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A replication study of a theory of quality management underlying the Deming management method: insights from an Italian context

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Abstract

We present research that contributes to the debate on the universal applicability of quality management, and in doing so, subject the 'one size fits all' assumption underlying quality management to an empirical examination. Specifically, with the exception of enhancements in instrumentation, we attempted to replicate, as closely as possible, Anderson et al.'s (1995) empirical evaluation of a Deming-based theory of quality management. In our replication, we applied path analysis to secondary, plant-level data provided by a stratified sample of plants in three different industries in Italy. The path analytical results from the current replication study were compared against those reported in Anderson et al. (1995), which used data from U.S.-based plants. These results were then discussed in the context of conducting and interpreting cross-cultural quality management research. We concluded with the need for more replication studies in the quality management discipline and with implications for research and practice.

Keywords: Replication; Quality management; Deming management method; Universality; National culture

1. Introduction

Despite the paucity of scientific evidence attesting to the effectiveness of W. Edwards Deming's quality management approach (see Deming, 1986, 1993), it has received considerable attention from manufacturing and service organizations around the world (see Hodgson, 1987). In part, this is because Deming has often been credited with contributing to Japan's economic revitalization after World War II (Deming, 1986; Walton, 1986; Yoshida, 1989). Deming's quality management approach, also known as the Deming Management Method (see Walton, 1986), continues to be the subject of global discussion (e.g., the Deming Electronic Network). [1]

On one hand, the global interest in adopting the Deming Management Method implies that the under-

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[1] The Deming Electronic Network, found at http://deming.eng.clemson.edu:80/pub/den/, was formed by the spontaneous convergence of various groups, nationally (e.g., Wisconsin, California, Georgia, etc.) and internationally (e.g., Great Britain, France, Russia, etc.), and dedicated to the study and diffusion of Deming's quality management approach and his system of 'profound knowledge' (see Deming, 1990).

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lying concepts, principles, and techniques of the Deming Management Method are universal and readily transferable across organizations, industries, and countries. Support for those adhering to this 'universal perspective' can be inferred from (1) broad statements that encourage firms to adopt quality management (e.g., General Accounting Office, 1991), (2) claims that quality management is not bound by national culture (e.g., Choi and Liker, 1995), (3) research describing the successful adoption of quality management globally, including Russia (Birch and Pooley, 1995), Israel (Mitki and Shani, 1995), and Singapore (Sohal et al., 1989), or encouraging the adoption of quality management in other regions of the world (Lee et al., 1992), and (4) conclusions of research comparing U.S. companies against companies in other countries (e.g., Japan) that generally urge U.S. companies to adopt quality management in order to enhance their competitive ability (e.g. Yavas, 1995). Additionally, the institutionalization of regional (e.g., Minnesota Quality Award), national (e.g., Australian National Quality Award), and international quality awards (e.g., European Foundation Quality Management Award), and the increasingly global emphasis on ISO 9000 certification (see Uzumeri, 1997) are highly visible events fueling the perspective that quality management is universally applicable and beneficial.

Yet, there are also scholars who question the universal applicability of quality management (e.g., Garvin, 1986; Goonatilake, 1988; Yoshida, 1989; Amundson et al., 1997; Mersha, 1997). Goonatilake (1988) and Mersha (1997) have argued, for example, that developing countries possess a host of sociopolitical and socioeconomic factors that inhibit the transferability of quality management concepts, principles, and techniques to these countries. With respect to the Deming Management Method, Yoshida (1989) argued that certain cultural constraints hinder the widespread applicability of the Deming Management Method in the U.S. and other Western civilizations. Garvin (1986, p. 669) also had the following caution: ''...attempts by U.S. firms to mimic Japanese quality practices without first adapting them to local conditions are unlikely to be completely successful, even though practices in both countries were originally derived from the same sources.''

In this paper, we present research that contributes to the debate on the universal applicability of quality management, and in doing so, subject the 'one size fits all' assumption (see Newman and Nollen, 1996; p. 753) of quality management to an empirical examination. We intend our research to be a stimulus into more theoretical and empirical investigations of when and where quality management might be applicable, as well as how quality management might need to be adapted in its application. Specifically, we present the replication results of an empirical evaluation of a Deming-based theory of quality management. This theory was recently articulated by Anderson et al. (1994b) and subsequently subjected to an empirical examination in the work of Anderson et al. (1995). Except for enhancements in instrumentation, we attempted to replicate, as closely as possible, the Anderson et al. (1995) study. In our replication, we apply path analysis to secondary, plant-level, data provided by a stratified sample of plants in three different industries in Italy. The path analytical results from the current replication study are then compared against those reported in the study of Anderson et al. (1995) and discussed in the context of conducting and interpreting cross-cultural quality management research. We conclude with the need for more replication studies in the quality management discipline and with implications for research and practice.

2. A Deming-based theory of quality management

Anderson et al. (1994b) recently articulated an integrative theory of quality management to describe and explain the process and effectiveness of adopting the Deming Management Method (henceforth referred to as the ARS theory of quality management). In their theory development, Anderson et al. (1994b) identified and defined seven constructs as forming the theoretical blocks for describing, explaining, and predicting the organizational performance impact of quality management adoption. These seven constructs—Visionary Leadership, Internal and External Cooperation, Learning, Process Management, Continuous Improvement, Employee Fulfillment, and Customer Satisfaction—were derived from a conceptual synthesis of literature on the Deming Manage-

ment Method and from the input of a panel of subject-matter-experts identified from both academia and industry. Table 1 reproduces the nominal definitions for the seven constructs.

In theorizing the organizational performance impact of quality management adoption, Anderson et al. (1994b, pp. 479–480) postulated that the effectiveness of adopting Deming's quality management approach:

> ... arises from leadership efforts toward the simultaneous creation of a cooperative and learning organization to facilitate the implementation of process-management practices, which, when implemented, support customer satisfaction and organizational survival through sustained employee fulfillment and continuous improvement of processes, products, and services ...

Captured in this succinct statement are four propositions specifying the 'causal' relationships among the seven constructs that had been identified:

Proposition 1: Visionary leadership enables the simultaneous creation of a cooperative and learning organization.

