Description	QM Value
1. The basis of truth and rationality in the organization	The ideas about what is real and not real, and how what is true is ultimately discovered	Q1. Decision making should rely on factual information and the scientific method.
2. The nature of time and time horizon	The way time is defined and measured, what kinds of time exist, how important time is, and the time horizon for planning and goal setting	Q2. Improvement requires a long-term orientation and a strategic approach to management.
3. Motivation	The beliefs about what motivates people, where motivation originates, whether people are inherently good, how people should be rewarded or punished, and if effort or output can be changed by manipulating others' motivation	Q3. Quality problems are caused by poor systems—not the employees. Employees are intrinsically motivated to do quality work if the system supports their efforts.
4. Stability versus change/innovation/ personal growth	The openness to change, degree of risk acceptance, comfort with innovation, desire for constant improvement, need for security, and conceptions about what is good enough	Q4. Quality improvement is continuous and never-ending. Quality can be improved with existing resources.
5. Orientation to work, task and coworkers	The centrality of work in human life, the balance between work as a production activity and a social activity, and the degree that productivity is important versus social relationships at work	Q5. The main purpose of the organization is to achieve results that its stakeholders consider important. Results are achieved through internal process improvement, prevention of defects, and customer focus.
6. Isolation versus collaboration/cooperation	The nature of human relationships, whether work is most effective by working together or by individual autonomy, and the importance of collaboration in decisions	Q6. Cooperation and collaboration (internal and external) are necessary for a successful organization.
7. Control, coordination, and responsibility	The location and degree to which control is concentrated, the "tightness" of control, how formal rules are set and by whom, the extent of guidance for behavior, and degree of autonomy	Q7. A shared vision and shared goals are necessary for organizational success. All employees should be involved in decision making and support the shared vision.
8. Orientation and focus – internal and/or external	The relationship between an organization and its environment, how much the environment can be controlled, and if innovation is defined within the organization (internal members) or from outside the organization (external stakeholders).	Q8. An organization should be customer driven. Financial results will follow.

[a] From Detert et al. (2000).

The following subsections develop hypotheses as follows: (1) cultural dimensions that are expected to be positively related to QM effectiveness and (2) those dimensions that are negatively related. Hypotheses follow directly from Detert et al.'s (2000) theory that cultures *incongruent* with QM values will negatively impact QM practice success. In this study, the degree of incongruence between all the QM values and a GLOBE cultural dimension indicates how a dimension moderates QM effectiveness (Kujala and Lillrank, 2004). This is shown in Table 3 by presenting the attributes underlying each relevant GLOBE cultural dimension, the relatedness among dimensional attributes and QM values, and the overall expected influence of a cultural dimension on QM effectiveness. The grey backgrounds are positively related to a QM value category, while the black backgrounds are negatively related, and the white backgrounds are unrelated. The overall result of this theoretic approach to determine a GLOBE dimension's hypothesized effect is presented in the bottom row. GLOBE dimensions theoretically determined to be insignificant are not presented in Table 3 but are discussed below. Thus, both the significance and direction of each hypothesis follow from the theoretical congruence between a GLOBE dimension and QM values.

2.2.1. Positive cultural moderation on quality management effectiveness

Four cultural dimensions are expected to positively increase QM effectiveness and are expected to be consistent with underlying QM values.

2.2.1.1. Future orientation (FO). The extent individuals engage in future-oriented behaviors is a dimension highly congruent with QM values. Underpinning this dimension is a longer planning horizon that suggests an appreciation for delayed gratification, a conviction that current actions influence future events, a premium on planning, and an acceptance for short-term failures (Ashkanasy et al., 2004). Cultures with high FO prefer strategic thinking, encourage knowledge acquisition, develop long-term objectives, and accept flexible current structures. Confucian Asian countries have been associated with a long-term orientation (Hofstede and Bond, 1988). In the GLOBE study, countries classified as Confucian Asian clustered toward the middle of all other countries sampled regarding valuing FO. Many Western countries have low FO scores.

With respect to QM effectiveness, a long-term cultural orientation suggests: (1) a strategic emphasis for management, (2) an ideal of never-ending improvement, (3) and a belief that rewards eventually follow customer satisfaction. Valuing continuous improvement and customer focus are key underpinnings of successful QM (Dean and Bowen, 1994). Employees in a future oriented culture should be easier to motivate because they understand that changes often require short-term aggravation to yield long-term benefits. For instance, employees in a high FO culture can foresee that ISO 9000 certification will aid operations and bring business in years to come. By contrast, low FO cultures will likely "corrupt" the intent of ISO 9000, only increasing the intensity of QM immediately before the certification inspection and ignoring QM otherwise (Lozeau et al., 2002). Although FO may allow an over-acceptance for short-term failures, few aspects of this dimension contradict QM values. A higher future oriented facility should yield much higher benefits from implementing QM. Therefore it is proposed that:

Hypothesis H_a2. The degree of *future orientation* in a manufacturing facility's country culture positively moderates the effectiveness of QM in the facility.

2.2.1.2. Institutional collectivism (IC). The cultural encouragement of collective resource distribution and action is a dimension highly congruent with QM values. Cultures with high IC emphasize the importance of the group, the interdependence of individuals, the respect for group processes, and the parochial role of organizations (Gelfand et al., 2004). Cultures with high IC encourage long-term relations, prefer group goals, seek consensus in decision-making, resolve conflicts through compromise, and share the distribution of rewards. Confucian Asian countries are commonly characterized by the general concept of collectivism (Triandis et al., 1988), yet this concept has many facets that may not all relate to Confucian Asia (Kim and Nam, 1998). In the GLOBE study, Confucian Asians

Table 3
Hypothesized relationships among quality management values to country cultural values[a].

Quality Management Values	Future Orientation (FO)	Institutional Collectivism (IC)	Humane Orientation (HO)	Uncertainty Avoidance (UA)	Assertiveness (AS)	Power Distance (PD)
Q1. Decisions should rely on facts and science.		Relationship over rationality (self-interest)	Decision are individualistic, not standard, trust informal processes	World is predictable, laws reduce ambiguity, formal systems	Rational thought, direct communication	Superiors know best, discussion unhelpful
Q2. Improvement is long-term and strategic.	Long time horizon, advantageous times come/go, be strategic	Relational (long-term) over transactional (short-term)				Status and worth are constant over time, difficult to change in short-term
Q3. Problems are systemic, people intrinsically motivated.	Future outcomes matter most, self-control, immediate needs unclear	Desire to achieve group goals	Altruism, benevolence, kindness, need for affiliation, self-sacrifice	Avoid uncertainty, people are unpredictable, conform	Personal responsibility for results, work hard, difficult targets	Please/emulate superiors, superiors maintain control/order
Q4. Improvement is never-ending, accomplished with existing resources.	Knowledge acquisition, development for future	Respect structures in place		Legitimate procedures, codes, keep status quo	Value progress, not bound by tradition	Concentrated power assures stability, order, new skills unnecessary
Q5. Results are for stakeholders, achieved through internal change, prevention, and customer focus.	Ideals exist and can be attained,	Team-work is the approach, consensus, relation-based hiring not skill-based (need training)	Profit-oriented, social relations critical, human rights, forgive errors, resources for needs, shareholders over stakeholders	Need rules and process control to increase trust	Change environment, satisfy internal needs, competition, opportunistic, results over relationships	Titles/ranking expected, accept automated technology, personal choice unimportant
Q6. Cooperation and collaboration are necessary.		Resolve conflicts with compromise, cooperate for group, collective concern	Relationship oriented, sensitive of others, share power	Group-processes provide assurance, avoid risks	Dominant, tough, trust capabilities not obligation, cooperation not useful	
Q7. Shared vision is necessary for success, with employees involved in decisions.	Actions always influence future, strategies, current structures flexible, goal-oriented	Reward group, poor performance tolerated, group decision-making	Work with others, mentor, paternalistic, informal control, responsible for co-workers	Systems need control, planning, experts help, solidarity important	Individuals are in control, control over environment,	Workers aren't responsible, superiors decide, resources unequally distributed
Q8. Be customer driven and financial results will follow.			Internal means of solutions, informal relationships crucial	External highly uncertain, careful selection of relations	Internal culture, the external needs aren't important	Higher status organizations and institutions should direct company
Overall Hypothesized Moderation of QM Effectiveness	H2: Positive	H3: Positive	H4: Positive	H5: Positive	H6: Negative	H7: Negative

[a] Grey boxes show where there is agreement, black boxes show disagreement, and white boxes show no effect.

clustered somewhat lower than Western countries, yet both score in the middle when compared to other countries' IC value scores.

