An Employee Survey Measuring Total Quality Management Practices and Culture

DEVELOPMENT AND VALIDATION

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This article presents a survey instrument designed to measure total quality management (TQM) and supporting organizational culture. In this study, 13 a priori dimensions of TQM and 10 a priori dimensions of organizational culture or climate were operationalized in a 113-item survey designed to measure the level of culture and TQM as experienced by individual members. The instrument was successfully administered to a diverse sample of organization members. A factor analysis of results from 886 respondents indicates that seven TQM and five culture dimensions, comprising only 56 of the original items, account for most of the scale variance. This produces a relatively compact instrument that allows researchers and practitioners to measure perceived culture and TQM implementation among all types of employees, work contexts, and TQM program levels. Revised index scores were found to be significantly related to stage of formal TQM program, thus supporting scale validity. Suggestions for using the instrument are presented.

This article reports findings from a research program to develop a relatively brief, individual-level survey measuring total quality management (TQM) implementation and related cultural dimensions for use in research and application. TQM has been widely implemented in U.S. business and nonbusiness organizations (Carr & Littman, 1990) and even more widely discussed in the business and popular press during the past 5 to 10 years (Zeitz, Mittal, & McAuley, 1995). Until recently, most published reports on TQM were practice-oriented management prescriptions or brief anecdotal case reports. Such reports are good at documenting dates and locations of TQM programs, and the best of them may identify process dynamics and barriers to implementation. However, they are not suited for benchmarking the ac-

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tual practices and informal culture of ordinary organization members. Several recent studies of TQM implementation have used surveys administered to key organization informants, principally managers, to measure the extent of TQM characteristics in the formal policies and programs of organizations (Grandzol, 1996; Lawler, Mohrman, & Ledford, 1995; Saraph, Benson, & Schroeder, 1989).

A common problem in TQM programs is that policies are formally instituted at the top management level but do not affect actual behavior and work group culture of supervisors and operatives. At least three methods are appropriate for measuring work practices and culture: surveys, intensive interviews, and participant observation (Martin, 1992, pp. 65, 106, 162; Ott, 1989, p. 102). Each of these methods has advantages and disadvantages, and their combination or "triangulation" (see Ott, 1989, p. 103) would, no doubt, yield the most valid measure (Glick, 1985, p. 607; Reichers & Schneider, 1990, p. 25). Intensive interviews and participant observation are relatively time-consuming and costly (Smith, 1975, p. 252), and they may be unreliable, compromising benchmarking comparisons with other organizations or with previous periods of the same organization. Standardized mail surveys may suffer from response bias, domain restriction, and lack of respondent awareness (Dutka & Frankel, 1993). However, they are cost-effective, reliable, and useful for between-group comparisons.

These features of surveys are especially crucial for practitioners. First, practitioners are usually not highly skilled at research and are more likely to correctly use standardized surveys than to conduct reliable and valid interviews or observations. Second, benchmarking generally requires quantitative estimates, which standardized surveys readily supply. Third, external agencies are often skeptical of expenditures on employee development (Levine, 1995), and quantitative survey results may seem more valid to outside agencies in justifying TQM programs. These factors suggest the need for a standardized survey measuring TQM implementation and cultural change at the work group level. The few existing survey studies of TQM are not well described in reports and contain no statistics on reliability or validity (see Conference Board, 1993; Hunt, 1992, p. 145).

The present article describes development and validation of a scale that measures TQM implementation and related cultural dimensions and was designed to be filled out by ordinary organization members. It presents and interprets statistics on factor dimensions, reliability, and validity from a large sample of respondents in a wide variety of organization types. Scale items and instructions that should allow both researchers and practitioners to administer and score this scale are included.

DIMENSIONS IN THE TQM LITERATURE

The first step in the research was to identify the conceptual dimensions of TQM based on previous theory and research. Authors have given such a variety of definitions and typologies for TQM that one might view it not as a specific construct but as a family of related ideas. Our approach will draw from Deming (1986) and derive seven broad classes of constructs (cf. Anderson, Rungtusanatham, & Schroeder, 1994).

TQM DIMENSIONS

One problem in reaching consensus on TQM dimensions is the broad range of properties included by various authors. Some authors focus on the technical and programmatic properties of TQM as a system of expanded or company-wide quality control (Crosby, 1979; Imai, 1986), for instance, using control charts to map process variation (Scholtes, 1988). Others view TQM broadly, as a general management philosophy (e.g., Deming, 1986). We define TQM as consisting of those features that (a) pertain to core elements of the formal TQM program, (b) are significantly under the control of top managers, and (c) are generally included in formal TQM literature on program design and implementation.

Considering both our theoretical conception of TQM as a management system and the lists provided by others, we arrived at 13 dimensions of TQM: quality philosophy, quality planning, management leadership, quality supervision, continuous improvement, use of data, quality procedures, equipment adequacy, supplier relationships, teamwork, quality training, employee suggestions, and customer orientation. Each of these dimensions has been mentioned by one or more writers in the TQM tradition, although none has mentioned all of them (see Table 1). Note that these authors should be consulted directly for an accurate conception of their typologies because they often mention dimensions not fitting into our own and they use a variety of different terms for what we consider to be the same concept.

Perhaps the best known treatment is by Deming (1986), who presents 14 prescriptive points that he says "are the basis for transformation of American industry" (p. 23). Crosby (1979), another major figure, also proposes 14 prescriptions as part of his program for quality. Imai's (1986) influential book, *Kaizen*, does not give a systematic list but mentions many of the same prescriptive points as Deming and Crosby do. Scholtes's (1988) influential *Team Handbook* lists specific principles of what he calls the "quality leadership" system.

TABLE 1

Total Quality Management Dimensions and Authors

Author	Quality Philosophy	Quality Planning	Management Leadership	Quality Supervision	Continuous Improvement	Use of Data	Quality Procedures	Equipment Adequacy	Supplier Relationships	Teamwork	Quality Training	Employee Suggestions	Customer Orientation
Anderson, Rungtusanatham, and Schroeder (1994)			X		X	X			X	X			X
Berry (1991)	X	X	X		X	X				X	X		X
Crosby (1979)	X	X	X	X	X	X				X			
Dean and Bowen (1994)		X	X		X	X	X		X	X	X		X
Deming (1986)	X	X	X	X	X	X	X		X	X	X	X	X
Grandzol (1996)			X		X		X			X	X		X
Hackman and Wageman (1995)	X	X	X		X	X	X	X	X	X	X		X
Hunt (1992)	X	X	X	X	X	X		X	X	X	X		
Imai (1986)					X	X		X	X	X		X	X
Juran and Gryna (1988)	X	X	X		X	X	X	X	X	X	X		X
Juran (1995)		X	X		X	X	X			X	X	X	X
Lawler, Mohrman, and Ledford (1995)		X				X	X		X	X			X
Saraph, Benson, and Schroeder (1989)	X		X			X	X	X	X		X		
Scholtes (1988)	X				X		X			X	X		X
Spencer (1994)	X		X				X				X		X

Juran and Gryna's (1988) authoritative compendium is an extremely detailed treatment of nearly every aspect of quality, including analysis, prescription, and lengthy accounts of quality practices both in the United States and worldwide. Their "quality trilogy" (planning, control, and improvement) and other sections in the book suggest 11 dimensions. Berry's (1991) approach is also primarily prescriptive and managerial, consisting of a detailed description of how to plan, organize, and staff an effective quality program in a large company. He summarizes these prescriptions in a list of 11 TQM values (pp. 117-118). The Malcolm Baldridge National Quality Award (1993) has its own 7-dimension scheme, conveniently classified into subdimensions for use by examiners in assessing a company's quality program.