Proposition 2: An organization that simultaneously fosters cooperation and learning facilitates the implementation of process management practices.

Proposition 3: Process management practices simultaneously result in continuous improvement of quality and employee fulfillment.

Proposition 4: An organization's simultaneous efforts continuously to improve its quality and to fulfill its employees lead to higher customer satisfaction.

Proposition 1 stresses the critical role that leadership plays in ensuring the success of quality management adoption. Proposition 2 emphasizes the importance of both cooperation and continual learning in helping an organization to implement process management practices that include both human resource management practices (e.g., teams) and methodological approaches (e.g., statistical process control). Proposition 3 describes the two immediate outcomes of continuous quality improvement and employee fulfillment that an organization derives from effective implementation methodological and human re-

Table 1
Theoretical constructs and nominal definitions (From Anderson et al., 1994b; p. 480)

Visionary Leadership
The ability of management to establish, practice, and lead a long-term vision for the organization, driven by changing customer requirements, as opposed to an internal management control role
Internal and External Cooperation
The propensity of the organization to engage in non-competitive activities internally among employees and externally with respect to suppliers
Learning
The organizational capability to recognize and nurture the development of its skills, abilities, and knowledge bases
Process Management
The set of methodological and behavioral practices emphasizing the management of process, or means of actions, rather than results
Continuous Improvement
The propensity of the organization to pursue incremental and innovative improvements of its processes, products, and services
Employee Fulfillment
The degree to which employees of an organization feel that the organization continually satisfies their needs
Customer Satisfaction
The degree to which an organization's customers continually perceive that their needs are being met by the organization's products and services

sources management practices underlying Process Management. Proposition 4 theorizes that continuously improving quality and fulfilling employees represent requisite conditions that, in turn, contribute to an organization's ability to satisfy its present customers and, at the same time, to identify opportunities for satisfying future customers. Together, these four propositions depict the path diagram in Fig. 1.

In a subsequent paper, Anderson et al. (1995) reported the results for an empirical examination of the four propositions comprising their theory of quality management. These empirical results were based on a secondary data source provided by U.S. plants in Round 1 of the World-Class Manufacturing (WCM) research project. Data for the WCM research project were collected from multiple informants (eight different managers, three supervisors, and 10 workers) in 41 plants via pen-and-paper questionnaires. Different informants received questionnaires with different content measurement items. For instance, the human resources manager received a questionnaire asking about the plant's approach to issues of training, compensation, selection, etc., whereas, the process engineer responded to questions about process design and control. The majority of these measurement items were structured as perceptual questions with forced-choice response formats, but several measurement items, asking for factual, quantifiable data (e.g., scrap rate), were also included in the relevant questionnaires.

To empirically examine the ARS theory of quality management, Anderson et al. (1995) performed four sequential tasks. First, they selected perceptual measurement items from Round 1 of the WCM research project in order to create multi-item measurement scales for each of the seven constructs. The internal consistency reliability and dimensionality of these measurement scales were respectively assessed by computing and evaluating Cronbach's α coefficient (see Cronbach, 1951) and by interpreting the results of exploratory factor analysis with no rotation, with these results indicating acceptable reliability and uni-dimensionality. Second, Anderson et al. (1995) constructed plant-by-plant, composite scores for each of the seven constructs. These aggregate scores were computed by firstly averaging the responses of different within-plant informants to the same measurement item. Then the measurement items within the same measurement scale were averaged by plant. Each construct, therefore, had a vector of 41 composite scores, one for each plant. Third, Anderson et al. (1995) conducted an analysis of industry effects on the mean and variance levels of the empirical measures for the seven constructs. Industry effects were found to be significant in explaining differences across the three industries and were subsequently controlled for by standardizing the data by industry. Fourth, path analysis was applied to the standardized-by-industry data to compute eight path coefficients, two for each of the four propositions. Direct, indirect, and unexplained effects were then decomposed from the observed correlation among the empirical measures for the seven constructs and the path analytical results. In summary, the path

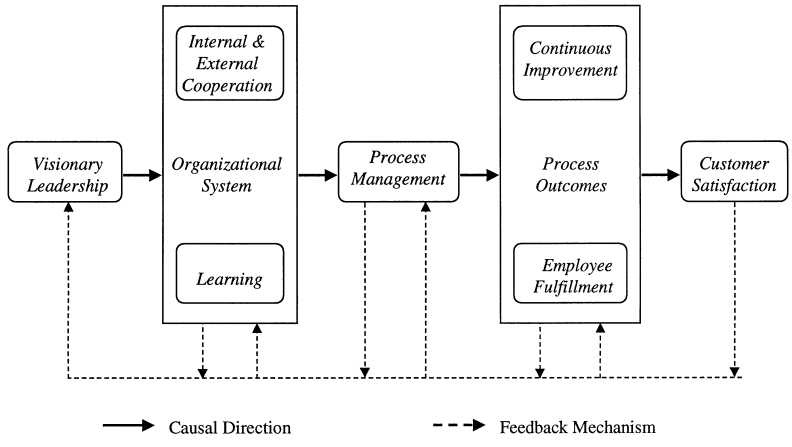

Fig. 1. The theory of quality management underlying the Deming Management Method (from Anderson et al., 1994b; p. 481).

analytical results supported Propositions 1 and 3, but provided only partial support for Propositions 2 and 4.

3. The present replication study

Since our intent is to conduct a constructive replication of the Anderson et al. (1995) study, we attempted to maximize the similarities between this replication and the earlier study. Two differences, however, deserve further clarification, these being the source of data for this replication and the operationalization of the seven constructs.

3.1. Round 2 of the WCM research project: Italian plants

Whereas data for the Anderson et al. (1995) study were provided by Round 1 of the WCM research project, data for this replication came from Italian plants that were studied in Round 2 of the WCM research project. The WCM research project was a multi-year project to develop a better understanding of what world-class manufacturing practices included and how these practices would affect organizational performance. 'World-Class Manufacturing,' for the project, was defined based on the writings of Hayes and Wheelwright (1985) and Schonberger (1986). Round 1 data were collected from U.S. plants during 1989 and 1990. A recent description of Round 1 of the WCM project can be found in the work of Flynn et al. (1997). Round 2 of the WCM project extended data collection to plants in other countries, including Italy, Japan, Germany, and the United Kingdom. The Italian plant data were collected during 1992. When the current replication study began in 1995, only the data from the Italian plants had been completed, cleaned, and made available to the researchers.