Regarding quality practices, employees with an institutional collectivist predisposition are expected to be comfortable with the values within QM due to the emphases on cooperation, collaboration, goal sharing, and employee involvement. Institutional norms, such as group duties and social contracts, complement and support the team-based approaches of QM. In particular, high IC cultures have social mechanism for rewarding groups, making them well prepared for decision-making to transfer from individuals to groups as prescribed by TQM. However, low IC cultures reward individuals and are not prepared to transfer decisions to groups. QM in this culture can be corrupted by giving groups less important decisions to make (Lozeau et al., 2002), like the color of equipment instead of the type of equipment. There is a possibility that institutional collectivism may interfere with QM efforts because of a reticence to change institutional structures and traditions. However, a cooperative work environment is considered key to QM success. A high level of institutional collectivism is congruent with QM values and therefore the following hypothesis is given:

Hypothesis H_a3. The degree of *institutional collectivism* in a manufacturing facility's country culture positively moderates the effectiveness of QM in the facility.

2.2.1.3. Humane orientation (HO). This dimension is the degree that a collective encourages individuals to be fair, altruistic, and kind to others. Cultures with a high HO strongly recognize human rights, egalitarianism, forgiveness, sensitivity, situational uniqueness, and informal processes. In these societies, welfare outweighs achievement, relations outweigh rationality, and needs outweigh rewards. Confucian Asian countries were not significantly different from other country clusters in valuing a humane orientation, demonstrating the universality of this value.

Some of the characteristics of a humane orientation are congruent with QM values, such as believing that people are intrinsically motivated, valuing cooperation over competition, believing opinions should be shared, and placing importance on relationships. Cooperation and relationships – particularly with customers – are considered especially important to QM. Low HO cultures will symbolically use QM practices, superficially asking for customer feedback because of procedures but not basing decisions on customer opinion. By contrast, high HO cultures are likely to genuinely ask customers for their opinion, taking the information gathered as critical inputs for structural change. However, because QM relies on standard procedures and scientific methods, a culture accommodating of personal circumstances and opinions may struggle with some of QM's methods. Yet overall the processes involved in QM are closely associated with a culture with a high HO. Therefore it is proposed that

Hypothesis H_a4. The degree of *humane orientation* in a manufacturing facility's country culture positively moderates the effectiveness of QM in the facility.

2.2.1.4. Uncertainty avoidance (UA). This dimension is the reliance on norms and procedures to alleviate unpredictability. The UA dimension is high in cultures that believe risks are dangerous, ambiguity is threatening, nature is controllable, feedback is important, innovations cause uncertainty, people are unpredictable and dissent is intolerable. Employees from high UA cultures are personally motivated to make choices that increase predictability. Because of this, UA is associated with formal systems, process controls, risk-averting group decisions, expert reliance, and a status quo preference. Although the GLOBE study finds Confucian Asian managers to have an average level of importance for avoiding uncertainty, it is significantly higher than Western managers.

Some aspects of high uncertainty avoidance are consistent with QM values, such as the importance of feedback mechanism and the emphasis on standardized processes. In particular, the variance controls procedures of six-sigma should be used by high UA employees to add workplace predictability in novel ways. Low UA employees are expected to see such procedures as wasting time; they follow procedures but do not making real improvement (Lozeau et al., 2002). Although high UA employees may dislike QM's need to change existing systems to make improvements, they are more likely to follow standard procedures very closely, listen intently to customer feedback, and make changes in orderly ways. It is for these reasons that high uncertainty avoidance will help QM practices improve product quality. Therefore, the following hypothesis is given:

Hypothesis H_a5. The degree of *uncertainty avoidance* in a manufacturing facility's country culture positively moderates the effectiveness of QM in the facility.

2.2.2. Negative cultural moderation on quality management effectiveness

2.2.2.1. Assertiveness (AS). Assertiveness is the degree that individuals are confident, confrontational, and aggressively defend their positions (Hartog, 2004). Countries high in this cultural dimension imply a preference for rationality over emotion. Assertiveness is associated with a belief that individuals can dominate external forces and that there are winners and losers. Employees with high assertiveness use rational decision-making to achieve personal advancement. This desire for advancement leads people in these countries to be not bound by tradition but have an inward-looking need for satisfaction. A recent study shows assertiveness to be a valuable attribute for Chinese negotiators (Ma and Jaeger, 2005), and in general Confucian Asian countries have a high GLOBE score for assertiveness (Gupta and Hanges, 2004).

Contrary to QM values, employees in a country with high assertiveness have a predisposition to blame errors not on the system, but on individual ignorance and incompetence. Moreover, a highly assertive culture would view the QM expectation for cooperation as stifling and demotivating. Managers in these cultures are poorly equipped to build a shared vision with employees who are disbelieving in the organizational QM mission. QM can get corrupted under these conditions. For instance, control charts can be used to punish employees for out-of-control processes, motivating employees to undermine the activity. As well, mission statements can be memorized and repeated to symbolize a shared vision (Christmann and Taylor, 2006), but not used by employees to guide behavior. Although assertiveness is congruent with the QM value pertaining to results, it is incongruent with two crucial values – cooperation and customer focus – because of its emphasis on individual rewards and focus on internal needs. Overall, high-level assertiveness will have a highly detrimental influence on how effective quality practices are. The related hypothesis is:

Hypothesis H_a6. The degree of *assertiveness* in a manufacturing facility's county culture negatively moderates the effectiveness of QM in the facility.

2.2.2.2. Power distance (PD). The power distance dimension indicates the degree that members expect power to be stratified and concentrated at higher levels. Power distance cultures accept

the authority hierarchies to ensure social responsibility (Carl et al., 2004). Superiors generally have less dependence on lower status people. Members of a high PD country fear disagreement and accept automated systems, hoping their superiors exhibit paternalistic behaviors in order to relieve their responsibility. In Confucian Asia, PD is generally higher than in most countries (Carl et al., 2004) and has been shown to create difficulties in team-oriented activities (Harrison et al., 2000).

Facilities in high PD countries will have difficulties with QM practices. Employees in such counties expect the primary responsibility for quality performance to be with their managers. QM will be corrupted if hierarchical power structures are maintained, preventing the prescribed transfer of power (Lozeau et al., 2002). Team meetings will not be effective since facts contradicting superiors' decisions will be deemphasized. By contrast, facilities in low PD countries should see QM to align with their structures, allowing decisions to be made by those with the most knowledge rather than those with the most status. In high PD countries, cross-organizational collaboration is unidirectional. Consequently, more PD in a culture causes the objective of "satisfying the customer" to be the manager's responsibility. Therefore, a high power distance is expected to decrease the deep acceptance of QM practices, leading to symbolic implementation and inappropriate usage. Therefore, the related hypothesis is:

Hypothesis H_a7. The degree of *power distance* in a manufacturing facility's country culture negatively moderates the effectiveness of QM in the facility.

2.2.3. Cultural dimensions with no net influence on QM effectiveness

The two GLOBE dimensions performance orientation and in-group collectivism have equal positive and negative influences on QM. Because these theoretically have counterbalancing effects, no hypothesized relationship is given; but for completeness these are reviewed here and assessed in post-hoc analysis.