Anderson et al. (1994) used the Delphi method to determine the basic concepts underlying Deming's (1986) 14 points. Experts mentioned 37 concepts and nominal definitions, which were further reduced to 7 overall concepts. Dean and Bowen (1994) outline three basic principles of total quality: customer focus, continuous improvement, and teamwork (p. 395) and refer to other dimensions of quality organizations, as noted in Table 1. Spencer (1994) also takes a theoretical and analytical approach to TQM, presenting seven major components (p. 447). Grandzol (1996), Hunt (1992), and Saraph et al. (1989) have classifications and survey measures that will be discussed below in the section on existing surveys.

ORGANIZATIONAL CULTURE

The boundary between TQM as a management program and TQM as an organizational culture is not well defined. Many of the TQM classifications reviewed contain individual dimensions or elements that could be interpreted as belonging to organizational culture or climate. Indeed, one might argue that the essence of TQM is culture change and that TQM practices are merely tools for cultural transformation (Flood, 1993). The answer to this puzzle depends on what is meant by organizational culture. In our view, culture consists of the beliefs, values, and underlying assumptions supporting behavioral patterns and artifacts (cf. Ott, 1989, p. 50; Schein, 1986, p. 6). Defining characteristics typically say what a thing is but also they say what a thing is not. We assume that culture is distinct from TQM programs and practices even though the two often overlap in practice. In our view, TQM practices are formal, programmatic, and behavioral, whereas culture refers to attitudes, firmly held beliefs, and situational (and often not formally sanctioned) interactions. One clear operational distinction between the two is that cultural dimensions can be readily recognized without a TQM program present.

Few researchers have developed distinct, general dimensions of organizational culture. Reichers and Schneider (1990) argue that this aversion to such general dimensions stems from the anthropological roots of culture studies, which prefer idiographic (emic) methodologies to nomothetic (etic) ones, a point on which Denison (1996) elaborates. Those in the idiographic tradition use detailed observation and analysis to capture the unique logic or gestalt of each organization's culture. They view nomothetic methods, employing ordinal dimensions universally applicable to all cultures, as likely to overlook or even distort important cultural features. We agree with Reichers and Schneider (1990) and with Denison (1996) that culture can be studied using such nomothetic procedures. Indeed, several authors suggest measurable dimensions of culture based on theory.[1] O'Reilly, Chatman, and Caldwell (1991) have developed a survey measure of culture, and reveal 7 dimensions derived from factor analysis: innovation, stability, respect for people, outcome orientation, attention to detail, team orientation, and aggressiveness. In addition, organizational climate bears a strong conceptual resemblance to culture (Denison, 1996; Reichers & Schneider, 1990) and has often been measured quantitatively. Among the best known of these measures are those by Payne and Mansfield (1973), who uncovered 19 dimensions through factor analysis; those by Litwin and Stringer (1968), which reveal 9 climate dimensions partly based on data; and those by Schneider and Bartlett (1968), which produce 6 climate dimensions based on factor analysis.

In the survey, our concern was to include only those culture dimensions that accompany and support TQM implementation (Berry, 1991, p. 22). Indeed, some have argued that culture is difficult or impossible to identify in a general sense and that only cultural dimensions relevant to some particular purpose can be identified (Denison, 1996, p. 628). Some authors identify the cultural dimensions that must exist prior to TQM implementation and that help facilitate acceptance and adoption (Hunt, 1992, p. 145). Zeitz (1996) reviews the literature on cultural factors that resist TQM implementation. And finally, some treatments view cultural change as a result of TQM programmatic efforts (Schmidt & Finnegan, 1992, p. 119). We identify 10 supportive, cultural dimensions.

Perhaps the most central prerequisite of successful TQM programs is good communication between top management and employees, mentioned explicitly by most of the authors reviewed. A second important dimension is employee involvement or empowerment. Some authors classify this as a core TQM feature, but according to our definition, it belongs as a part of supportive culture (for a similar view, see Lawler et al., 1995; Levine, 1995). A third cultural dimension, also closely identified with successful TQM implementation,

is trust, especially between management and employees. Indeed, Deming (1986) includes trust or "driving out fear" as a core feature of TQM. Our definition identifies it as a feature of supportive culture. Innovation refers to the climate that supports new ideas concerning work methods as well as products. Whereas Imai (1986) explicitly contrasts innovation and "continuous improvement," most authors imply that any climate orientation toward innovation is consistent with, and conceptually overlaps, continuous improvement, a feature of TQM. Social cohesion refers to the quality of relationships between employees: whether there is a sense of solidarity and cooperation or whether other employees are viewed as antagonistic competitors. Such a feeling is, of course, fostered through team participation and through group-based rewards. Closely related to cohesion is a climate that fosters effective conflict resolution. Effective conflict resolution begins with the organizationally supported value that conflict is normal and appropriate, that different sides have the right to be heard, and that the organization should provide forums for the hearing and resolution of conflict.

A proper culture for giving rewards is a key variable mediating the impact of a TQM program on employee commitment and satisfaction (Brooks & Zeitz, 1996). As a cultural dimension, we refer primarily to the climate of fairness in the giving of rewards, a concept akin to the notion of procedural justice. Do members believe that proper procedures are used in giving rewards, that measurement of contribution to performance is accurate, and that they are fairly paid? Organizational commitment, closely related both to trust and to reward equity, is the extent to which employees identify with organization interests. Indeed, although not mentioned by Deming (1986) as 1 of his 14 points, it seems to underlie his philosophy. Employees must be committed to improving the organization as a system of production, and this commitment must be internalized: It cannot be sustained adequately by quid pro quo financial rewards or by punitive actions.

The final two cultural features may also be viewed as features of job design: clarity of role expectations and job challenge. Clear role expectations result from well-designed jobs; good communication between employee and supervisors; and a constant, top management vision. Although role clarity is experienced by the employee as part of his or her own work role, we view such clarity as a product of the larger climate of communication and goal setting. Likewise, job challenge is central to successful TQM implementation. The characteristics of high-challenge jobs have been classically developed by Hackman and Oldham (1980) and include work variety and autonomy. Table 2 lists each of these 10 dimensions, along with authors who have referred to them. Also included are two well-known climate studies that are.

conceptually and empirically, closely related to the culture studies. TQM-related culture dimensions are usually quite consistent with those reported in the general culture/climate literature. Note that cultural properties, especially in the TQM literature, are often referred to by a variety of terms and are often scattered throughout the text without being organized into recognizable lists. Dimensions mentioned by these authors but not included in our typology are excluded from Table 2. Therefore, the original works cited should be consulted for a full appreciation of each author's conception. A more complete matrix of cultural, and TQM, dimensions, together with exact terms used and page references, is available from the authors.