For Round 2, the various questionnaires that were employed in Round 1 were modified and improved. Table 2 provides a breakdown of the total number of questionnaires employed in Round 2, the total number of different employees that answered these questionnaires, and the total number of informants from each plant.

A panel of five Italian academic experts on manufacturing management then engaged in an iterative process to translate these modified questionnaires from English into Italian. All translation disagreements were resolved via a group process involving all five experts. A professional translator, whose native language was English, then back translated the Italian versions into English in order to verify the equivalence of the Italian versions to the English versions. As a final check, the Italian questionnaires were reviewed and pre-tested with a small group of

Table 2
Questionnaires and informants in the Italian WCM sample

Type of informant	Questionnaire code	Target # of informants
Plant research coordinator	PR	1
Plant manager	PM	1
Plant superintendent	PS	1
Quality manager	QM	1
Process engineer	PE	1
Inventory and purchasing manager	IC	1
Production control manager	PC	1
Information system manager	IS	1
Human resource manager	HR	1
Plant accountant	AC	1
Supervisor (A)	SA	2
Supervisor (B)	SB	2
Direct labor (A)	DL(A)	4
Direct labor (B)	DL(B)	4
Direct labor (C)	DL(C)	4
Total expected informants		26

three non-academic individuals to assess whether or not the questionnaires could be answered by individuals with limited education, with two of these individuals having received only a secondary level education.

In building the sample of Italian plants, only manufacturing companies from the Machine Tools, Electronics, and Transportation-Related industries were considered; this strategy allowed the Italian sample to be comparable with the U.S. sample from Round 1 of the WCM research project. Furthermore, these companies had to have manufacturing facilities located in Italy and to employ at least 100 employees. Companies with these characteristics were then classified as either 'Traditional' or 'World-Class,' based on the opinions of 10 experts and on their organizational profiles in Italian trade journals. The 10 experts included academic researchers, consultants, and industry managers, with expertise in particular industrial sectors and/or managerial aspects of WCM. Italian trade journals were used to expand the list of possible WCM firms, and in some cases, to confirm the 'World-Class' status of companies that had been identified by experts. To ensure the integrity of the classification, a face-to-face meeting was arranged so that the 10 experts could discuss the classification results. During this discussion, whenever doubts arose as to a firm's designation as 'World-Class,' evidence that the firm had implemented some WCM practices, either from trade journals or from expert knowledge, had to be provided. Otherwise, the firm would not be included in the sampling frame.

From this sampling frame, the Italian WCM research team in Italy then contacted 85 companies by phone and by mail to explain the research program and objectives. Thirty companies refused to participate; these 30 companies were either facing major restructuring problems or had defense contracts that prohibited them from sharing sensitive company-related information. The remaining 55 companies (65%) selected one plant to participate in Round 2 of the WCM research project. Generally, the 'best' plant was selected. A plant research coordinator from each selected plant was appointed to serve as a liaison between the plant and the Italian WCM research team. Plant visits were scheduled with each of the 55 plants, during which the research objectives and design were explained and interviews were conducted with the plant research coordinators and various managers within the plants.

During initial plant visits, the plant research coordinator, along with at least one member of the Italian WCM research team, would jointly select the plant informants to answer the various questionnaires, with the exception of the three questionnaires for direct labor. In the case of direct labor, because of the promise of anonymity, the names of employees were kept anonymous, although the selection process attempted to include both union and non-union representation. Questionnaires would then be administered to the selected informants by the plant research coordinator and returned to the plant research coordinator who then forwarded the completed questionnaires to the research team.

Of the 55 plants that had been visited, 10 dropped out for various reasons discovered during or after the visit. Some plant research coordinators did not wish to continue after learning of the research objectives and design, citing a lack of interest or believing that the data were too sensitive. Some agreed to participate but were not able to guarantee sufficient completeness of the various questionnaires to warrant further consideration. Finally, some agreed to administer the questionnaires but heavy production demands prevented the timely administration of the questionnaires for inclusion into Round 2 of the WCM project.

The remaining 45 plants that agreed to participate in the WCM study did return their questionnaires, but the questionnaire sets from two plants were discarded because of excessive missing data. The final sample, therefore, contained 43 plants of which 38 are Italian-owned plants, 2 are American-owned plants, 2 are French-owned plants, and 1 is a German-owned plant. The distribution of these plants across industries and across 'Traditional' vs. 'World-Class' categories is shown in Table 3.

3.2. Operationalization and measurement of theoretical constructs

For this replication, the seven theoretical constructs were operationalized as multi-item measurement scales, containing selected perceptual measurement items from Round 2 of the WCM research

Table 3
Italian plants in the replication sample

	Traditional	World-class	Total	Products
Machine Tools	9	7	16	Mini-diggers; FMS; manufacturing cells; measurement and control systems; robots and lasers; hydraulic plants and lifts; industrial boilers
Electronics	7	9	16	Radio bridges; personal and mini computers; printers; TV aerials and circuit boards; electronic boards for consumer lamps; asynchronous electric motors; electronic control devices for refrigeration
Transportation-Related	5	6	11	Air-conditioners for automobiles; mechanical transmission devices; car lights and aerials; axles for industrial vehicles, motorbikes, and scooters
Total	21	22	43	

questionnaires. Many of the measurement items employed in the Anderson et al. (1995) study were retained, with exceptions noted in Appendix A. These exceptions included the addition of new measurement items to, and/or the deletion of measurement items from, the measurement scales used in Anderson et al. (1995). In general, the addition and/or deletion of measurement items were undertaken to maximize the internal consistency reliability and the dimensionality of the respective measurement scales, an approach suggested in the work by Churchill (1979) and successfully applied by Graham et al. (1994). Table 4 shows Cronbach's α coefficients and principal components factor analysis results for these modified measurement scales.