2.2.3.1. Performance orientation (PO). Performance orientation is the degree that a collective encourages members to achieve excellence. Underlying this cultural dimension is the belief that the environment can be controlled, a personal responsibility for successes, a need for achievement, a value on independence and skills, and an importance placed on work (Javidan, 2004). In the GLOBE study, Confucian Asian countries generally scored low in valuing a performance orientation, which can explain why worker autonomy increases stress levels in such countries (Hirst et al., 2008). Portions of this dimension are congruent with QM values, particularly the importance of continuous improvement and the focus on results. However, other aspects are incongruent, such as the tendency towards independence and the immediacy for results. Because of these counterbalancing effects, no relationship is hypothesized between performance orientation and QM effectiveness.

2.2.3.2. In-group collectivism (GC). In-group collectivism is the degree to which individuals express pride, loyalty, and cohesiveness in their collectives. In-group collectivism is formed around the security that exists within groups, loyalties, and affiliations with group membership, deference towards the collective "general will," and clear distinctions between who is and who is not a group member (Gelfand et al., 2004). Although the preferential treatment towards one's in-group is a common behavior in Asia (Chung, 2006; Zhao et al., 2008), Confucian Asian managers in the GLOBE survey valued in-group collectivism relatively low (Gupta and Hanges, 2004). The QM importance of shared goals within an organization would be supported by in-group predispositions, yet this emphasis on harmony and tradition resists making drastic changes sometimes needed to achieve QM goals. The influences of in-group collectivism on QM effectiveness will counteract each other and therefore no hypothesize relationship is given.

Table 4
Comparison of adjusted GLOBE cultural dimensions values.

	FO	IC	HO	UA	AS	PD
China	87.9	100.3	97.2	119.4	146.3	109.7
South Korea	109.0	85.2	102.1	106.0	97.8	87.1
Taiwan	92.4	109.8	93.7	114.9	77.1	101.0
Asian Average	96.4	98.4	97.7	113.4	107.1	99.3
Albania	96.7	95.4	93.9	115.6	116.3	126.5
Australia	97.4	99.2	101.9	89.2	101.5	101.0
Austria	96.3	106.0	103.4	81.6	75.5	91.9
Finland	98.0	96.3	105.5	90.3	103.6	89.7
Germanyc	97.4	110.3	101.9	82.7	85.6	98.4
Hungary	107.4	101.4	99.7	106.0	90.6	94.4
Italy	112.4	115.4	101.4	101.0	102.6	91.5
Mexico	107.4	105.8	92.8	115.8	97.3	100.3
Nigeria	108.5	107.8	103.9	121.8	83.2	97.0
Poland	96.7	94.1	96.8	106.2	104.7	116.3
Sweden	92.8	86.7	104.1	77.1	92.5	90.8
USA	99.9	93.2	100.3	89.2	115.5	105.0
Non-Asian Average	100.9	101.0	100.5	98.0	97.4	100.2
Std. Error of Estimate	1.7	2.2	1.0	3.8	4.4	2.6
GLOBE Range %	84	75	81	71	68	78

2.3. Asian cultures affect quality management effectiveness

This section develops culture-based hypotheses pertaining to QM effectiveness in China, Korea, Taiwan, and non-Asian countries. Prasad and Tata (2003) emphasized that although other country conditions exist – such as political, legal, economic, and educational – these are less defined and often explain QM's existence, while socio-cultural conditions are better defined and often explain QM's effectiveness. This study is culturally focused and thus uses the GLOBE project to develop hypotheses.

Table 4 presents the overall GLOBE scores on the cultural dimensions for all countries included in this study. Without loss of generalizability, the GLOBE scores are normalized by dividing by the overall mean and multiplying by 100. This normalization aids interpretation of how each county compares to the overall mean. For example, FO in South Korea has a normalized score of 109, illustrating this country to be 9% above the average score. China's normalized score of 87.9 is interpreted as being 12.1% below the average score. The standard error of the estimate is computed and used to the 95% confidence interval to reveal if a country's specific cultural dimension is above or below the mean.

To assist developing the culture-based moderation hypotheses of China, South Korea, and Taiwan on quality effectiveness, Table 5 integrates the *a priori* hypothesized cultural influence with each Asian country's specific GLOBE score. Each cultural dimension is presented in Column 1 with the sign of its hypothesized moderating impact in Column 2. Under each country are the significant GLOBE characteristics from Table 4, shown with a *plus* sign for above average and *minus* sign for below average. The combination of the cultural dimension's impact and the specific country characteristics are presented in the last three columns. The significance of each cultural dimension is represented by double signs. To illustrate, FO has an expected strong, positive influence on QM effectiveness, but China's GLOBE score is significantly below average. The combination of these factors make China's FO effect strongly decrease QM effectiveness. This logic is likewise carried out for each country, resulting in a set of positive and negative effects that illustrate the multidimensionality and general

Table 5
Relationships among cultural values, Asian country values and QM effectiveness.

Cultural Moderation of QM Effectiveness[a]		Asian Country Values			Influence of Country Values on Quality Effectiveness[a]			
		China	South Korea	Taiwan		China	South Korea	Taiwan
FO	++	–	+	–	FO	––	++	––
IC	+		–	+	IC		–	+
HO	++	–	+	–	HO	––	++	––
UA	+	+		+	UA	+		+
AS	––	+		–	AS	––		++
PD	–	+	–		PD	–	+	

[a] Double plus and double minus signs indicate especially strong influences.

tendency of a country's culture to moderate QM effectiveness. Thus, the efficacy of the GLOBE scores to predict Asian QM effectiveness is to be tested.

2.3.1. Quality management effectiveness in China

Although Chinese values are based on Confucian principles, China's culture significantly differs from other East Asian cultures (Paik, 1996). In their award-winning paper, Ralston et al. (1997) classified Chain and Japan as collectivist countries but delineated capitalist Japan from socialist China. Their results suggest that China is dramatically different in its cultural values from free-market cultures. These differences are exhibited on Table 5: The cultural values that are expected to be positively related to QM values are statistically lower than the international average. These below average FO and HO scores show that Chinese managers generally devalue a long-term orientation and a humane approach to management. Both these characteristics of Chinese culture are expected to deter QM effectiveness. Moreover, additional dimensions undermine QM; Chinese managers highly value power distance and assertiveness, the latter being a recent development resulting from a modernizing society (Ralston et al., 1999).

In comparison with both South Korea and Taiwan, China's GLOBE scores imply a culture significantly different than the other two Confucian Asian countries, and much less congruent with QM values. This may be expected regarding Korea, where histories are quite distant; the largest differences being the FO and HO scores. Less expected is China's difference with Taiwan, where Taiwan's AS and IC scores imply a culture more congruent with QM values. Although China's and Taiwan's recent histories are more related than Korea's, many forces can explain their differences: Taiwan's occupation and modernization by Japan in the early 1900s, and subsequent imposition of Chinese Kuomintang rule in the 1940s, created a lack of self-determination for the Taiwanese people (Rubinstein, 2007); China's Great Leap Forward, Cultural Revolution, and market reforms over the past 50 years demonstrated massive attempts at social control and inspired personal responsibility for prosperity (Meisner, 1999); and Taiwan's political system was democratized in the 1980s while China's remains a socialist republic with one-party rule. The result of these and other forces are evident in the GLOBE scores.[5] On each of the dimensions considered most influential – that is, FO, HO, and AS – China's GLOBE characteristics imply a strongly negative moderation of QM effectiveness as compared to Taiwan and South Korea. Therefore, the overall culture-based assessment of QM effectiveness in China is expected to be relatively lower than the other Confucian Asian countries. The related hypothesis is:

Hypothesis H_a8. The effectiveness of quality management in China is lower than both Korea and Taiwan.

[5] Taiwan's GLOBE scores average a 1.3 standard deviation difference from China's. In fact, China's GLOBE scores are closer to Poland, Albania and the United States than to Taiwan.

