A QUALITY MEASUREMENT FRAMEWORK FOR TURKISH FIRMS: VALIDATION OF AN INSTRUMENT

Dr. Türker BAŞ
Turkish Armed Forces, Project Officer
turkerbas@kaliteofisi.com

ÖZET

Toplam kalite yönetiminin geçtiğimiz on yıl içerisinde artan önemine rağmen, Türkçe literatürde kritik kalite faktörlerinin belirlenmesi ve kullanımına yönelik sistematik bir çaba bulunmamaktadır. Bu eksikliği gidermek amacı ile bu çalışmada, Saraph ve diğ. (1989) tarafından belirlenen kritik kalite faktörlerinin Türk firmaları için geçerli olup olmadığı sorgulanmıştır. Bunun için orijinal soru formu Küçük ve Orta Ölçekli Sanayi Geliştirme ve Destekleme İdaresi Başkanlığı (KOSGEB) üyesi 400 firmaya gönderilmiş olup, ankete 84 firma cevap vermiştir. Bu firmalardan elde edilen veriler kullanılarak ölçeğin güvenilirlik ve geçerliği test edilmiştir. Analiz sonuçları, Saraph ve diğ. tarafından geliştirilen ölçeğin Türk firmalarının kalite yönetimi uygulamalarını değerlendirmek için kullanılabilecek güvenilir ve geçerli bir araç olduğunu göstermektedir. Ölçeğin kullanım alanları ayrıca tartışılmıştır.

ABSTRACT

Despite the increasing popularity of total quality management (TQM) during past decade, there is no systematic attempt had been made in Turkish literature to organize and synthesize the various sets of critical quality factors. To overcome this limitation, the present study attempted to determine if the TQM critical factors identified by Saraph et al. (1989) were pertinent to Turkish firms. The question form was sent to 400 members of Small and Medium Industry Development Organization (KOSGEB) with 84 responding. Using data from these firms, reliability and validity of an instrument is tested. In conclusion, the researcher determined that, the instrument developed by Saraph et al. appears to be reliable and valid for the measurement of the quality management practices of Turkish firms. A framework for application of an instrument also discussed.Dergiye Türkçe veya İngilizce makaleler kabul edilmektedir.

INTRODUCTION

The rapidly changing market and economic environments in the 1990's characterized by such phenomena as globalization of markets, increasing expectations of customers and rapid technology transfer, have presented challenges to most firms in Turkey. In response to these changes, increasing attention has been paid to the need for new managerial practices, especially the possibility of emulating western management practices. One such management practice that captured the attention of industry and business community in Turkey was total quality management (TQM).

The introduction of TQM has generated a tremendous amount of interest in many sectors of the economy – manufacturing, service, construction and public organizations. Now many Turkish firms are actively pursuing TQM to improve their quality and productivity performance so that they can compete more effectively in market place. In recent years, for these firms, quality has moved to the forefront of corporate strategy in the light of increasing international competition for revenues and profits.

Notwithstanding the present popularity of TQM in Turkish firms, there has been little empirical research on this issue within Turkish firms. Most of the useful evidence regarding to subject is based on case studies (Parlak, 1994; Mellahi&Eyuboğlu, 2001; Bektaş, 2002; Özkara, 2000; Savaş, 1999; Özdipçiner, 1999, Güneş&Özgener, 2001). A few papers involve more generalizable research methodologies (Araslı, 2002; Mızıkacı, 2001, Takan, 1998, Balcı, 1998). However these studies do not provide any rationale for the selection of factors included in their questionnaire. Although it is generally acknowledged that poor measurement properties of instruments can lead to erroneous conclusions, many quality management studies have used instruments that don't meet the minimal standards of reliability and validity.

To overcome this limitation, the present study attempts to identify the critical factors in quality management in firms operating in Turkey. A valid measurement instrument including these factors will be helpful from practical as well as academic perspectives. Firms could use such an instrument for measuring and benchmarking their quality practices. Researchers would benefit from such an instrument in theory development and model testing on quality practices.