The data for the measurement scales were then used to create plant-level aggregate scores for each construct, following the approach in Anderson et al. (1995). First, the average score for each item was computed across all within-plant informants who responded to the item. Then, the measurement items constituting each measurement scale were averaged by plant to form an aggregate, plant-level score for the corresponding theoretical construct. Each construct, therefore, has 43 values, one per plant, with the exception of Employee Fulfillment, which has only 34 values due to missing data.

3.3. Hypotheses

The four propositions in the ARS theory of quality management can be restated as eight testable hypotheses. For example, stated in standard null form, Proposition 1 suggests the following two hypotheses, as follows.

Hypothesis 1: Visionary Leadership is not positively related to Internal and External Cooperation.

Hypothesis 2: Visionary Leadership is not positively related to Learning.

Table 4
Measurement scales for the constructs underlying the ARS theory of quality management: Psychometric properties[a]

Measurement scale for construct	Cronbach's α	# Extracted factors (% variance explained)
Visionary Leadership	0.77	1 factor (56%)
Internal and External Cooperation	0.88	1 factor (62%)
Learning	0.84	1 factor (58%)
Process Management	0.90	1 factor (67%)
Continuous Improvement	0.76	1 factor (80%)
Employee Fulfillment	0.66	1 factor (75%)
Customer Satisfaction	0.67	1 factor (51%)

[a] Because the unit of analysis is the 'plant,' both Cronbach's α and dimensionality for the measurement scales for the seven constructs were assessed at the plant level.

The remaining six hypotheses that can be derived from Proposition 2 (Hypotheses 3 and 4), from Proposition 3 (Hypotheses 5 and 6), and from Proposition 4 (Hypotheses 7 and 8) include the following hypotheses.

Hypothesis 3: Internal and External Cooperation is not positively related to Process Management.

Hypothesis 4: Learning is not positively related to Process Management.

Hypothesis 5: Process Management is not positively related to Continuous Improvement.

Hypothesis 6: Process Management is not positively related to Employee Fulfillment.

Hypothesis 7: Continuous Improvement is not positively related to Customer Satisfaction.

Hypothesis 8: Employee Fulfillment is not positively related to Customer Satisfaction.

3.4. Analytical approach

In this replication, the eight hypotheses were empirically examined by applying the method of path analysis to the data from the Italian plants (see Land, 1969; Li, 1975 for an introduction to the theory and mechanics of path analysis). In the context of path analysis, the eight hypotheses can be operationalized as the path diagram shown in Fig. 2. The two arrows from Visionary Leadership to Internal and External Cooperation and from Visionary Leadership to Learning are, therefore, consistent with Hypotheses 1 and 2, respectively.

Because the 43 plants were drawn from three different industries, industry effects were suspected to play a significant role in explaining the variation in the data, just as industry effects were significant in the Anderson et al. (1995) study. This suspicion was confirmed by analyzing the across-industry mean and variance levels for the empirical measures of the seven constructs (see Table 5). To remove industry effects, the data were standardized by industry.

To apply path analysis, the data were standardized again and regression analysis was then employed to estimate the magnitudes of the eight path coefficients in Fig. 2. Because path coefficients are equivalent to standardized regression coefficients (Wright, 1960; see also the work of Li, 1975), the statistical significance of path coefficients can be examined using conventional *t*-tests and the statistical significance of hypothesized relationships can be evaluated by interpreting coefficients of determination, R^2 (Lewis-Beck, 1974; McPherson and Huang, 1974). Additionally, support (or lack of support) for the eight hypotheses was determined by computing and evaluating the magnitude of the pair-wise direct, indirect, and unexplained effects between empirical measures for the seven constructs (see Alwin and Hauser, 1981). These effects are derived by decomposing the observed correlation (R_{xy}) between two empirical measures, x and y, into the direct effects from x to y (D_{xy}), the indirect effects from x to y (I_{xy}), and

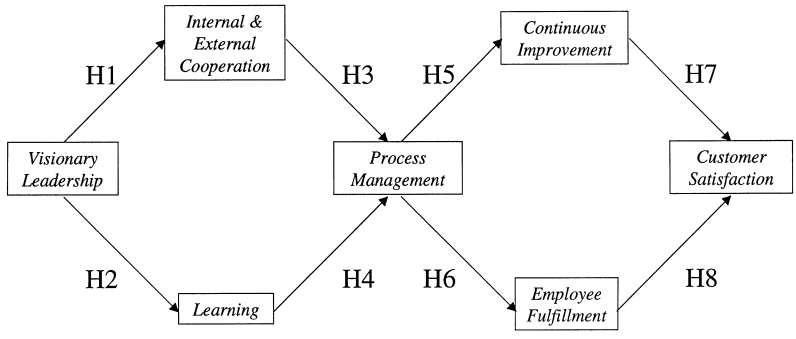

Fig. 2. A path model of the eight hypotheses.

Table 5
Comparing mean and variance levels across industries: one-way ANOVA results

Measurement scale for constructs	Industry means (variances)			
	Machine tools	Electronics	Transportation-related	Prob. > F[a]
Visionary Leadership	3.18 (0.419)	3.28 (0.431)	3.79 (0.242)	0.039
Internal and External Cooperation	3.01 (0.600)	3.41 (0.490)	3.58 (0.638)	0.133
Learning	2.83 (0.559)	3.21 (0.338)	3.01 (0.362)	0.273
Process Management	2.37 (0.520)	3.19 (0.594)	3.44 (0.722)	0.002
Continuous Improvement	3.17 (0.476)	3.16 (0.889)	3.73 (0.587)	0.117
Employee Fulfillment	3.93 (0.192)	3.33 (1.183)	3.65 (0.438)	0.073
Customer Satisfaction	2.94 (0.414)	3.33 (0.559)	3.09 (0.265)	0.047

[a]Prob. > F is based on the following F-test: H_0: $\mu_{\text{Machine Tools}} = \mu_{\text{Electronics}} = \mu_{\text{Transportation-Related}}$, H_1: $\mu_{\text{Machine Tools}} \neq \mu_{\text{Electronics}} \neq \mu_{\text{Transportation-Related}}$.

the unexplained effects between x and y (U_{xy}), using Eq. (1):

$$R_{xy} = D_{xy} + I_{xy} + U_{xy} \quad (1)$$

On a path diagram, a direct effect between x and y is represented by an arrow from x to y, and the indirect effect between x and y is the impact that x has on y through other intervening empirical measure(s) specified in the path diagram. The unexplained effects between x and y, therefore, indicate the residual portion of the observed correlation between x and y that is not captured by the hypothesized set of relationships depicted in the path diagram.