METHODS

The questionnaire needed to be relatively brief, answerable by any member of the organization, applicable to all types of organizations, and appropriate for different stages of TQM development. Given the number of dimensions to be measured (13 TQM and 10 culture), coupled with minimum requirements for internal reliability, we limited ourselves to about five items per dimension. The usual format of standardized questions and Likert-type response formats also seems appropriate for a survey that can be widely administered and can deliver comparative data on a dimension-by-dimension basis.

EXISTING SURVEYS

We could not locate any survey instrument designed to measure a range of TQM behaviors among ordinary employees, which has been validated in empirical research, and for which statistics are published (though assuredly at least some must be under development). Three instruments were found that almost meet these criteria. Hunt (1992) presents a comprehensive instrument designed for diagnostic purposes in an applied context. Designed by a consulting firm for the federal government and available in the public domain (Hunt, 1992, p. 146), it uses agree-disagree, Likert-type responses to 215 statements regarding aspects of climate, TQM process, and TQM outcomes. The statements refer to aspects of the group context or whole organization rather than just individual behavior or attitudes. For instance, one item is worded "people in my work unit are friendly toward one another." The instrument is designed to be answered by respondents presumably at any level, in almost any type of organization, and with any intensity of TQM program.

TABLE 2

Culture Dimensions and Authors

Authors	Communication	Conflict Resolution	Empowerment	Innovation	Job Challenge	Commitment	Rewards	Clarity of Role Expectation	Social Cohesion	Trust
Total quality management related culture dimensions										
Berry (1991)	X		X				X			X
Carr and Littman (1990)	X		X	X		X	X		X	X
Crosby (1979)	X			X						X
Dean and Evans (1994)	X	X	X	X	X	X	X			X
Deming (1986)					X		X	X		X
Hunt (1992)	X		X	X		X			X	X
Juran (1995)	X		X				X			X
Lawler, Mohrman, and Ledford (1995)	X		X	X			X			
McMillan (1989)	X	X	X		X	X			X	X
Ross (1993)	X		X			X	X			
Schmidt and Finnegan (1992)	X		X		X		X		X	X
Scholtes (1988)	X	X	X			X			X	
General culture/climate dimensions										
Denison (1996)	X		X		X		X	X	X	
Hofstede (1984)		X	X							
Litwin and Stringer (1968)		X	X	X		X	X	X	X	
O'Reilley, Chatman, and Caldwell (1991)				X						X
Payne and Mansfield (1973)	X	X	X	X	X	X		X	X	
Weatherly and Beach (1994)	X		X	X		X	X			X

The items are grouped into 20 climate scores, 22 TQM process scores, and 11 outcomes scores, thus producing about 4 items per index score. Some TQM process dimensions from this scale are included in Table 1, however Hunt (1992) did not include statistics on factor analysis, reliability, or construct validity. Saraph et al. (1989) developed and tested a 78-item instrument to measure the extent to which fairly technical aspects of a quality system have been implemented in a plant or company. It was administered to 162 managers in 20 companies. A factor analysis produced eight different factors. Although statistics are included in their published report, the items are focused more on the collective level and are meant to be answered by a single, knowledgeable informant. More recently, Grandzol (1996) has developed and tested a scale, similarly meant for top managers, consisting of seven dimensions.

QUESTIONNAIRE CONSTRUCTION

Some items in our scale are drawn from the public domain scale mentioned in Hunt (1992)[2], and some were based on two other TQM surveys located by the authors. Most of the culture items were adapted from previous surveys used by the authors, a few were from Hackman and Oldham's (1980) JDI scale, and some were composed by the authors specifically for this study. This procedure produced a preliminary list of 120 items. The scale was administered to a university class of working, part-time business students, and alpha reliability scores were the basis for revision. This resulted in a 113-item instrument.[3] We used a 5-point response scale (see Appendix A, Note a) asking the respondent how often an activity occurred. We felt that such responses would focus the respondent's attention on specific behaviors and, thus, reduce the amount of halo effects.

SAMPLE

This revised survey was administered to a broad range of respondents, including 288 employees from a manufacturing firm; 123 members of a nonprofit service agency; and 475 employed, undergraduate and master's degree students (most of whom were employed full-time) in the evening business program of a large, urban university. The response rate was more than 95%. Students filled out the surveys during regular class sessions and employees in both organizations were asked to complete them in group meetings on company time. Only a few were returned not completed. The final sample consisted of 886 respondents and included a wide variety of types of

organizations, positions, education levels, and levels of TQM development (Appendix B).

RESULTS

We first analyzed the original 23 indexes arrived at from theory. They showed modest to good reliability with alphas generally greater than .70. Several indexes had lower reliability scores: quality planning ($\alpha = .691$), training ($\alpha = .576$), work commitment ($\alpha = .606$), rewards ($\alpha = .626$), role clarity ($\alpha = .609$), and quality procedures ($\alpha = .652$). Many of the indexes were moderately to strongly correlated with one another, suggesting some redundancy. Copies of the long form of the survey and a correlation matrix of original (theoretical) indexes are available from the authors.

On theoretical grounds, the items were first divided into TQM and culture items, and a separate exploratory factor analysis was performed on each. Oblique rotation was used because there is general agreement that these dimensions are normally associated with one another (i.e., not orthogonal). The number of factors was unconstrained. In this survey, 66 TQM items and 45 culture items (1 item from each set was dropped because of high missing data[4]) were analyzed separately with pairwise deletion of missing data and the standard 1.0 minimum eigenvalue (see Table 3).[5] Initial results revealed 11 TQM and 7 culture factors. Factors and items were eliminated if they failed the following test: (a) individual items must have a minimum factor loading of .40 (convergent validity), (b) items must display a .30 loading difference with any other valid factor (discriminant validity), (c) factors must have at least 3 items, and (d) indexes formed from factors must have Cronbach's alpha reliability scores of .65 or greater. Use of these criteria reduced the survey to 7 TQM factors with a total of 32 items out of 67 in the original 13 indexes, and 5 valid culture factors with a total of 24 items out of 46 in the original list.[6] We also used a procedure that combines both exploratory and confirmatory factor analysis. Results from this analysis give nearly identical results.[7]

From the SAS PROMAX solution, seven TQM factors meet our acceptance criteria. The first factor contains items from three of the original (a priori) dimensions: quality philosophy, management support, and quality planning. We term it management support. Each of the remaining TQM indexes closely corresponds to an original dimension and thus can be named with some confidence: employee suggestions, use of data, adequacy of supplies, quality supervision, continuous improvement, and customer orientation.