2.3.2. Quality management effectiveness in South Korea and Taiwan

The implementation of QM in South Korea has largely been driven by governmental and organizational leadership (Lee et al., 2003). Contrary to China, South Korea's culture is complementary to the values underlying QM and has been influenced by management practices from Japan (Dahlgaard et al., 1998). This is demonstrated from the GLOBE scores being above average from Korean managers for FO and HO. Moreover, Korean managers devalue power distance, which helps QM practices that empower employees. Although South Korea's culture is incongruent with QM values with respect to institutional collectivism (IC), this is not considered a highly influential cultural dimension. The overall assessment is that the effectiveness of QM in South Korea is expected to be relatively high.

The Taiwanese are likewise expected to be amenable to QM. Both managers and workers in Taiwan have been shown to readily accept non-adversarial and more cooperative management techniques (Chen, 2007). However, as presented in Table 5, Taiwan's cultural scores reveal traits that both complement and contradict underlying QM values. The above average IC and UA scores show that Taiwanese managers generally value rewarding collective behavior and avoiding uncertainty. In addition, AS is highly devalued in Taiwan, creating a culture that is passive in individual relations and that views problems systemically rather than individually. Such cultural aspects of Taiwan highly benefit the use of QM. However, a future orientation and a humane orientation are not valued in Taiwan. Because Taiwanese employee work performance is substantially influenced by social forces (Farmer et al., 2003), group norms dissuading FO and HO will diminish employee buy-in to QM practices, dampening other highly beneficial influences. Therefore, Taiwanese culture is expected to overall positively moderate QM effectiveness, but not as much as Korea. The related hypothesis is:

Hypothesis H_a9. The effectiveness of quality management in South Korea is higher than Taiwan.

2.3.3. Quality management effectiveness between Confucian and Western Cultures

As noted in the above culture-dimension hypotheses, there are some clear cultural value differences between Confucian Asian and Western countries, particularly regarding institutional collectivism and uncertainty avoidance. Studies have long shown cultural distinctions between Asian (i.e. Far Eastern) and Western (i.e. Anglo and Western European) countries (Ronen and Shenkar, 1985; Toynbee, 1947). Common distinctions between these two groups are that Far Eastern cultures have higher power distance and lower individualism than Western cultures (Hofstede, 1980). Yet somewhat recently, Furnham et al. (1994) found that young Easterners score higher on individual competitiveness than their counterparts in Europe, attributing this finding to cultural as well as economic growth differences.

The GLOBE study also configures countries into eastern and western cultures, with Confucian Asia in the east, while Latin Europe (e.g. Italy) and Germanic Europe (e.g. Germany and Austria) are the most western of cultures. To capture the best distinction, countries in this study most epitomizing western values – Italy, Germany, and Austria – are expected to have different QM effectiveness than Confucian Asian countries. Reviewing the GLOBE scores in Table 4 reveals the most Western countries have on average substantially higher IC, but lower UA and AS. The other values are nearly the same. Although Confucian Asian countries are more likely to be receptive to standards because of a higher UA than Western countries, they are less likely to view quality errors systemically because of their higher AS. Moreover, because IC is lower in Confucian Asia, formal approaches toward employee involvement likely would not be used effectively. Overall, based on the GLOBE values for the countries under study, the hypothesis is:

Hypothesis H_a10. The effectiveness of quality management in Confucian Asia is lower than in the most Western countries.

3. Method

This section discusses the sample used to test the hypotheses and discusses how the GLOBE study is utilized. Additionally, the hierarchical linear modeling (HLM) method is presented along with the empirical model.

3.1. Sample

The data used for this study were gathered by the Global Manufacturing Research Group (GMRG), a multi-national community of researchers studying worldwide manufacturing practices (www.gmrg.org), comprised of researchers from leading international academic researchers representing more than 20 countries. The GMRG survey instrument was developed to assess and improve the effectiveness of manufacturing practices around the world (Whybark, 1997). Three rounds of worldwide surveys have been conducted since 1985, and the fourth survey round is currently near completion (Whybark et al., 2009). Academics from each country translated and back-translated the questionnaire; in some cases the same language was modified to reflect country and regional differences. This analysis uses a portion of the GMRG 4.0 database, containing 913 samples from 15 countries and 21 industry classifications. The most common industry for each Confucian Asian country sampled was electronics. The data contains adequate variety for generalizability, with a majority of plants range from 50 to 500 employees, with about 17% over 500 employees (see Appendix A).

The GMRG survey questions relating to quality management practices and product quality performance are used for hypothesis testing. Specifically, managers indicated the extent of resources (money, time, and/or people) invested toward programs in the following areas: total quality management, ISO 9000, statistical process control, and six sigma. Each of these programs are instrumental for successful quality management implementation (Schroeder et al., 2005; Zu et al., 2008) and collectively reflect the extent to which quality management practices are within a plant. Managers also reported how their plant performs compared to their competitors along the following dimensions: product performance, product features, and perceived overall product quality. Similar dimensions have been stated in past research to ascertain the extent of product quality performance (Flynn et al., 1995; Garvin, 1987). These practice and performance questions appeared on different pages to avoid method bias from close proximity (Podsakoff et al., 2003). A one-factor analysis accounts for only 41% of data variance.

Because the intent of this study is to focus on Asian and cultural influences on QM effectiveness, it is necessary to perform data reduction on the quality-related measures. This simplifies hypotheses testing without loss of theoretical insights. The manufacturing facilities are assessed for two overall factors: QM practices and product quality performance, extracted through principal component analysis with promax rotation using Kaiser Normalization in SPSS 16.0. Two distinct factors are found, with eigen values being 2.9 and 1.7, accounting for 66% of data variance. The pattern matrix (shown in the Appendix A) exhibits satisfactory item-to-factor correlation, each above the 0.5 threshold, and both factors exhibit high reliability—Cronbach alphas above the 0.70 threshold (Nunnally and Bernstein, 1994). Satisfactory unidimensionality is demonstrated by correlations of within-factor items being higher than correlations with non-factor items. Single factor values are required for HLM analysis; therefore, the measures are summed to form the variables indicating the level of QM practices and product quality performance. These full results are presented in the Appendix A along with sample statistical characteristics.

3.2. GLOBE measures of culture

The measures used from the GLOBE study are the result of a 10-year study, completed in 1997, based on responses of about 17,000 managers from 951 organizations in 62 societies around the world (House et al., 2004). Usage of the GLOBE study has appeared in numerous managerial research studies (Euwema et al., 2007; Luo, 2008). Nine cultural dimensions – an extension of Hofstede's original dimensions – were measured along with other societal variables and leadership attributes; eight dimensions, as shown in Table 1, were used for this study. The scales were developed by the GLOBE research team through a multistage process of Q-sorting, forward and back translation, multiple pilot studies, multilevel confirmatory factor analysis, reliability and validity tests, and correlation analyses; the interested reader is referred to Hanges and Dickson (2004) for further reading. The GLOBE study provides a list of response bias corrected scores for the most of the countries surveyed in the GMRG database; the bias corrected scores were used to test the moderation hypotheses.

3.3. Hierarchical Linear Model (HLM) approach

The hypotheses are tested using HLM 6.0 (Raudenbush et al., 2004), where the coefficient representing QM effectiveness is the influence of QM practices (QM) on product quality (PQ) at the facility level. In turn, this facility-level coefficient is dependent on country-level cultural dimensions. HLM is a random coefficients method, explicitly modeling culture's moderation of QM effectiveness while accounting for the non-independence of samples (facilities are nested within countries). Thus, HLM is more appropriate than interaction terms in multiple regression (Hofmann, 1997). Moreover, HLM accounts for differing sample sizes within countries that otherwise would bias results (Raudenbush and Bryk, 2002). HLM provides accurate statistical effects of cultural influences (Nezlek et al., 2008; Wong et al., 2008). The first set of data, termed level-1, contains the GMRG responses for facility i within country j for each factor (i.e., PQ_{ij} and QM_{ij}). The second data set, termed level-2, contains the GLOBE cultural scores for each country: future orientation (FO), institutional collectivism (IC), humane orientation (HO), uncertainty avoidance (UA), assertiveness (AS), and power distance (PD).[6]

[6] Performance orientation and in-group collectivism were included in post-hoc analysis and were verified to not have a significant influence on QM effectiveness.