4. Results

For the sample of Italian plants in this replication, three of the eight paths (for Hypotheses 1, 3, and 5) supported path coefficients that were statistically significant at the $\alpha = 0.05$ level of significance (see Table 6). Two of the eight paths supported path coefficients of 0.056 and 0.055 (for Hypotheses 2

Table 6
Theoretical propositions, hypotheses, path coefficients, and R^2 values for the ARS theory of quality management: the Italian context

Proposition	Hypothesis	Path	Path coefficient	p	R^2	Standard Error
1	1	Visionary Leadership → Internal and External Cooperation	0.385	0.011	0.148	0.144
	2	Visionary Leadership → Learning	0.293	0.056	0.086	0.149
2	3	Internal and External Cooperation → Process Management	0.581	0.001	0.286[a]	0.166
	4	Learning → Process Management	**−0.084**	**0.616**[b]	—	—
3	5	Process Management → Continuous Improvement	0.613	0.000	0.348	0.146
	6	Process Management → Employee Fulfillment	0.023	0.890	0.001	0.171
4	7	Continuous Improvement → Customer Satisfaction	0.292	0.055	0.151[c]	0.155
	8	Employee Fulfillment → Customer Satisfaction	**0.181**	**0.252**	—	—

[a]R^2 ''(Standard Error)'' is the amount of variation in Process Management that is explained by both Internal and External Cooperation and Learning.
[b]Bold-faced values indicate statistically non-significant path coefficients; other path coefficients are generally considered to be statistically significant at the $\alpha = 0.05$ level of significance.
[c]R^2 ''(Standard Error)'' is the amount of variation in Customer Satisfaction that is explained by both Continuous Improvement and Employee Fulfillment.

and 7, respectively) that were minimally beyond the standard $\alpha = 0.05$ level of significance; these two paths were, therefore, considered to be statistically significant for this study. Three of the eight hypothesized paths—from Learning to Process Management (Hypothesis 4), from Process Management to Employee Fulfillment (Hypothesis 6) and from Employee Fulfillment to Customer Satisfaction (Hypothesis 8)—did not support statistically significant path coefficients. Therefore, in the context of the four theoretical propositions, only Proposition 1 received full empirical support, whereas the remaining three propositions received mixed empirical support.

Table 7 reports the decomposition of the empirical correlation coefficients into direct, indirect, and unexplained effects. For example, the correlation between empirical measures for Visionary Leadership and Continuous Improvement is 0.493 ($p < 0.001$), but the path model in Fig. 2 hypothesized an indirect relationship between Visionary Leadership and Continuous Improvement, with this indirect effect amounting to 0.122. Therefore, Fig. 2, as hypothesized, explained only 24.7% of the observed correlation between Visionary Leadership and Continuous Improvement. Consequently, Visionary Leadership may affect Continuous Improvement either directly (i.e., a direct path exists between the two) or in some other indirect manner via another variable that is not currently included in the path diagram. The decomposition results for the empirical measures of other constructs in Fig. 2 can be interpreted in a similar manner.

Finally, Table 8 compares the replication results for the Italian plants to the results for the U.S. plants in Anderson et al. (1995). As highlighted in Table 8, consistent empirical support for four of the eight hypothesized paths can be observed between the U.S. sample and the Italian sample. For plants in both the U.S. and Italian samples, Visionary Leadership was observed to have a positive and statistically significant effect on Internal and External Cooperation (Hypothesis 1). Likewise, Internal and External

Table 7
Direct, indirect, and unexplained effects based on the hypothesized path diagram

Effects of row on column		Internal and external cooperation	Learning	Process management	Continuous improvement	Employee fulfillment	Customer satisfaction
Visionary Leadership	Correlation (R)	0.385[b]	0.293[d]	0.374[c]	0.493[a]	0.494[b]	0.453[b]
	Direct (D)	0.385	0.293	–	–	–	–
	Indirect (I)	–	–	0.199	0.122	0.004	0.036
	Unexplained (U)	–	–	0.175	0.371	0.490	0.417
Internal and External Cooperation	Correlation (R)		0.604[a]	0.531[a]	0.571[a]	−0.028[ns]	0.521[a]
	Direct (D)		–	0.581	–	–	–
	Indirect (I)		–	–	0.356	0.013	0.106
	Unexplained (U)		0.604	−0.050	0.215	−0.041	0.415
Learning	Correlation (R)			0.268[d]	0.591[a]	−0.045[ns]	0.482[b]
	Direct (D)			−0.084	–	–	–
	Indirect (I)			–	−0.051	−0.002	−0.015
	Unexplained (U)			0.351	0.642	−0.043	0.497
Process Management	Correlation (R)				0.613[a]	0.023[ns]	0.298[d]
	Direct (D)				0.613	0.023	–
	Indirect (I)				–	–	0.183
	Unexplained (U)				–	–	0.115
Continuous Improvement	Correlation (R)					0.040[ns]	0.378[c]
	Direct (D)					–	0.292
	Indirect (I)					–	–
	Unexplained (U)					0.040	0.086
Employee Fulfillment	Correlation (R)						0.207[ns]
	Direct (D)						0.181
	Indirect (I)						–
	Unexplained (U)						0.026

[ns] Not significant, [a] $p < 0.001$, [b] $p < 0.01$, [c] $p < 0.05$, [d] $p < 0.09$.