TABLE 3

Factor Items—Listed by Method

	Total Quality Management (TQM) and Culture Separately			*All Items Together*
Dimension	*SAS—Full Sample*	*SAS—Subsample A*	*SPSS—Full Sample*	*SAS—Full Sample*
Total quality management				
Management	1. **A1 A2 A3 A5 (A8)**[a] A9 A11 A12 (A13 A14)[a] **A19**	1. A1 A2 A3 A5 (A8)[a] A9 A11 A12 (A13 A14)[a] A19	1. A1 A2 A3 A5 A8 A19	1. A1 A2 A3 A5 (A8)[a] A9 A11 A12 (A13)[a] A19
Data	2. **B1 B3 B8 B17 B23**	2. B1 B3 B8 B17 B23	3. B1 B3 B8 B17 B23	3. B1 B3 B8 B17 B23
Supplies	3. **B6 B7 B13** B22	3. B6 B7 B13 B22	4. B2 B6 B7 B13	5. B6 B7 B13 B22
Suggestions	4. **I3 I4 I5 I6** E7	4. I3 I4 I5 I6 E7	2. I3 I4 I5 I6 E7	8. I3 I4 I5 I6
[Procedures]	5. [A6 B4 B14][b]	5. [A6 B4 B14][b]	5. [B4 B11 B14 B19][b]	9. [B4 B14]
Supervisor	6. **A15 A17** A21	6. A15 A17 A21	6. A15 A17 A20 A21	7. D5 A15 A17
Improvement	7. **B10 B18 B21**	7. B10 B18 B21	7. B10 B18 B21	9. B10 B18 B21 F1
Customers	8. **C2 C3 C4**	8. C2 C3 C4	10. C1 C2 C3 C4[c]	13. C2 C3 C4
[Teams]	9. [E2 E3][d]	9. [E2 E3][d]	9. [E2 E3][d]	12. E2 E3 E14
Culture				
Challenge	1. **D2 D9 D10 D11 D13**	1. D2 D9 D10 D11 D13	2. D2 D9 D10 D11 D12 D13	3. D2 D9 D10 D11 D13
Communication	2. E1 E9 E11 F3 F5 F11	2. E1 F3 F5 F11	1. E1 E9 E11 F3 F5	——[e]
Trust	3. E16 F14 F16 F17	3. E16 F14 F16 F17	8. [F6 F14][d]	11. E22 F6 F14
Innovation	4. D1 **D4** D7 D8 D14	4. D1 D3 D4 D7 D8 D14 D15	9. D3 D4 D7 D8	14. A16 D3
Cohesion	6. **E5 E15 E18**	6. E5 E15 E18	3. E5 E18 E19 F15[c]	6. E5 E18 E19

NOTE: Subsample A consists of one half the full sample, based on choosing every other case (first, third, fifth, etc.). Index item criteria: (i) .40 loading or greater, (ii) .30 or greater loading difference with any other valid factor ("procedures" considered invalid), (iii) 3 or more items, (iv) alpha reliability is .65 or greater. Items in bold type are valid in all three factor analysis methods. Factor numbers immediately precede sample list and are derived from initial solution.

a. Items omitted merely to shorten scale.

b. Not used as index because alpha reliability score is lower than .65.

c. The SPSS-derived scale was used in subsequent analysis because its reliability score is significantly higher for social cohesion (.75 vs. .67) and for customers (.69 vs. .61).

d. Scale omitted because there were only two items.

e. No communication factor emerged using this method.

Of the culture factors from the SAS PROMAX solution (TQM and culture run separately), five meet our acceptance criteria. The second factor contains items from four different original dimensions. It is termed communication based on the highest loading item. The remaining four factors correspond closely to four original indexes and thus can be readily named: job challenge, trust, innovation, and group cohesion. Of the original 11 culture indexes, 6 are dropped. Appendix A lists the revised index items along with alpha reliability scores, factor loadings, and the original (a priori) dimension of each item.

Most of the indexes are correlated in the .3 and .4 range, with some higher. In general, TQM indexes are about as strongly correlated with other TQM indexes as they are with culture indexes. For instance, management support (derived from the first TQM factor) and communication (derived from the second culture factor) have a high correlation of .65 (see Table 4). Admittedly, this high association does not support discriminant validity of the TQM/culture distinction in this sample. However, we interpret this as demonstrating a substantive point, namely, that a necessary condition of TQM programs, support from top management, is dependent on the general quality of communication within the organization's culture.

CONSTRUCT VALIDITY

Construct validity is the degree to which a measured construct relates to other variables according to established theory (DeVellis, 1991, p. 46). Theory suggests that culture should be related to TQM. Structural equation modeling is appropriate to represent this relationship. This procedure allows the researcher to posit several independent variables and several dependent variables in a single model.

For this model we use the five revised culture indexes and seven revised TQM indexes. All five culture variables are considered exogenous (independent) and all seven TQM variables are considered endogenous (dependent). We initially assumed that the seven TQM variables were indicators of a single TQM construct (latent variable) and that the five culture indexes were indicators of a single culture construct (latent variable). This represents the most parsimonious solution, but the model was found to have a poor fit with the data using conventional fit measures. We then attempted a number of progressively more complex models, that is, those employing two or more latent variables in either or both of the culture and TQM clusters of variables.

Figure 1 portrays the optimal solution. Quality content is found to be significantly related to communication and trust (standardized regression coefficients are .434 and .143 respectively), quality methods is related to social

TABLE 4

Correlations and Descriptive Statistics

	MGTX	*DATAX*	*SUPPX*	*SUGGX*	*SUPERX*	*IMPX*	*CUSTX*	*CHALX*	*COMMX*	*TRUSTX*	*INNX*	*COHX*	*TQM*
MGTX	1.00												
DATAX	.394**	1.00											
SUPPX	.493**	.228**	1.00										
SUGGX	.108**	.116**	.085*	1.00									
SUPERX	.517**	.259**	.320**	.239**	1.00								
IMPX	.529**	.383**	.351**	.077*	.347**	1.00							
CUSTX	.424**	.339**	.362**	.261**	.375**	.380**	1.00						
CHALX	.230**	.098**	.234**	.329**	.326**	.293**	.318**	1.00					
COMMX	.694**	.303**	.478**	.166**	.590**	.419**	.402**	.368**	1.00				
TRUSTX	.470**	.184**	.366**	.195**	.527**	.324**	.263**	.251**	.545**	1.00			
INNX	.595**	.254**	.434**	.277**	.546**	.482**	.418**	.438**	.666**	.543**	1.00		
COHX	.474**	.212**	.359**	.076*	.408**	.479**	.369**	.241**	.489**	.444**	.454**	1.00	
TQM	.191**	.131**	.229**	.163**	.166**	.107**	.236**	.147**	.187**	.055	.201**	.038	1.00
Cases	882	875	876	874	881	879	874	878	878	976	875	878	833
Mean	3.03	2.22	3.25	2.62	3.12	2.94	3.27	3.37	2.59	3.15	3.07	3.17	1.45
SD	.86	.97	.92	.87	1.06	.97	.92	1.03	.88	.91	.92	.85	.73

NOTE: MGTX = management support, DATAX = use of data, SUPPX = supplies, SUGGX = suggestions, SUPERX = supervision, IMPX = improvement, CUSTX = customers, CHALX = job challenge, COMMX = communication, TRUSTX = trust, INNX = innovation, COHX = social cohesion, TQM = total quality management.
*Significant = .05. **Significant = .01 (two-tailed).