The HLM analysis tests the hypothesized relationships through the following random-coefficients with level-1 covariate model (Raudenbush and Bryk, 2002):

Level 1—Quality Management Practices Effect[7]

$$PQ_{ij} = \beta_{0j} + \beta_1(SIZE_{ij}) + \beta_{2j}(QM_{ij}) + r_{ij} \quad (1)$$

Level 2—Country Effects

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(GDP_j) + u_{0j} \quad (2)$$

$$\beta_1 = \gamma_{10} + u_1 \quad (3)$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}(FO_j) + \gamma_{22}(IC_j) + \gamma_{23}(HO_j) + \gamma_{24}(UA_j) + \gamma_{25}(AS_j) + \gamma_{26}(PD_j) + u_{2j} \quad (4)$$

In this two-level model, the variance of facility product quality performance in (1) is explained by four parameters: a random intercept β_{0j} varying by country, a non-varying facility size effect β_1 (discussed below), the influence of QM β_{2j} also varying by country, and error r_{ij}. The β_{0j} parameter is interpreted as a country's average product quality without QM practices, and the slope β_{2j} is QM *effectiveness* within country *j*. The intercept parameter is the level-2 dependent coefficient in (2), controlled for the level of country development (discussed below). To be consistent and focus on the culture-as-moderator perspective, it is appropriate that in (2) no cultural dimensions are included (Snijders and Bosker, 1999). The slope parameter is the level-2 dependent coefficient in (4). Because the effectiveness of QM was of interest for this study, only the level-1 slope parameter β_{2j} is regressed onto the cultural dimensions. The gamma parameters in (4) will be used to test H1 through H7. The average effectiveness of QM is represented by γ_{20} and the relative impact of each cultural dimension is represented by γ_{21} through γ_{26}. A base model 1a with QM effects fixed and without the cultural effects will test H1, while a base model 1b with QM random effects will be used to estimate β_{2j} for each country and test the Asian country hypotheses H8 and H9. A random effect u_{2j} is associated with each country. Level-1 variables are uncentered while level-2 variables are grand-centered. HLM is thus used to fit this system of nested models, and parameter significance is examined to test the research hypotheses.

To estimate level-2 parameters, HLM uses a generalized least squares (GLS) estimation procedure. This procedure provides a weighted level-2 regression such that the countries with more precise level-1 estimates of the dependent variable receive more weight in the level-2 regression equation (Hofmann, 1997; Snijders and Bosker, 1999). For each country, two predicted intercept and slope values are estimated: one from the level-1 model, and the other from the level-2 model. To combine both estimates, HLM computes an empirical Bayesian estimate of the level-l intercepts and slopes for each country that optimally weights the ordinary least squares (OLS) level-l estimates and the level-2 predicted values for these same estimates. These empirical Bayesian estimates are in the residual output file generated by the HLM software. This output will be used to examine the relative QM effectiveness in China, Korea, and Taiwan. Hypothesis testing is conducted using the point estimates and significance levels for the parameters corresponding to the hypothesized relationships.

It is common to have a low number of countries in such a study (Flynn and Saladin, 2006; Ralston et al., 1997). Subsequently the level-two degree of freedom is low. Snijders and Bosker (1999) explain that detecting effects of level-2 variables strongly depends on the number of groups, which in this study is 15 countries. These authors recommend using a backward model-fitting process to handle the difficulty. This study uses this statistical process for the cultural dimension set, starting with all six dimensions, step-wise removing the most statistically insignificant dimensions, until a final set of significant coefficients remained.

3.4. Control variables

Two control variables are added, one to each level. Organizational size (*SIZE*) reflects the degree of difficulty in coordinating a large group of people (Douglas and Fredendall, 2004). The organization size is measured by the number of employees. The second level of control is per capita gross domestic product (*GDP*), representing a country's degree of development, and thus capturing the degree of market competitiveness, strength of auditing and standards, technological readiness, and the like.[8] These controls are entered first in model 0.

4. Results

The results of the HLM analysis are shown in Table 6. Following Snijders and Bosker (1999), an "empty" model is first analyzed that is equivalent to a one-way random effects ANOVA model. The empty model divides the variance of *PQ* into within-group (level 1) variance σ^2 and between group (level 2) variance τ_0^2. Utilizing these variances and coefficient reliabilities, percent reductions in prediction error are computed as a surrogate for R^2 in HLM (see Snijders and Bosker (1999, p. 99) for more detail). Model 0 is presented next with the fixed control variables *GDP* and *SIZE* included only. Both controls are statistically significant in this model, revealing that product quality performance relative to competitors is higher in less developed countries and in larger organizations. The deviance value D, which is a relative lack of fit measure, is 4484.4 and is comparable to subsequent models. The reliability estimate for the randomly varying intercept parameter is 0.627, revealing relatively high between-country *PQ* variance. The variance of the facility random effect σ^2 and the variance of the country random effect τ^2 are shown.

4.1. Overall effectiveness of quality management

When the presence of *QM* is included, as shown in model 1a, the control variables are insignificant. This reveals a potential relationship between *QM* and both *SIZE* and *GDP*. Model 1a results show QM practices positively influence product quality, $\gamma_{20}^0 = 0.107$ [9] ($p < 0.01$), thus supporting H1. Note all subsequent models also estimate *QM* to positively influence *PQ*. The slight increase in reliability indicates more between-country variability in base *PQ* when QM is accounted for. Finally, the percent MSE reduction indicates that 3.6% of facility-level *PQ* variance is explained, while 11.1% of country-level variance (i.e. changes in $\bar{Y}_j$ without *QM*) is explained by model 1a. As expected, these R^2 values show an improvement in facility-level variance explained. Model 1b is shown next for comparison with model 2. The output from model 1b estimates QM effectiveness for each country and is discussed in Section 4.3.

4.2. Effects of country cultural dimensions

Model 2 shows the results of including cultural values dimensions. Following the backward model-fitting, dimensions

[7] Note the "empty" model is a random intercept only model with $Y_{ij} = \beta_{0j} + r_{ij}$ and $\beta_{0j} = \gamma_{00} + u_{oj}$.

[8] Positive correlations exist among these based on data from the World Economic Forum (see http://www.weforum.org/pdf/GCR08/GCR08.pdf).

[9] The regression coefficient are unstandardized following typical HLM output.

Table 6
HLM results.

Parameters	Dependent variable: product quality performance				
	Empty model Est. (std. error) [*t*-value]	Model 0 Est. (std. error) [*t*-value]	Model 1a Est. (std. error) [*t*-value]	Model 1b Est. (std. error) [*t*-value]	Model 2 Est. (std. error) [*t*-value]
Grand intercept					
γ_{00}[a]	15.949 (0.179) [88.830]***	15.959 (0.167) [95.497]***	14.514 (0.317) [45.748]***	14.464 (0.450) [32.076]***	14.382 (0.447) [32.131]***
Control variables					
γ_{00}(GDP)[b]		−0.001[a] (0.001) [−2.008]*	−0.001[a] (0.001) [−1.405]	−0.001[a] (0.001) [−1.861]	−0.001[a] (0.001) [−0.652]
γ_{10}(SIZE)[b]		0.001[a] (0.001) [1.729]*	0.001[a] (0.001) [−0.246]	0.001[a] (0.001) [−0.684]	0.001[a] (0.001) [−0.480]
Hypotheses					
γ_{20}QM (H1+)[c]			0.107[b] (0.019) [5.415]***	0.107 (0.029) [3.627]***	0.111 (0.023) [4.665]***
γ_{21}FO (H2+)					n.s.
γ_{22}IC (H3+)					n.s.
γ_{23}HO (H4+)					n.s.
γ_{24}UA (H5+)					0.053 (0.023) [2.285]**
γ_{25}AS (H6−)					−0.041 (0.014) [−2.806]**
γ_{26}PD (H7−)					n.s.
Deviance (*D*)	4450.4	4484.4	4459.7	4453.1	4458.9
σ^2	7.507	7.507	7.272	7.137	7.121
τ_0^2	0.328	0.255	0.281	1.609	1.597
τ_2^2				0.006	0.002
Reliability					
β_{0j}	0.679	0.627	0.654	0.522	0.520
β_{2j}				0.480	0.249
% MSE reduction Y_{ij} (R_1^2)	n/a	0.9%	3.6%[d]	n/a	0.3%[e]
% MSE reduction β_{0j} (R_2^2)	n/a	15.8%	11.1%	n/a	0.4%[e]
% MSE reduction β_{2j}					36.4%[e]