Table 8
Empirical support for the ARS theory of quality management: comparing the U.S. context to the Italian context

Proposition	Hypothesis	Path	Empirical support by U.S. sample (path coefficient, p)	Empirical support by Italian sample (path coefficient, p)
1	1	Visionary Leadership → Internal and External Cooperation	Supported (0.46, $p < 0.002$)	Supported (0.39, $p < 0.011$)
	2	Visionary Leadership → Learning	Supported (0.46, $p < 0.002$)	Supported (0.29, $p < 0.056$)
2	3	Internal and External Cooperation → Process Management	Supported (0.71, $p < 0.001$)	Supported (0.58, $p < 0.001$)
	4	Learning → Process Management	Not Supported (-0.17, n.s.)	Not Supported (-0.08, n.s.)
3	5	Process Management → Continuous Improvement	Supported (0.21, $p < 0.002$)	Supported (0.61, $p < 0.000$)
	6	Process Management → Employee Fulfillment	Weakly Supported (0.27, $p < 0.085$)	Not Supported (0.02, n.s.)
4	7	Continuous Improvement → Customer Satisfaction	Not Supported (0.15, n.s.)	Supported (0.29, $p < 0.055$)
	8	Employee Fulfillment → Customer Satisfaction	Supported (0.35, $p < 0.026$)	Not Supported (0.18, n.s.)

Cooperation was observed to have a positive and statistically significant effect on Process Management (Hypothesis 3), and Process Management was observed to have a positive and statistically significant effect on Continuous Improvement (Hypothesis 5). Furthermore, for the samples of plants from both countries, Learning and Process Management were not statistically related, after adjusting for the effect of Internal and External Cooperation on Process Management (Hypothesis 4).

For two of the remaining four hypothesized paths, minor differences were detected. For example, Hypothesis 2, which relates Visionary Leadership to Learning, received strong empirical support in the Anderson et al. (1995) study—a path coefficient of 0.46 that was statistically significant at $p < 0.002$. But, for the Italian data, the path coefficient from Visionary Leadership to Learning was statistically significant at $p < 0.056$ only. As for Hypothesis 6, the U.S. sample provided weak support for the path from Process Management to Employee Fulfillment, (path coefficient = 0.27, $p < 0.085$); whereas, this relationship was not statistically supported in this replication. However, when interpreted in a more conservative manner (e.g., $\alpha = 0.05$), it could be argued that Hypothesis 6 would have been rejected for both samples of U.S. and Italian plants.

The remaining two hypotheses involving Customer Satisfaction (Hypotheses 7 and 8) are, perhaps, most intriguing. In the Anderson et al. (1995; p. 650) study, Customer Satisfaction was reported to correlate statistically with Visionary Leadership ($R_{\text{Customer Satisfaction} \cdot \text{Visionary Leadership}} = 0.57$, $p < 0.001$) and Employee Fulfillment ($R_{\text{Customer Satisfaction} \cdot \text{Employee Fulfillment}} = 0.39$, $p < 0.05$) only. But in this replication, Customer Satisfaction was found to correlate with all constructs except Employee Fulfillment (see Table 7), explaining empirically the statistically non-significant path from Employee Fulfillment to Customer Satisfaction.

5. Discussion of results

To date, the Anderson et al. (1995) study is the only empirical examination of the ARS theory of quality management. While there have been other empirical studies of quality management, these empirical studies have been based on other quality management frameworks (e.g., Flynn et al., 1995; Hendricks and Singhal, 1996; Powell, 1995).

Considered from the typology of management studies involving culture by Adler (1983), the Anderson et al. (1995) study represents a parochial study, since the research was conducted in one culture (U.S. context) by researchers in that culture (U.S.-trained researchers). According to Adler (1983, p. 32), a parochial study typically makes the implicit assumption that the underlying theory and resulting empirical findings are universal, when, in fact, they are most likely:

... applicable only to one culture, the culture in which the research was conducted... American studies conducted in the United States are, at best applicable to the United States. They may or may not be applicable to Africa, Asia, Europe, or Central and South America.

Therefore, in order to assess whether a theory is potentially applicable outside of one culture, Adler (1983) urged that research designs explicitly incorporate and evaluate the impact of culture, one suggested research design being ethnocentric research. Ethnocentric research designs:

... ask the question: 'Can this theory, which is applicable in Culture A be extended to Culture B?'... [and are] primarily searching for similarity across cultural conditions, for validation in extending... theoretical frameworks under the more extreme conditions... [with replications being]... the most common approach to ethnocentric research... an attempt is made to keep all aspects of the research design and its implementation (with the exception of language) identical across the two cultures. As far as possible, the research is conducted in the same way, with the same types of people, using the same instrumentation (except for language), administered with the same instructions, and analyzed using the same methods in both cultures... (Adler, 1983, p. 33).

From the preceding description, it is clear that the conduct of the empirical study reported herein approximates ethnocentric research. The detraction from an ideal ethnocentric research design arises because the data collection instrument employed in this replication differed from that used in Anderson et al. (1995). However, differences in instrumentation do not necessarily deter cross-cultural comparisons in management research, a case in point being the examination of negotiation behavior in multiple countries by Graham et al. (1994). Because Cronbach's α's for several constructs were unacceptably low for several foreign samples, Graham et al. (1994) deleted relevant measurement items on a country-by-country basis to maximize Cronbach's α's and employed formative measurement indicators to operationalize theoretical constructs (for a discussion of formative indicators, see Fornell and Bookstein, 1982). Likewise, in this replication, we maximized Cronbach's α for the Italian sample, and in our empirical analysis, operationalized theoretical constructs as aggregate scores formed by averaging individual measurement items.

Furthermore, from a cross-cultural comparative perspective, Hofstede (1984) has shown that the Italian culture differs from the U.S. culture along such cultural dimensions as Power Distance (higher in Italy), Uncertainty Avoidance (higher in Italy), Individualism (lower in Italy), and Masculinity (higher in Italy). Because the U.S. and Italian cultures are dissimilar, observed similarities between the research results in this replication and those in the Anderson et al. (1995) study can be conservatively interpreted to be indicative of possible, rather than confirming, universality. More precisely, Adler (1983, p. 34) has provided the following caution:

In cross-cultural replication studies, similar findings are most frequently interpreted as confirmation that the theory being tested is, in fact, universal... [the] more appropriate conclusion would be either that the particular results are not solely dependent on cultural factors in the first culture or that the results appear applicable to the second culture. The conclusion, from a two-culture study, that the results are universal is unwarranted.