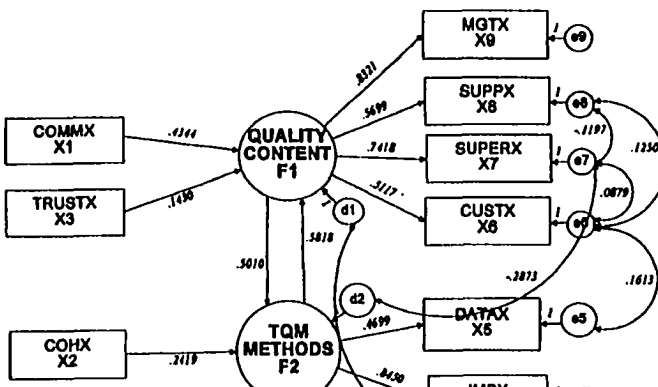

Figure 1: TQM Process Model
NOTE: Standardized parameter estimates are reported. All unstandardized estimates were statistically significant ($p < .05$).

cohesion (standardized regression coefficient is .242), and the two latent variables are moderately correlated with one another. This is represented in the model as reciprocal causal paths between the two. Thus, quality methods has a .582 path to quality content whereas quality content has a .501 coefficient leading to methods. Also included in the model are correlation coefficients between error terms, when necessary, as well as correlations between the three culture indexes. The model fits the sample data quite well.[8]

One TQM index (employee suggestions) and two culture indexes (innovation and job challenge) are not present in this model. Despite numerous iterations, no model could be found that incorporated direct causal paths between these indexes and any other index in the model. Thus, it is concluded that the influence of job challenge and innovation on employee suggestions constitutes a separate subprocess.[9]

PREDICTIVE VALIDITY

A second measure of validity is whether a construct predicts what theory says it should (DeVellis, 1991, p. 44). In the present study, theory says that

TABLE 5
Index Scores by Level of Total Quality Management (TQM) Program

Index	*None*	*Beginning*	*Middle/ Advanced*	*Eta*[a]	*Probability*[b]	*Deviation From Linearity*[c]
TQM						
Management support	2.93	3.11	3.40	.19	.000	*ns*
Employee suggestions	2.52	2.93	2.82	.19	.000	.003
Use of data	2.15	2.40	2.46	.14	.001	*ns*
Supplier relationships	3.09	3.42	3.65	.23	.000	*ns*
Supervision	3.01	3.28	3.48	.17	.000	*ns*
Improvement	2.90	2.95	3.22	.11	.004	*ns*
Customers	3.12	3.39	3.72	.24	.000	*ns*
Culture						
Communication	2.49	2.68	2.96	.18	.000	*ns*
Job challenge	3.28	3.49	3.70	.15	.000	*ns*
Social cohesion	3.15	3.17	3.25	.04	.523 (*ns*)	*ns*
Innovation	2.96	3.15	3.48	.20	.000	*ns*
Trust	3.13	3.15	3.28	.06	.253 (*ns*)	*ns*
Number[d]	579	134	120			

NOTE: *ns* means "not significant," that is, a probability greater than .05.
a. Eta is a measure of association between a continuous variable and a categorical (group) variable and can have a value of –1 to +1. It is similar to a Pearson correlation coefficient, indeed, nearly identical, when the interval variable is linear.
b. Probability that between-group differences are present by chance. Significance level = .05.
c. The probability that a nonlinear relationship occurred by chance.
d. Fifty three people did not respond to the question.

TQM and culture index scores should increase with more advanced, formal TQM programs. We were able to measure formal TQM programs by classifying each respondent's organization into one of three levels: none, beginning, and middle/advanced. Overall, 579 respondents were classified as having no TQM program, 134 had a beginning program, 120 had a middle or advanced program, and 53 did not respond to the question.

Table 5 lists TQM and culture index scores for each of the three levels of TQM program implementation. Each of the index scores is higher when there is a TQM program and most are still higher when the program is advanced. ANOVA showed that all but work procedures and group cohesion are significantly different by TQM program level. The overall strong association between TQM program and these dimensions lends support to the predictive validity of our instrument. Index scores do predict what TQM theory suggests they should.

PERCEPTUAL BIAS

One major problem with perceptual measures of supposedly objective phenomena is the existence of bias (Dutka & Frankel, 1993). Questionnaire items in our scale are designed to reduce perceptual bias by asking about overt behavioral characteristics of work group activities. Nonetheless, estimates of such behaviors are subject to biased interpretation by each respondent. It may be possible to model such bias by measuring individual traits that may affect perceptions. Four such traits were included in the survey: gender, number of years employed in the organization, education, and age. No convincing case has been made in the TQM or other organizational literature stating that such traits are functionally related to TQM practices or related cultural characteristics. Therefore, we interpret them as sources of bias.

Bias can be modeled by entering such traits in a regression model predicting TQM indexes. However, for control purposes, such a regression model also needs to include other individual traits that are functionally related to actual TQM behavior. Three such variables were measured in the survey: managerial status, manufacturing industry, and organizational size. As a control, we also include the measure of TQM program development discussed above. Thus, TQM program is entered in the first stage of a stepwise regression model followed by the three structural variables: manager status, industry type, and size. Finally, the four individual variables are entered in a third stage, the assumption being that any further increments to variance explained by these variables suggests perceptual bias.

As expected, a formal TQM program does have significant effects on all TQM indexes and on four of the five culture indexes (Table 6). Management status significantly affects five indexes, all positively, as previous literature suggests. Manufacturing industry significantly affects five indexes, but all in a negative direction, contrary to what is normally found. Organization size has a negative effect on two indexes, suggestions and social cohesion, both contrary to previous experience. Several individual variables explain additional variance, suggesting that some perceptual bias exists. Organization seniority is significantly related to six TQM dimensions, and in five of these the coefficient is negative. As expected, older employees perceive less TQM in their organizations. This is especially pronounced with management support, which most clearly refers to properties of the whole organization and should not be functionally related to seniority. Presumably, these perceptions stem from more experienced employees' cognitive maps of their organizations, which are more developed and deeply rooted (Reger, Gustafson, DeMarie, & Mullane, 1994).

TABLE 6

Predictors of Total Quality Management (TQM)/Culture Indexes: Program, Structural, and Individual

	Step 1: Program		*Step 2: Structural*				*Step 3: Individual Bias*				
	Beta		*Beta*				*Beta*				
Dependent Variable	*TQM*	R^2	*MGR*	*MFG*	*SIZE*	R^2	*FEM*	*SEN*	*EDUC*	*AGE*	R^2
TQM											
Management support	.33	(3.6%)	.01	**–.10**	–.07	(5.8%)	.00	**–.23**	**–.19**	**.20**	(13.0%)
Suppliers	**.21**	(5.2%)	.06	–.04	.04	(5.9%)	– .03	–.08	.00	.06	(6.4%)
Data use	**.20**	(1.7%)	.06	**–.12**	–.05	(3.3%)	.00	**–.09**	**–.17**	.04	(5.9%)
Suggestions	**.16**	(2.7%)	**.31**	**–.17**	**–.14**	(17.0%)	.01	**.08**	.03	–.06	(17.6%)
Improvement	**.20**	(1.1%)	.01	.01	–.02	(3.4%)	–.02	**–.08**	**–.10**	**.18**	(5.9%)
Customers	**.21**	(5.6%)	.06	**–.22**	–.04	(12.3%)	.00	**–.07**	.04	.02	(12.9%)
Supervisors	**.20**	(2.8%)	**.11**	**–.11**	–.07	(6.1%)	.04	**–.11**	.01	**.11**	(7.4%)
Culture											
Job challenge	.08	(2.2%)	**.24**	.02	.03	(10.5%)	**–.07**	**.08**	**.17**	**.10**	(14.2%)
Cohesion	**.11**	(0.1%)	.05	–.05	**–.10**	(1.3%)	–.01	–.06	–.01	.05	(1.5%)
Communication	**.24**	(3.5%)	**.13**	–.03	–.03	(5.3%)	–.03	**–.22**	–.02	**.18**	(9.5%)
Innovation	**.27**	(4.0%)	**.14**	–.01	–.08	(5.9%)	**.07**	–.05	–.04	**.13**	(7.8%)
Trust	**.17**	(0.3%)	.06	–.06	–.08	(1.5%)	.04	**–.08**	**–.09**	**.18**	(5.1%)

NOTE: Variable blocks are entered stepwise into multiple regression model, using the "Enter" option in SPSS. Listed in parentheses are the total variance explained of the preceding variables. Other figures are the standardized partial regression coefficient (beta) with all variables entered. Statistically significant coefficients (at .05 level) are shown in bold. MGR = supervisor or manager; MFG = manufacturing industry; SIZE = organization size; FEM = female; SEN = seniority in the organization; EDUC = formal educational level; AGE = respondent's age.