[a] Values below 0.001 are shown as .001.
[b] Assumed constant across countries.
[c] Provides overall average of β_2 or QM effectiveness.
[d] *df is* the difference in no. of parameters.
[e] Based upon Model 1b with variable QM effectiveness u_{ij} added for comparison.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

that are removed for statistical insignificance are noted with an "n.s." designation. The first four cultural dimensions are expected to positively influence QM effectiveness. The first dimension, future orientation, is insignificant and is removed from the model. This result does not support Hypothesis H_a2 that QM effectiveness will benefit from cultures valuing future outcomes over short-term gains. The next dimension, institutional collectivism, is also insignificant, thus not supporting Hypothesis H_a3. This suggests that social mechanism for rewarding collectivist behavior does not help QM practices improve product quality as expected. A humane orientation is the third dimension tested, and this cultural dimension is also statistically insignificant. Thus, Hypothesis H_a4 is not supported, suggesting that beliefs in people's intrinsic motivation and the importance of interpersonal relationships are unrelated to QM effectiveness. The fourth dimension, uncertainty avoidance, significantly increases QM effectiveness in model 2 $\gamma_{24} = 0.053$ ($p < 0.05$). This result gives support to Hypothesis H_a5 and indicates that cultures threatened by unpredictability are more amenable to the process controls and standardizations present in ISO 9000 and six-sigma.

The next two cultural values are expected to negatively influence QM effectiveness. Assertiveness, the fifth dimension tested, has the expected negative impact $\gamma_{25}^V = -0.041$ ($p < 0.05$) on QM effectiveness. Thus, Hypothesis H_a6 is supported, indicating that cultures valuing competition and individual responsibility have less effective group decision-making and seek to correct individual error rather than systemic error.[10] The sixth dimension, power distance, is not significant, showing no support for Hypothesis H_a7. This suggests that in high PD countries, as long as QM is implemented, it will have a similar effect on product quality as in low PD countries.

As expected, model 2 improves the explanation of QM effectiveness β_{2j} variance while not improving the explanation of *PQ* variance. Overall, the deviance values change little among the models, indicating equivalent model fitness for predicting facility *PQ*. Compared to model 1b, the percent mean square error (MSE) reduction indicates a 0.3% improvement in predicting facility-level *PQ* variance and 0.4% improvement in country-level *PQ* variance. These small improvements are as expected because the addition of cultural dimensions is intended to predict QM effectiveness. Indeed, the percent improvement over model 1b in predicting the QM slope is 36.4%. This indicates the benefit of knowing country cultural values when implementing QM. It should be noted that although two GLOBE dimensions – in-group collectivism and performance orientation – are excluded for theoretical reasons, post-hoc analysis shows that when these dimensions are included the results are the same. Therefore, both GC and PO are verified empirically not to have a significant impact on QM effectiveness.

4.3. Effects of Asian countries

To compare QM effectiveness in China, Korea, and Taiwan, Table 7's Bayesian estimates β_{2j} and standard errors for each country from model 1b are used. Model 1b intentionally removes the cultural dimensions to allow the country indicators to represent the composite of cultural influences shown in Table 4, thereby testing Hypotheses H_a8 and H_a9. Significant variation exists between each of the Asian countries. The β_2 empirical Bayesian

[10] The recent Chinese use of executions to correct the melamine in milk crisis is a recent example. The Chinese culture has one of the highest levels of valuing assertiveness.

Table 7
HLM estimates of QM effectiveness by country.

Country	n	β_{2j}	S.E.
China	57	0.068	0.058
Korea	115	0.191	0.043
Taiwan	50	0.180	0.064
Asian Average		0.146	
Albania	15	0.144	0.071
Australia	50	0.095	0.057
Austria	17	0.131	0.075
Finland	139	0.069	0.048
Germany	53	0.109	0.057
Hungary	53	0.146	0.061
Italy	54	0.060	0.059
Mexico	105	0.157	0.049
Nigeria	32	0.146	0.066
Poland	57	0.105	0.054
Sweden	32	0.034	0.068
USA	84	−0.018	0.049
Non-Asian Average		0.098	

estimates and standard errors are as follows: China $\beta_2 = 0.068$ (0.058), Korea $\beta_2 = 0.191$ (0.043), and Taiwan $\beta_2 = 0.180$ (0.064). To test whether QM effectiveness among China, Korea, and Taiwan are significantly different; a one-tail Welch t-test for parameter differences in unequal group sizes is conducted (Welch, 1947). China's QM coefficient is significantly less than South Korea's, t-value (df) of 1.69 (116), with $p = 0.047$. However, China's QM coefficient is not significantly less than Taiwan's, with a t-value (df) of 1.29 (102), $p = 0.099$, thereby partially supporting Hypothesis H_a8 that China has the lowest QM effectiveness. Korea and Taiwan do not have significantly different QM effectiveness, t-value (df) of 0.14 (95), $p = 0.444$. Thus Hypothesis H_a9 is not supported. The overall average β_2 for the Asian countries is 0.146, higher than the non-Asian country average of 0.098.

Table 7 results are also used to test Hypothesis H_a10, proposing that based on the GLOBE scores, the Confucian Asian countries will exhibit less QM effectiveness than countries most representing Western values. A weighted inverse variance method (Lipsey and Wilson, 2001) is used to create the composite β_2 and standard error for Confucian Asian and Western countries, which are 0.155 (0.030) and 0.096 (0.036) respectively. Although the Confucian Asian β_2 estimate is higher, a one-tail Welch t-test for unequal group sizes produces an insignificant result, t-value (df) of 1.25 (281), $p = 0.106$. Thus Hypothesis H_a10 is not supported.

A different country-level factor possibly explaining the variation of QM effectiveness in Table 7 is whether the country's economic system was communist in recent history. This is tested by comparing those countries in the study that are historically communist (i.e. China, Albania, Hungary and Poland[11]) to those that are historically capitalist (i.e. all remaining but Nigeria). A Welch t-test using weighted inverse variance composites, as above, results in an statistically insignificant difference in QM effectiveness, t-value (df) of 0.243 (327), $p = 0.404$; further bolstering the culture-based findings.

5. Discussion

The purpose of this study is to assess how country cultural dimensions impact QM effectiveness and examine the particular managerially relevant issue of QM in Asia. Using quality and culture literatures, 10 research hypotheses were tested, and four were supported. The results show that Asian countries vary substantially in QM effectiveness, and that effectiveness varies depending on specific cultural dimensions. This is the first multilevel study to show such results with manufacturing plants around the world using GLOBE cultural dimensions.

5.1. Theoretical implications

First, this study finds that the control variables of organization size and per capita GDP do not significantly change the level of product quality performance. This result is supported even when cultural dimensions are included in the estimate. It should not be surprising that quality practice investments are effective in improving quality competitiveness in manufacturing companies, small or large, and in developed or developing countries. The results of this study show that QM investments are nearly universal in their improvement of product quality performance.

Yet, this study finds that specific country cultural values impact how effective QM investments are. Uncertainty avoidance (UA) has a positive influence on QM effectiveness. This suggests that employees in cultures desiring predictability and law-like understanding will be motivated to frequently apply QM's systematic approaches, as in six sigma's improvement heuristics. Moreover, high UA cultures are not uncomfortable with rules and process controls. Therefore, employees in high UA organizations with established ISO 9000 procedures will be motivated to follow the written standards, while low UA organizations will be less concerned about deviating from set processes. A desire to adhere to the systemization of QM is an important cultural value for achieving quality improvements.