With this caution in mind, it can be concluded that several of the hypothesized relationships in the ARS theory of quality management appear to be applicable in describing, explaining, and predicting 'quality management'-related organizational forms and behavior beyond the U.S. context (i.e., in Italy). In both the U.S. and the Italian contexts, organizational leaders play a critical role in developing and communicating a vision that can enable the creation of an organizational system—one that is cooperative in nature and willing to engage in learning. Cooperation, in turn, makes it easier to implement practices that focus on managing the process as opposed to managing the outcomes of the process. These process management practices ultimately support the continuous improvement of process, product, and service quality.

Also, in both the U.S. and Italy, Learning did not appear to facilitate the implementation of process management practices, as conjectured. However, the failure to observe a statistically significant relationship between Learning and Process Management may be attributed to the effects of multi-collinearity, since Learning and Internal and External Cooperation were observed to be positively and statistically correlated. In Anderson et al. (1995, p. 650), the zero-order correlation between Learning and Internal and External Cooperation was found to be 0.76 ($p < 0.001$); whereas, for this replication sample, a correlation of 0.604 ($p < 0.001$) was computed. Another possible explanation, however, may be the inadequate operationalization of the Learning construct's domain. Deming (1990) and others (e.g., Anderson et al., 1992, 1994a) have urged organizations to supplement training in domain or task knowledge with training and education in 'profound knowledge' (i.e., systems theory, statistics, psychology, and theory of knowledge). In their urgings, these scholars argued that training and education in the disciplines of 'profound knowledge' are critical to effective continuous quality improvement efforts. Yet, in both the Anderson et al. (1995) study and the current replication, the Learning construct could only be operationalized as task-related training.

Whereas similar findings in cross-cultural replications support the applicability of a particular theory across different cultures, inconsistent findings across different cultures should arguably lead to the conclusion that the particular theory does not apply across different cultures. Such a conclusion seems appropriate for the hypothesized relationships involving the Employee Fulfillment construct in the ARS theory of quality management. However, the same logic about not drawing conclusions of universality based on similar findings from a two-culture study can be made in the case of differences in the comparative results of two cultures. Furthermore, as Shenkar and von Glinow (1994; p. 68) demonstrated in studying the applicability of different theories in China, there may be '...degrees of applicability...'—these degrees of applicability possibly arising because of one or more of the following conditions: (a) the assumptions underlying the theory do not hold in different cultures, (b) problems in conceptualization or instrumentation, (c) marginal empirical support, and (d) missing constructs in the theory being tested. Hence, observed differences in the Employee Fulfillment results reported here and in the Anderson et al. (1995) study may be attributed to one or more of these conditions.

In retrospect, we suspect that the conceptualization of Employee Fulfillment, defined as the degree to which employees are able to derive pride from the workmanship, satisfaction, and commitment from what they do (see Anderson et al., 1994b; p. 489), may not be applicable in the Italian culture for two reasons. First, as computed in Hofstede (1984, p. 189), the Italian culture has a relatively high Masculinity score of 70 compared to an mean of 51—a reflection of strong Catholic tenets, that fundamentally view the female gender as being secondary to the male gender. The man, being the primary provider in a family, is under societal pressure to be a source of financial resources, and is motivated more by extrinsic benefits such as wages and bonuses than by pride of workmanship (Bonazzi, 1993). Second, since the end of the Second World War, the Italian industrial work environment has been influenced strongly by Marxism. Marxist ideology has led to a clear demarcation between employers and employees (and unions), resulting in both sides maintaining a traditional 'arm's length' approach in dealing with one another. On one hand, employees generally do not believe that management is concerned for their welfare and are extremely wary of management initiatives that relate to the work they do. On the other hand, employers are more inclined to devise extrinsic, as opposed to intrinsic, modes to motivate and satisfy the workforce (see Pinaud, 1992; Gunnigle et al., 1994; Sirianni, 1995; Hardy and Clegg, 1996). Therefore, the lack of empirical support for hypothesized relationships involving Employee Fulfillment in the Italian data may arise not because these relationships are conceptually invalid but, perhaps, because the Employee Fulfillment construct itself does not have definitional equivalence from the U.S. context to the Italian context.

6. Conclusion

Lindsay and Ehrenberg (1993; p. 217) made the observation that ''...replication in the social sciences is rare...'' It should, therefore, not come as a

surprise to observe that in the quality management discipline, there are virtually no replication studies of previously published results. Yet, the conduct of replication studies has long been recognized as being crucial to the ongoing process of scientific inquiry and to the development and growth of scientific knowledge within a given discipline (see Lykken, 1968; Reynolds, 1971).

In this respect, our replication, although not a 'pure' replication of the Anderson et al. (1995) study, does make a unique contribution to the discipline of quality management—it represents the first explicit attempt to determine ''... whether or not... [the empirical results reported in Anderson et al. (1995) are]... potentially generalizable at all'' (Lindsay and Ehrenberg, 1993, p. 217). We believe that more replications are necessary and should be encouraged before any conclusive statements, either in favor or against, the proposed Deming-based theory of quality management can and should be made. According to Lykken (1968, p. 155): ... demonstrating an empirical fact ''must involve a chain of confidence in the replicability of one's findings...,'' such confidence naturally resulting from numerous attempts to falsify previously reported findings. Hence, we urge that future research efforts not only replicate the earlier Anderson et al. (1995) study with a different U.S.-based sample, either within the same or in different sets of industries, but also replicate the current study involving Italian organizations. Ideally, simultaneous empirical examinations of the ARS theory of quality management across multiple cultures should be pursued. To do so, researchers in quality management need to develop critical understanding and appreciation of the methodological issues involved in conducting cross-cultural empirical research. Many of these issues have been raised and discussed in the works of Mullen (1995), Singh (1995), Riordan and Vandenberg (1994), and, more recently, Cavusgil and Das (1997).

While existing empirical studies on the relationships conceptualized in the ARS theory of quality management have been informative, from a research standpoint, we want to encourage the design and conduct of confirmatory, as opposed to exploratory, empirical tests of the ARS theory of quality management. A critical challenge, however, lies ahead for those interested in conducting such confirmatory empirical studies—one that pertains to the construction of reliable and valid methods for measuring the seven constructs in the ARS theory of quality management. The importance of satisfying this challenge cannot be over-emphasized; for without reliable and valid measures that enable data collection from primary sources, the substantive validity of the relationships in the ARS theory of quality management cannot be definitively established (see Bagozzi et al., 1991).