These results indicate potential problems in using the perceptions of only 1 respondent in estimating an organization's implementation of TQM, especially when the position of the person actually completing the survey may vary within a study. For instance, surveys of TQM properties may be addressed to the chief executive officer (CEO) of a company, but experience shows that this task is often delegated to subordinates. Because our research shows that perceived TQM dimensions vary by such individual characteristics as management level and seniority, it is possible that between-organization differences in scores may be affected more by the position and biases of the respondent than by organizational parameters. This casts doubt on the results of any survey of TQM dimensions derived from the perceptions of only 1 respondent per organization, which unfortunately happens to include nearly all TQM surveys to date (for an exception, see Zeitz, 1996). Use of an individual-level survey with multiple respondents can control for such bias in two ways: aggregating responses and measuring potential sources. Aggregating responses to form organizational scores controls for random sources of bias. Measuring potential sources of bias in the individual respondent survey means that such bias can be measured and controlled for, producing organization scores that are adjusted for systematic effects of individual variables (McGranahan, 1976).

SUMMARY

Based on existing theoretical and empirical studies, we proposed 13 TQM and 10 culture dimensions that we believed were mutually exclusive and exhaustive. We incorporated items from existing scales and created new scales to produce a 113-item instrument measuring these 23 dimensions. Data from a sample of 886 respondents in a variety of organizations indicated that almost all of these dimensions were reliable. However, many of the resulting indexes were moderately to highly correlated with one another. This, in itself, does not indicate a problem with the survey because theory suggests that the various dimensions of TQM and culture are likely to be correlated with one another, but a more parsimonious set of dimensions underlying this data, and fewer total items, could be derived using exploratory factor analysis. This procedure reduced the instrument to 56 items measuring 7 TQM and 5 culture dimensions. Indexes in this revised instrument are found to have good internal consistency reliability. In addition, they exhibit good construct validity because TQM measures are found to be related to culture measures, according to theory. The indexes also are found to have good predictive validity because index scores predict the existence of a formal TQM program.

Thus, the full instrument consists of 113 items and 23 dimensions. The reduced instrument contains 56 items and 12 dimensions. The 7 TQM dimensions in the reduced instrument (management support, suggestions, use of data, supplies, supervision, continuous improvement, and customer orientation) are quite consistent with the thrust of most TQM authors. It is instructive that the first and strongest factor here is perceived management support for TQM, a theme stressed by Deming (1986) and repeated by numerous authors. Five dimensions of culture remain in the reduced instrument: job challenge, communication, trust, innovation, and social cohesion. Again, these results are quite consistent with the TQM literature, which has long seen trusting social relationships and communication as key prerequisites for a successful TQM program. These dimensions have also been important themes in the climate literature and in the few studies that have attempted to dimensionalize culture.

DISCUSSION

TQM has now been well discussed and often adopted by numerous organizations in the United States. Although implementation is sometimes effective, commentators generally agree that many companies only pay lip-service to their TQM programs and that most others still have a long way to go in driving TQM principles throughout their operations. Authors have waxed eloquent about the reasons for such resistance to full implementations and many different lists of barriers to TQM have been presented. Masters (1996) reviews this literature and finds consensus on 15 different barriers. One barrier is lack of proper fit between people and structure, in which we include inconsistency between the culture of the workforce and the demands of a formal TQM program. A second barrier is poor measurement of the variables critical to success.

The instrument proposed here directly addresses each of these problems and indirectly speaks to many others. First and foremost, our survey allows practitioners to assess the readiness of the organization's culture to embrace a formal TQM program. For instance, initial administration of the culture survey may show that an organization is low in trust and social cohesion and, thus, not ready for full TQM intervention, which involves teams, quality circles, and extensive communication. (In this case, one should first attack the cohesion and trust issues directly.) Second, our survey provides baseline measures of the amount of TQM implementation that can be used to track progress and achieve continuous improvement. The statistics presented in

Table 6 provides bases for comparison. Third, the survey measures the distinct dimensions of both culture and TQM. This allows the practitioner to target only those features that require attention, thus saving on overall resources.

Almost all managers have now heard of TQM and many organizations have attempted to implement it. Studies continue to find (a) that when fully implemented, TQM brings good benefits to organizations in terms of quality, productivity, and employee development (Lawler et al., 1995), and (b) that TQM is often not well implemented. Given the considerable experience with TQM, there are now vast resources to help companies implement it properly. This includes numerous textbooks, several applied and theoretical journals, excellent sources of publications, and many qualified consultants. Rather than repeat what has been said quite well elsewhere, we refer the reader to these sources.[10] Our main point in this article is that this literature lacks a good diagnostic questionnaire that is convenient to administer and that includes norming data. This is what we have provided.

ADMINISTERING THE TQM/CULTURE SURVEY

The most important requirement in administering the survey is to not identify respondents by name or number when they fill out the survey. A close second is that the survey should not be directly used for rewards or punishments. Most practitioners may prefer the reduced form of the instrument because its brevity makes it easier to administer. Some practitioners may wish to use the full instrument for a finely grained assessment of a broad range of dimensions. For instance, one may wish to focus on quality supervision or teamwork, which are excluded from the reduced survey. In whatever form, the survey may be administered either by an outside consultant or by those in the organization itself. Outside consultants may produce more accurate results because employees may feel freer to express what they really think if they know their colleagues, or worse yet, their supervisors, are not going to see their survey responses even if they are anonymous. If outsiders do administer the survey, they should also conduct some observations and interviews to help pick up on things not contained in the survey. Such probing may lead to suggestions for improving the survey. If administered internally, it would be best to have it done by a special committee that included only lower rank supervisors and employees so there would be less fear of offending higher level managers. For instance, a quality improvement team may be given the job of assessing culture and TQM progress and making

recommendations based on results. In addition, it would be useful for such a team to conduct interviews and/or focus groups to supplement their findings.