This study found that assertiveness (AS) has a negative effect on QM effectiveness, suggesting managers in high AS societies have difficulty in how QM practices are used because of inter-employee competition and opportunistic behavior. High AS organizations are less likely to see problems as systemic, since they believe people are in control of their environment. Moreover, employees from high AS cultures are less motivated when rewards and recognition are given to groups rather than individuals. Thus, workers will find ways to corrupt QM, perhaps by exemplifying quality champions and punishing individuals for out-of-control processes. Countries that have high assertiveness are also expected to have significant difficulties in discovering the root cause of quality problems. The cultural attributes underlying an assertive culture create these conditions to deter QM effectiveness.

Combining these two results leads to the conclusion that countries amenable to rules (high UA) and system-thinking (low AS) will have highly effective QM systems. There is a reason why these, and not the other GLOBE dimensions, are significant. Lozeau et al. (2002) state that much of QM acceptance, rejection, or corruption stems from individual decisions, which Higgins (1997) argues is motivated by a need to promote personally desired outcomes and to prevent anxiety from negative outcomes. Employees in UA cultures have negative predispositions toward uncontrolled and unpredictable situations. Because QM helps prevent process uncertainty and thus avoid such anxiety, there's a personal reason to promote this practice. By contrast, AS cultures have a positive opinion for personal responsibility and reward. Because QM encourages systemic responsibility and collective reward, there's a personal reason to prevent this outcome through practice corruption. In fact, Wallace et al. (2009) find that personal avoidance and accomplishment mechanisms are strongly predictive of work-related outcomes. Consequently, the statistical relationships of UA and AS to QM effectiveness are explained; these

[11] Based upon data provided by Pearson Education 2000-2007, publishing as Infoplease (see http://www.infoplease.com/ipa/A0933874.html).

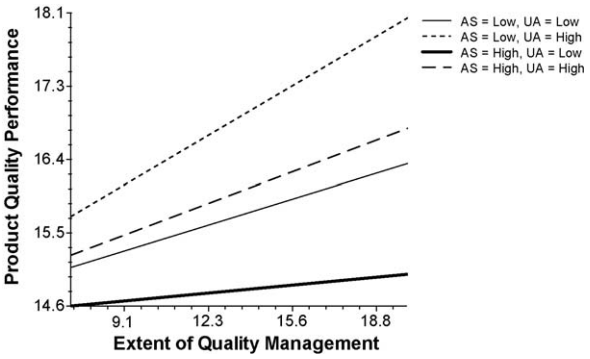

Fig. 2. Post hoc extrapolation regarding the influence of culture on quality management effectiveness.

dimensions directly characterize individual motivations toward work practices.

A post-hoc extrapolation of the significant HLM results shown in Fig. 2 further illustrates the combined influences of UA and AS. Graphically, this figure depicts that getting excellent results from QM should be easiest in cultures with low AS and high UA (like Taiwan and Nigeria), and most difficult in high AS and low UA cultures (like Finland and the US). Thus, this research contributes by parsing from the large number of cultural dimensions which crucial dimensions impact QM effectiveness.

Contrary to initial predictions, many cultural dimensions do not significantly influence QM effectiveness. These dimensions were future orientation, institutional collectivism, humane orientation and power distance. There are several explanations for this. First, these other GLOBE dimensions don't directly relate to Higgins' (1997) personal work motivations of avoidance and accomplishment; rather, they are general tendencies and preferences. For instance, it was expected that future-oriented employees would prefer QM; however, short-term oriented employees can quickly learn the benefits of QM through observing the immediacy of less rework (Ahire and Dreyfus, 2000). Second, the four insignificant country-level dimensions may be less penetrating to the facility level than expected. For instance, a facility's country may have high power distance, but if its managerial structure is deliberately flat then this could counteract the country-level influences. Third, there may be counteracting effects within these dimensions. That is, as shown in Table 3, each dimension has multiple facets, with some congruent with QM values. The institutional collectivism dimension illustrates this because only one facet – preservation of existing structures – is incongruent with a crucial QM value – never ending improvement. Possibly this counteracts the other congruent facets. Future multilevel research could include the multiple facets of each dimension, as well as the unique facility cultures, to explore these insignificant findings and better understand how QM effectiveness changes within Asia and other cultures.

Turning to Confucian Asian results, it was found that China had overall the least effective use of QM. This result is culturally predicted and provides some support for the underlying theoretical framework linking QM value theory to the GLOBE dimensional scores. As shown in Table 4, China highly values assertiveness, a dimension associated with a significant decrease in the effectiveness of QM. By contrast, Taiwan, with higher QM effectiveness, substantially devalues assertiveness. China has been rapidly growing in importance on the global stage, with many traditional ways of behaving being challenged, and many behaviors previously deemed inappropriate are accepted (Fu et al., 2004). Valuing assertiveness represents placing an importance on competition and dominance, satisfying needs and gaining results. These values are antithetical to quality management. Possibly, managers and employees in Chinese facilities struggle with the intent of QM practices, causing them to be less effective.

The discrepancy in QM effectiveness among these Asian countries also explains why no statistically significant difference is found in comparison with the select Western countries. That is, the range is high. Yet also a substantial range in QM effectiveness exists among the Western countries. The rejection of H10 reveals that making generalities above the country level has little utility when considering how well QM will be received within a facility. Overall, however, the Asian countries did exhibit a higher effectiveness in using QM than non-Asian countries. This is largely attributable to Korea and Taiwan having the highest β_2 parameter estimates in the sample. This can partially be explained by the higher than average uncertainty avoidance in these countries. Asian countries have experienced in recent memory high economic volatility and likely welcome QM as a means to avoid environmental uncertainty (Bae et al., 2003; Zhao et al., 2004). However, there are many other cultural reasons beyond what the GLOBE dimensions can offer. For instance, Japan's 50-year control of Taiwan was friendly, and one may expect the Taiwanese to be accepting of management practices of Japanese origin. Yet this would not be the case in South Korea. These important country-specific cultural histories undoubtedly influence the mindsets of employees. Be that as it may, UA in Asia is the highest among other average GLOBE scores, revealing why some Asian cultures respond better to QM and underscoring the importance of examining country-specific cultural values rather than make regional generalities.

5.2. Managerial implications

The issue of quality performance of Asian suppliers is very important to purchasing managers since these managers are responsible for incoming product quality. The results of this study will assist such managers in knowing what to expect from QM in Asia. Namely, quality practice investment is statistically strongly related to quality competitive performance, indicating such practices are a necessary condition for quality competitiveness. However, the presence of quality practice investment is not a sufficient condition since a country's culture may hinder the effect of quality practices on performance and competitiveness. Therefore, these managers need to be aware of how a country's culture significantly impacts QM effectiveness. So, the mere fact that a supplier has invested in quality programs does *not* mean that the program will be well-implemented or deliver competitive advantage. This study finds that the ability to achieve quality performance through QM is highly affected by a country's cultural values. Culturally valuing behaviors, like actions that remove uncertainty, can assist QM programs to improve quality; while valuing other behaviors, like assertiveness in relationships, contradict QM and hurt quality performance. Purchasing managers must recognize when these cultural elements are present.

As a pragmatic approach to quality performance, sourcing decisions need to consider which country cultural values are in line with QM values. Certainly, sourcing decisions from China may have to be more incisive. The fact that a specific China factory has all the QM practices does not mean that it will deliver quality products. Therefore, because many sourcing decisions are made after visiting Chinese factories, visiting sourcing managers must carefully scrutinize the degree of cooperative and non-dominating behavior since Chinese culture has a high degree of assertiveness. For South Korea, there is an indication that the assertiveness may hinder team-building as in China. However, South Korea may have more

of a tendency toward systematic team-building than in China due its lower assertiveness. Yet, the country that possesses the most compatibility with quality management is Taiwan. It has a high degree of uncertainty avoidance that leads to more systematization. This systematization is complemented by a culture of better team building and less internal competition due to the low assertiveness. In whichever country a facility is, buyers sourcing from such a facility or managers operating at the facility would benefit from understanding how country culture is manifested within that facility when seeking to improve quality practices.