From a managerial perspective, the results from this replication should further raise awareness of the potential cultural bounds of the quality management phenomenon as multinational corporations make conscious decisions to transfer the organizational forms and behaviors underlying quality management to other countries. This awareness should help organizations to better manage the diffusion of quality management from the home country environment to foreign country environments, and specifically to identify cultural barriers that may inhibit the adoption of quality management principles, concepts, and practices.

Our research results, particularly with respect to Employee Fulfillment, suggest that in instances where the values underlying quality management conflict with the values of the culture in which quality management is to be diffused (i.e., the target culture), this diffusion might be hindered (see also, Amundson et al., 1997). In such instances, for quality management practices to be successfully transferred, the conflict between values underlying quality management practices and those of the target culture should be reconciled. Pragmatically, this reconciliation can be undertaken by adapting quality management practices to the target culture or by selectively implementing those quality management practices that would be more amenable to the target culture. Conversely, companies, through selective employee hiring or retention and organizational development initiatives, might be able to instill or adapt their own organizational cultures to be more supportive of quality management.

Appendix A. Measurement items for theoretical constructs in the ARS theory of quality management

Construct	· Measurement Items	Current	ARSD
Visionary Leadership	· All major department heads within our plant accept their responsibility for quality	✓	✓
	· Plant management provides personal leadership for quality products and quality improvement	✓	✓
	· Our top management strongly encourages employee involvement in the production process	✓	✓
	· In our plant, goals, objectives, and strategies are communicated to me	Dropped	✓
	· Short-term losses affect our decision making, but are less important than pursuing long-term goals (Reverse-scored)	✓	✓
	· Management outside of the plant is primarily concerned with short-range financial performance (Reverse-scored)	✓	✓
	· Financial goals are the most important at our plant (Reverse-scored)	Dropped	✓
	· Strategies and goals are communicated primarily to managers (Reverse-scored)	Dropped	✓
Internal and External Cooperation	· Generally speaking, everyone in the plant works well together	Dropped	✓
	· Departments in the plant communicate frequently with each other	✓	✓
	· Departments within the plant seem to be in constant conflict (Reverse-scored)	Dropped	✓
	· Management works together well on all important decisions	✓	✓
	· During problem-solving sessions, we make an effort to get all team members' opinions and ideas before making a decision	✓	✓
	· Our plant is organized into permanent production teams	Dropped	✓
	· Problems are usually solved by supervisors (Reverse-scored)	Dropped	✓
	· In the past three years, many problems have been solved through small group sessions	Dropped	✓
	· Data about the quality of parts and components under purchasing considerations are at our disposal	✓	N/A-1
	· Our suppliers have to send us information (documents) certifying the results of specified tests and inspections	✓	N/A-1
	· We require evidence of statistical process control from suppliers of critical parts	✓	N/A-1
	· We can easily use data from tests of quality conducted by a supplier or by an independent laboratory	✓	N/A-1

Appendix A. (continued)

Learning	· Employees receive training to perform multiple tasks	✓	✓
	· Plant employees are rewarded for learning new skills	N/A-2	✓
	· Direct labor technical competence is high in this plant	N/A-2	✓
	· The longer an employee has been at this plant, the more tasks or jobs he (she) learns to perform	✓	N/A-1
	· Plant employees receive training and development in work-place skills on a regular basis	✓	N/A-1
	· Employees are cross-trained at this plant so that they can fill in for others if necessary	✓	N/A-1
	· Employees at this plant learn how to perform a variety of tasks/jobs	✓	N/A-1
	· At this plant, employees only learn how to do one job/task (Reverse-scored)	✓	N/A-1
Process Management	· Charts showing defect rates are posted on the shop floor	✓	✓
	· Charts plotting frequency of machine breakdowns are posted on the shop floor	Dropped	✓
	· We have standardized process instructions which are given to personnel	N/A-2	✓
	· We make extensive use of statistical techniques to reduce variance in processes	✓	✓
	· A large percent of the equipment or process on the shop floor are currently under statistical quality control	✓	✓
	· We use statistical methods to recognize the source of problems	✓	N/A-1
	· We use charts to determine whether our manufacturing processes are in control	✓	N/A-1
	· Process data gathered from manufacturing inspections are stored for subsequent analysis	✓	N/A-1
	· Information on quality performance is readily available to employees	✓	N/A-1
Continuous Improvement	· All employees believe that it is their responsibility to improve quality in the plant	✓	✓
	· Continuous improvement of quality is stressed in all work processes throughout our plant	✓	✓
Employee Fulfillment	· I would feel unhappy if I could not take pride in my work	✓	✓
	· Doing a good job should mean as much to a worker as a good paycheck	Dropped	✓
	· If I do a sloppy job at work, I feel a little ashamed of myself	Dropped	✓
	· I like to feel a sense of pride in my work	✓	✓

Customer Satisfaction	· How does your plant compare to its competitors in your industry in terms of customer relations? 1. Superior or better than average 2. Better than average 3. Average or equal to the competition 4. Below average 5. Poor or low end of the industry	✓	✓
	· How does your plant compare to its competitors in your industry in terms of quality of product conformance? 1. Superior or better than average 2. Better than average 3. Average or equal to the competition 4. Below average 5. Poor or low end of the industry	✓	✓
	· In general, our plant's level of quality performance over the past three years has been low, relative to industry norms (Reverse-scored)	✓	✓
	· Our customers have been well satisfied with the quality of our products over the past 3 years	✓	✓

ARSD = Anderson, Rungtusanatham, Schroeder, and Devaraj (1995).
Current = Current replication study.
Dropped = Item deleted to improve the measurement scale's Cronbach's α or dimensionality.
N/A-1 = Not available in Round 1.
N/A-2 = Not available in Round 2.
✓ = An '✓' indicates the inclusion of a particular measurement item. Therefore, an '✓' in the Current column but not in the ARSD column means that the corresponding measurement item was used in this replication study but not in the Anderson et al. (1995) study.

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