ORGANIZATIONAL DEVELOPMENT

The organizational development (OD) literature has long given survey feedback a key role in changing organizations (French & Bell, 1978). Our measures can be used with French's (1969) action research model, which includes measurement of the target organization at the first time, feedback of results to employees for development purposes at the second time, intervention leading to new training and structural change at the third time, and so on in a continuous cycle. There are also parallels to Sashkin and Burke's (1987) change methodology, which includes both "techno-structural" and "human-processual" change. One intriguing possibility is transorganizational development, in which organizations explore loosely coupled, interfirm alliances (Mohrman & Lawler, 1985). Criterion for fit between alliance partners may be consistency between cultural style and level of quality program development. Our instrument might be administered to prospective partner firms to determine this compatibility (Cummings, 1989).

For example, Acme Manufacturing (a pseudonym) is a small manufacturing subsidiary of a larger corporation. Several years ago, it attempted to implement a TQM program at the urging of the parent corporation. Most employees received some training, and a few work innovations consistent with TQM were implemented. But 2 years later, the consensus was that the program had not gone very far and had not led to any recognizable improvement in quality or productivity. At this point, the authors were called in as consultants. Both the TQM and culture portions of the longer form of the survey were administered to all employees and managers, including those in shop floor, white collar, and field sales positions. Results confirmed that TQM had been little implemented in the daily practices of work groups and that the culture was not yet supportive of a genuine TQM program. In particular, trust and communication were low. Additional interviews indicated that members viewed top management as unable to communicate effectively with subordinates and unwilling to allow significant empowerment. Interviews and observation indicated that the general manager was particularly unaware that his or her style was viewed as the problem; in the general manager's opinion, it was resistance by employees. Presented with survey data of results by level and unit, top managers agreed to conduct an organizational development program. This included a specialized trainer who conducted sessions with the top three levels of managers and extensive TQM training for all employees,

including managers. A follow-up survey can be conducted to determine how well this is working. The point is, regular, well-documented, accurate feedback can itself be a powerful force in changing an organization. This is why Deming (1986) and others in the TQM movement so strongly emphasize the gathering, analysis, and use of information. The survey presented here is an important tool in that assessment.

APPENDIX A
Index Items by Dimensions[a]

Total Quality Management Factors—Listed by Variance Explained[b]	*Original Dimension*	*Factor Loading*
Management support (MGTX) ($\alpha = .881$)[c]		
A3. There is a strong commitment to quality at all levels of this organization.	Philosophy	.81
A5. Members of this organization show concern for the need for quality.	Philosophy	.81
A19. Continuous quality improvement is an important goal of this organization.	Philosophy	.70
A12. Top managers in this organization follow up on suggestions for improvement.	Management	.64
A9. Our top management tries to make this organization a good place to work.	Management	.63
A11. Top managers in my department set clear goals for quality improvement.	Management	.62
A2. Managers here try to plan ahead for changes that might affect our performance.	Planning	.60
A1. People in this organization are aware of its overall mission.	Planning	.59
Suggestions (SUGGX) ($\alpha = .797$)		
I5. In the past 2 years, how often have you made suggestions to your supervisor or other managers about improving conditions for employees (such as safety, treatment of employees, lunch room conditions, rest rooms, etc.)?	Suggestions	.78
I6. In the past 2 years, how often have your suggestions about employee conditions actually been put into practice in this organization?	Suggestions	.77
I4. In the past 2 years, how often have your suggestions about better work methods actually been put into practice in this organization?	Suggestions	.62

I3. In the past 2 years, how often have you made suggestions to your supervisor or other managers about ways of doing the job better or more efficiently?	Suggestions	.59
E7. I make suggestions to management for ways of improving how we do our work.	Suggestions	.44
Use of data (DATAX) (α = .786)		
B17. In my work unit, we use statistical charts to check on the quality of our work or services.	Data	.75
B23. My work unit collects data on the quality of our work/services.	Data	.74
B8. My work unit keeps data to track work improvements.	Data	.71
B3. My work unit collects data on the amount of time it takes to get the job done.	Data	.53
B1. I keep records or charts measuring the quality of my work displayed at my desk or work station.	Data	.49
Supplies (SUPPX) (α = .794)		
B7. The parts/supplies/materials that I receive from those outside this organization meet my work needs.	Suppliers	.84
B6. The parts/supplies/materials that I receive from other units within this organization meet my work needs.	Suppliers	.83
B13. The materials and supplies we need in my work unit are delivered on time and as ordered.	Suppliers	.48
B22. I have the supplies/tools/equipment I need to do my work well.	Suppliers	.48
Supervision (SUPERX) (α = .749)[d]		
A15. My supervisor gives credit to people when they do a good job.	Supervision	.74
A17. My supervisor rewards being cooperative and a good team player.	Supervision	.71
A21. My supervisor fails to give me feedback on work I have done. (R)[e]	Supervision	.50
Improvement (IMPX) (α = .786)		
B18. People in my work unit try to improve the quality of their product.	Improvement	.78
B10. Employees in my work unit believe that quality improvement is their responsibility.	Improvement	.68

(Continued)

APPENDIX A Continued

Total Quality Management Factors—Listed by Variance Explained[a]	*Original Dimension*	*Factor Loading*
B21. People in my work unit analyze their work products to look for ways of doing a better job.	Improvement	.64
Customers (CUSTX) ($\alpha = .688$)		
C4. People in my work unit know who their customers are.	Customers	.67
C3. I think of my customers when doing my work.	Customers	.63
C2. How often do members of your work group attempt to measure your external customers' needs (your customers outside this organization)?	Customers	.51
C1. How often do members of your work group attempt to measure your internal customers' needs (your customers inside this organization)?	Customers	.51
Culture Factors—Listed by Variance Explained		
Job challenge (CHALX) ($\alpha = .859$)		
D13. The job requires me to use a number of complex or high-level skills.	Challenge	.85
D11. I have new and interesting things to do in my work.	Challenge	.80
D9. My work challenges me.	Challenge	.75
D10. The job is quite simple and repetitive. (R)	Challenge	.70
D2. The job requires me to do many different things at work, using a variety of skills and talents.	Challenge	.68
Communication (COMMX) ($\alpha = .822$)		
E1. Management here does a good job of communicating with employees.	Communication	.67
F3. This organization gives praise and recognition for outstanding performance.	Rewards	.65
F5. All in all, you can have trust and confidence in higher management in this organization.	Trust	.63
F11. People who perform well receive financial rewards such as higher pay, bonuses, or awards.	Rewards	.51
E9. There is poor communication between departments in this organization. (R)	Communication	.44
E11. Around here, conflicts are resolved to the satisfaction of those concerned.	Conflict	.43

Trust (TRUSTX) (α = .710)		
F16. I know exactly what is expected of me.	Clarity	.68
F17. My supervisor shows complete trust in employees' ability to perform their job well.	Trust	.56
E16. I feel free to discuss problems or negative feelings with my supervisor.	Trust	.53
F14. Within reason, people in this organization can say what they want without fear of punishment.	Trust	.44
Innovation (INNX) (α = .840)		
D8. We are encouraged to make suggestions for improvements in our work.	Empowerment	.75
D14. People in my work unit are encouraged to try new and better ways of doing the job.	Innovation	.66
D1. Creativity is actively encouraged in this organization.	Innovation	.54
D7. Innovators (those who come up with new ways of doing things) are the people who get rewarded in this organization.	Innovation	.54
D4. Trying new ways of solving problems is discouraged here. (R)	Innovation	.45
[D3. People around here stay to the old, established ways of doing the work. (R)	Innovation	.45[f]]
[D15. In my unit, the supervisor makes important decisions without consulting with employees.	Empowerment	.34[f]]
Social cohesion (COHX)[g] (α = .755)		
E18. People in my work unit enjoy their coworkers.	Social	.64[h]
E5. Coworkers in my work unit are like a family.	Social	.60
E19. Problems exist here between coworkers. (R)	Social	.22
F15. I trust my coworkers to do what is in the best interests of the organization.	Trust	.30

a. Based on SAS (oblique) factor analysis, with separate headings for TQM factors and culture factors.