Managers should not be concerned with firm size nor a country's level of development since these factors are not related to product quality. The presence of QM, by contrast, is generally of benefit throughout the world. However, similar levels of investment in quality practices in different countries do not have similar results in quality performance. Following from Table 7, it may on average take two to three times as many QM resources in China to get the same results as in South Korea or Taiwan. Although this will vary among organizational cultures, managers must be aware of the overall country tendencies in order to know what cultural aspects to look for.

The results of this research will assist managers in predicting where QM practices will be more or less effective with a given level of effort. Although this study's results directly apply to China, Korea, and Taiwan, they suggest possible difficulties and advantages other Asian cultures may have with QM practices. For example, India's assertiveness GLOBE value scores are fairly high and its uncertainty avoidance scores are average (House et al., 2004). Ceteris paribus, these cultural characteristics suggest that QM will be less effective in India, requiring on average more efforts to achieve quality goals. By contrast, on average QM may be more effective in Thailand because of its fairly low assertiveness and high uncertainty avoidance. In short, this study has found important cultural dimensions that help indicate where QM will be effective.

Although cultural dimensions are very important for QM effectiveness, the determination of effort required for successful QM at a facility must include other country-level and facility-level factors. For example, language barriers can slow QM training (Knotts and Tomlin, 1994) and efforts to gain top management support must be present (Flynn et al., 1995). These issues are critical to fully understand a facility's potential for QM effectiveness and are important future topics to extend this study. Yet, this research suggests that managers should anticipate expending more resources on average to achieve quality goals in cultures conflicting with QM values. By using the results of this study, managers will be more prepared to address effective QM implementation and use in Asia.

This research has highlighted that alternatives to traditional QM may be needed to improve product quality in certain Asian cultures. If the high assertive values that underlie China's culture are impeding QM effectiveness, then additional management techniques are warranted that take advantage of an assertive culture. Other researchers have recognized a need for creating QM specific to China (Noronha, 2002); in particular, how work gets done and how workers interrelate. Perhaps channeling competitions between workgroups can be used to focus the competitive spirit, while being careful not to induce counterproductive behavior. Combining this with semi-frequent rotations among workgroups may be beneficial, and may avoid excessive in-group behavior that creates exclusivity and poor overall cohesiveness. More study and experimentation will be required to test innovative work practices. However, managers may prefer to use their country's cultural characteristics, rather than struggle with them, in order to improve product quality.

6. Conclusion

Globalization has forced managers to use manufacturing capabilities in countries with different cultures than their own. Recent quality problems in China have raised the concern among managers and researchers as to how to assure product quality from Asian facilities. Either by management choice or through supply contracts, QM practices are implemented but are not always effective at increasing product quality. QM practices assume certain cultural traits to exist in a workforce, that if lacking will impact effectiveness. Not all Confucian Asian cultures are congruent with QM values, and therefore it was expected that QM effectiveness will vary among these Asian countries. This study found that differences do exist, and that two GLOBE cultural value dimensions explain these differences.

First was the GLOBE dimension assertiveness, which had the highest statistical significance. High assertiveness was associated with lower QM effectiveness. This finding explains China's lower QM practice effectiveness; China has the highest assertiveness among the sampled countries, likely a remnant of its past command economy. Uncertainty avoidance was the second important GLOBE dimension, with high levels of this dimension leading to higher QM effectiveness. China, South Korea, and Taiwan have higher uncertainty avoidance than many other cultures. This explains why overall the Confucian Asian counties had higher QM effectiveness than expected. In sum, this study found these country culture values to moderate the effect QM has on quality performance. The results of this study will assist managers in devising plans to assure high quality from Confucian and other Asian facilities, and in predicting where future problems may occur in other countries around the world.

Appendix A

See Tables A.1–A.3.

Table A.1
Pattern matrix of quality related factors[a].

	Component	
	Product Quality Performance ($\alpha = 0.865$)	Quality Management Practices ($\alpha = 0.740$)
Performance compared to competitors—product features	0.892	−0.026
Performance compared to competitors—product performance	0.903	0.015
Performance compared to competitors—product quality	0.864	−0.005
Extent invested in Total Quality Management	0.172	0.668
Extent invested in ISO 9000	−0.044	0.766
Extent invested in Statistical Process Control	0.004	0.793
Extent invested in Six Sigma	−0.099	0.763

[a] Extraction method: principal component analysis. Rotation method: promax with Kaiser Normalization.

Table A.2
Sample statistics by country.

Country	Product quality performance				Quality management practices			
	Mean	S.D.	Skewness	Kurtosis	Mean	S.D.	Skewness	Kurtosis
Albania	16.7454	3.44415	−0.714	0.311	17.5077	5.16400	−0.436	−0.658
Australia	16.0800	2.72434	−0.271	−0.675	12.7858	4.93322	0.196	−0.955
Austria	16.4081	2.15489	−1.029	0.092	14.5041	4.40438	−0.512	0.816
China	16.0000	2.67929	−0.185	−0.522	18.4028	3.98740	−0.679	−0.135
Finland	15.4317	2.35923	0.035	−0.553	10.4656	3.70953	0.444	−0.285
Germany	15.2307	2.51906	−0.068	0.177	11.6329	4.76211	0.454	−0.626
Hungary	14.7133	2.35611	0.106	0.114	13.6783	4.30712	0.060	−0.536
Italy	15.4435	2.74797	0.065	−0.985	13.8951	4.51804	−0.100	−0.968
Korea	16.2306	2.72432	−0.396	−0.559	16.2054	4.98680	−0.255	−0.350
Macedonia	17.2278	3.36285	−0.443	−0.946	12.9947	4.70015	−0.143	−0.552
Mexico	16.6501	2.82595	−0.510	−0.025	11.8841	4.34651	0.185	−0.458
Nigeria	17.7188	2.87631	−1.174	0.635	13.2893	4.73062	0.160	−1.418
Poland	15.5614	2.95210	−0.355	0.225	10.8401	4.83246	0.285	−1.054
Sweden	15.5669	3.06789	−0.525	0.517	11.7463	4.15773	0.329	−0.418
Taiwan	16.3200	3.26040	−0.589	0.110	17.9724	3.42113	−0.171	−0.953
USA	15.8675	2.92709	−0.193	−0.787	12.0803	4.82637	0.048	−0.837
Total	16.3517	2.88208	−0.298	−0.486	13.7790	5.03632	−0.014	−0.827

Table A.3
Sample demographics.

Number of Plant Employees	Percentages			
	Overall	China	South Korea	Taiwan
<50	23.8	5.3	16.5	8.0
50–100	25.8	8.7	17.4	22.0
101–500	33.3	40.4	33.1	26.0
>500	17.1	45.6	33.0	44.0
Mean Percent Sales from Exports	35.8	58.6	33.9	57.8
Mean Percent Materials Imported	36.5	48.1	39.2	32.7
Industry				
Apparel and other finished products	0.7			
Chemical products industry	4.3		13.0	
Electronic equipment	18.7	59.6	16.5	76.0
Fabricated metal	14.9		2.6	
Food Products GMP	7.7		7.8	
Furniture and fixtures	2.2			
Industrial machines and computer equipment	13.8	40.4	11.3	24.0
Leather and other products	0.4			
Lumber and wood products	2.4		1.7	
Measuring, control, photographic, and medical equipment	1.3			
Miscellaneous manufacturing	7.7			
Motor vehicles, trailers and semi trailers	3.6		6.1	
Other manufactured transport equipment	1.3			
Paper and allied products	1.9		1.7	
Petroleum refining and related products	0.3			
Primary metal industries	3.7		12.2	
Printing and publishing industries	1.3			
Recycling	1.0			
Rubber and plastic products	4.4		4.3	
Stone, clay, glass and concrete products	3.9			
Textile mill products	4.4		3.5	
Not reported	0.1			

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