LITERATURE REVIEW

Few attempts have been made to synthesize frameworks for measuring quality management practices. Only five published studies have developed and empirically validated measurement scales for quality management practices.

The first study by Saraph et al. (1989) using a sample of 162 managers from 20 firms in Minneapolis/St Paul area developed and empirically tested a quality measurement instrument in which they identified eight critical constructs of quality management. The validity and reliability of this instrument is also tested in fallowing studies using data from Indian firms (Motwani et al., 1992), United Arab Emirates firms (Badri et al., 1994) and Singapore firms (Quazi et al., 1998). Flynn et al. (1994) developed dimensions of quality management from literature. A study of 75 manufacturing plants from three industries across US, which sought multiple responses from managers and workers from various functions, formed the basis for empirical validation and refinement of these constructs. Black and Porter (1994) determined 10 TQM critical success factors using, as a sample, members of the European Foundation for Quality Management in UK. They developed survey questions from Baldridge Award criteria and from through literature review. This study is also reiterated by Dayton (2001) in US with 1000 members of the American Society of Quality. Ahire et al. (1996) identified 12 constructs of integrated quality management strategies and their study based on the vehicle parts and accessories industries that were located in the Midwest region of the US. Rao et al. (1999) conceptualized and developed valid measurements for 13 key dimensions of quality management. They used data from five countries: the US, India, China, Mexico and Taiwan.

Although these studies make a contribution to the measurement stream of quality measurement, none of these measures were empirically tested and validated in Turkey, which limits their use for Turkish firms. From the preceding discussion, it becomes apparent that there is need for a measurement instrument that is valid for Turkish firms to address the issues of quality management practices.

By using Saraph et al.' pioneer instrument, the present study attempts to identify the critical factors in quality management for firms operating in Turkey. Reliability and validity of the instrument are tested using the data collected from the firms in Turkey and compared with those of Saraph et al. and three other replicative studies that were conducted in India, in the United Arab Emirates and in Singapore.

BACKGROUND

It is claimed by Saraph et al. (1989) that no one has made an attempt to organize and synthesize the various sets of critical indicators expressed by different quality gurus. In addition they claimed that, even for commonly recognized critical factors in quality management, such as management leadership and employee involvement, no operational measures were available.

Accordingly they identified 120 organizational prescriptions from the literature for an effective quality management. Eight separate categories were formed through a judgmental process of grouping similar requirements with these prescriptions. Each of the eight categories (or critical factors) were consistent with the opinions of the quality gurus such as Shewhart, Deming, Juran, Crosby, Feigenbaum and Ishikawa. A formal pre-test was

conducted with general and quality managers of certain firms. Following the pre-test 42 items were dropped from initial questionnaire. Reliability and validity of remaining 78 measures were tested using data collected from a sample of 162 general and quality managers of different business units in 20 service and manufacturing firms in Minneapolis/St. Paul area in US.

Reliability and detailed item analysis were conducted to identify the measures of critical factors in quality management. Internal consistency analysis was performed for each critical factor separately. 12 items were discarded to increase the internal consistency and as a result 66 items remained. By using Nunnally's (1967) method the authors concluded that all items had been appropriately assigned to their scales.

The researchers also claimed that the developed instrument had content validity, because the selection of measurement items was based on an exhaustive review literature and a detailed evaluation by academics and practicing managers. Besides that they investigated the criterion-related validity of an instrument by correlating coefficient computed for the eight measures and a measure of the business unit's quality performance. For the composite measure of quality performance of the responding firms, the mean score for 'quality performance' and 'customer satisfaction' for the past three years was used.

A five-point interval rating scale was used for the study. For each critical factor, the actual level of practice was represented by the average of the measurement item ratings for that factor (referred to scale scores).

The authors strongly believe that further research should be done even though the initial results developed by Saraph et al. are encouraging. Replications of their work are needed to corroborate the results. The present study attempts to do just that.