b. Response categories for all items (excluding the first 4 items in the suggestions factor) are: 1 (*almost never*), 2 (*sometimes*), 3 (*often*), 4 (*very often*), and 5 (*almost always*). Response categories for the first 4 items in the suggestions factor (I3 to I6) are: 1 (*never*), 2 (*once or twice*), 3 (*several times a year*), 4 (*once a month or so*), 5 (*once or twice a week*), and 6 (*daily*). I3 has an additional category: 7 (*hourly*).

c. Headings are listed by exact wording of items, factor number/name, and reliability score.

d. Excluding A21, SUPERX has a reliability of .817.

e. Items indicated by (R) are reverse scored.

f. These items are present only in the SAS factor analysis performed on Subsample A. They are not included in the reduced instrument.

g. The cohesion factor from the SPSS solution was used here because it produces a much higher index reliability: .75 versus .67 in the SAS solution.

h. In SPSS, the cohesion factor loadings are: E18 (.799), E5 (.751), E19 (.497), and F15 (.576).

APPENDIX B

Sample Characteristics	*Number of People Surveyed*	*Percentage of Sample*[a]
Type of employer		
Educational	28	3.2%
Nonprofit	147	16.8%
Government	38	4.3%
Service	207	23.7%
Manufacturing	410	46.9%
Other	44	5.0%
No response	12	
		100%
Level of management		
Nonsupervisor	527	60.9%
First-level supervisor	201	23.2%
Middle manager	116	13.4%
Top manager	21	2.4%
No response	21	
		100%
Age		
29 years and less	13	36.5%
30 to 39 years	287	33.4%
40 to 49 years	176	20.5%
50 to 59 years	61	7.1%
60 years or more	21	2.4%
No response	28	
		100%
Gender		
Male	476	56.0%
Female	374	44.0%
No response	36	
		100%
Education		
Less than high school	36	4.2%
High school diploma	138	16.0%
1 to 3 years of college	171	19.9%
College degree	405	47.1%
Graduate degree	110	12.8%
No response	25	
		100%

a. Total percentages based on those responding to the question, that is, excluding nonresponses.

NOTES

1. Deal and Kennedy (1982) suggest 2 dimensions of culture based on theory: degree of risk and speed of external feedback. Kilmann and Saxton (1983) propose 4 dimensions: task support, task innovation, personal freedom, and social relationships. Hofstede (1984) outlines 4 dimensions: power distance, uncertainty avoidance, individualism, and masculinity, and Hofstede and Bond (1988) suggest adding a 5th dimension: Confucian dynamism. Reynolds (1986) offers 14 dimensions of culture whereas Weatherly and Beach (1994) propose 15 dimensions grouped into three categories: treatment of employees, professionalism and results, and process and environment. Denison (1996) reports the University of Michigan's Organizational Survey contains 21 dimensions organized into four overall constructs: organizational climate, job design, supervisory leadership, and peer leadership, all of which are seen as representing organizational culture.

2. The following items are adopted verbatim or with modifications from Hunt (1992): A1, A2, A4, A8, A10, A12, A18, A20, B9, B24, C4, C5, D1, D7, E8, F7, and F18. The following items are taken from a questionnaire used by the Bureau of Export Administration: A13, B8, B19, B23, C3, E2, E3, and F10. The following items are taken from Hackman and Oldham's (1980) JDI scale: D13 and D10.

3. For a complete list of survey items, a priori dimensions and reliabilities, and item loadings, please contact the authors.

4. One excluded item asked about the supply of information but had only 352 valid cases because it had been added to the survey after several initial waves had been collected. Another item, concerning departmental management communication (but otherwise similar to E1), had been added late to the survey and had a valid number of only 213 cases. All of the remaining items were used in the factor analysis, although one item had only 591 valid cases due to an error on the survey in one of the waves, another item on amount of training in SPC had only 745 valid cases, and an item measuring responsiveness to internal customers had 754 valid cases. Of the remaining items, all had a valid number of 861 cases or more.

5. Description of these procedures are contained in SPSS and SAS manuals.

6. We also ran factor analyses separately for student and nonstudent subsamples, and again for manufacturing and nonmanufacturing. There was little difference between these subsamples in the number and types of factors, although there were some changes in specific items. The most notable difference was that the customer items did not form a separate factor in the manufacturing subsample, which is not surprising since most employees of the manufacturing firm in this subsample did not have direct contacts with external customers and were not yet familiar with the concept of internal customer.

7. We ran an exploratory factor analysis on one randomly selected subsample and a confirmatory factor analysis on the remaining cases. The exploratory factor analysis solution from Subsample A is almost identical to that produced by the exploratory SAS factor analysis on the full sample. A confirmatory factor analysis was then run on Subsample B using the maximum likelihood method in CALIS. Fit measures for both the total quality management (TQM) and culture models were good, with both GFIs above .87 and both chi-square/degree of freedom ratios below 2.0.

8. We used the structural equation modeling program in SAS, called subprogram CALIS. Preliminary analysis of our data showed it to have some collinearity among exogenous variables, and skewness and kurtosis in some index scores. Under these conditions, and following the advice of Bollen (1989), we fit the model from a covariance (rather than correlation) matrix using a weighted least squares (WLS) estimator. Both positive (leptocurtic) kurtosis and excessive skewness are known to inflate the chi-square statistic, as are collinearity and large sample size (Bollen, 1989). Accordingly, we were not overly concerned when the chi-square of 66.57

($df = 16$) showed only a marginally acceptable model fit. Instead, we present a variety of other accepted fit indexes that all show good to excellent model fit: root mean square residual = .025; root mean square estimate of approximation (RMSEA) = .061 (90% confidence interval = .046, .076); an RMSEA less than .08, indicating a reasonable fit (Arbuckle, 1995); goodness of fit index = .982; and adjusted goodness of fit index = .949 (for both measures, values greater than .9 indicate acceptable fit) (Bollen, 1989).

9. The innovation index (INNX) was regressed against its two culture determinants: employee suggestions (SUGGX) and job challenge (CHALX). This regression model explained 21.2% of the variance in INNX with a .389 standardized beta coefficient from CHALX and a .149 beta coefficient from SUGGX. This is certain because both innovation and job challenge have strong associations with other culture variables, as the correlation matrix in Table 5 indicates.

10. The following are some sample sources. Textbooks: Berry (1991), Carr and Littman (1990), Dean and Evans (1994), and Scholtes (1988). Journals: *Quality Progress*, and the *Quality Management Journal*. Publications: Literature available through the American Society for Quality Control in Milwaukee, Wisconsin and GOAL/QPC in Boston, Massachusetts. Nearly all major consultants now include TQM implementation.

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