DATA COLLECTION

The questionnaire was send to 400 members of Small and Medium Industry Development Organization (KOSGEB) from both manufacturing and service sectors via internet. These firms were chosen from Small and Medium Enterprises Network (KOBİNET). In total 84 questionnaires were returned with the response rate of %18. Table I provides summary information, in the form of frequency distributions, for the respondents who participated in the survey. The participants assessed the degree or extent of quality management practice in his/her firm by rating each instrument item using the five point scale used by Saraph et al.

RELIABILITY OF AN INSTRUMENT

By analyzing pooled data, the 78-item instrument was refined (i.e., data from all industries considered together). The pooling of data was deliberate and appropriate because the main purpose of this research stage was to see whether Saraph et al.' instrument would be meaningful and reliable in assessing quality in variety type of industries. In other words the purpose was to obtain a scale that would have general applicability for Turkish firms.
Purification of an instrument began with the computation of coefficient alpha, in accordance with Churchill's recommendation (1979). The multidimensionality of the quality construct cause computation of coefficient alpha separately for the eight dimensions.

The values of coefficient alpha ranged from .90 to .97 across 8 dimensions and suggested that elimination of certain items from some dimensions would improve alpha values. The criterion to eliminate an item was the item's corrected item to total correlation (i.e., correlation between the score n the item and the sum of scores on all other items making up the dimension to which the item was assigned). The corrected item-to-total correlations were plotted in descending order for each dimension. The two items – item 29 and item 75, whose correlations produced a sharp drop in the plotted pattern, were discarded. Table II reports the sets of measurement items associated with eight factors, the reliability coefficients associated with the scale, corrected item-to-total correlations and the reliability associated with the scale when a certain item deleted.

Table II shows that the maximized reliability coefficients ranged from .91 to .98, indicating that some scales are more reliable than others. In addition, it clear that dropping any other item from the constructed scales would not improve the reliability of these scales. Typically, reliability coefficients of .7 or more are considered adequate (Coranbach, 1951). Table II also shows comparison between the reliability coefficients in the current study and the 1989 study. According to these results it is clear that the scales developed are judged to be reliable.

Table I Summary of organization information

	n	*Percent*
Industry type		
Production	57	67,85
Service	27	32,15
Activity area		
Tourism	6	7,14
Health	6	7,14
Electronics	6	7,14
Transportation	4	4,76
Automotive and its subsidiary	9	10,71
Furniture	4	4,76
Packing	3	3,57
Advertisement and promotion	4	4,76
Food	7	8,33
Metal	5	5,95
Construction	7	8,33
Textile	8	9,52
Machinery	6	7,14
Real estate	5	5,95
Counseling	4	4,76
Total sales volume per year		
less than $ 100.000	21	25
$ 100.000 – 250.000	14	16,63
$ 251.000 – 500.000	9	10,71
$ 501.000 – 1.000.000	24	28,57
$ 1.000.000+	16	19,04
Number of employees		
1-5	15	17,85
6-10	13	15,47
11-50	27	32,14
51-100	17	20,23
100 +	12	14,28
ISO 9000 Certification		
Certified	55	65,47
Doesn't certified	29	34,52
Foundation Date		
Before 1980	15	17,85
1981-1985	9	10,71
1986-1990	9	10,71
1991-1995	19	22,61
1996-2000	24	28,57
After 2001	8	9,52

FACTOR STRUCTURE

The next task in this stage of the scale purification was examining the dimensionality of the 76 item instrument. It was performed by Nunnally's detailed item analysis method. The method considers the correlation of each item with each scale. If an item does not correlate highly with any of the scales, this indicates that the item should not be associated with that scale. Table III reports the correlation matrix for the eight scales or measures of critical factors of quality and the measurement items. For example Item 1 has correlations of .77, .50, .51, .62, .45, .46, .44, and .43 with the critical factors. Since scale 1 (role of divisional top management and quality process) is the average of items 1 to 13, the high correlation between scale 1

and item 1 expected. In addition since item 1 showed relatively smaller correlations with the other scales it was concluded that it has been assigned appropriately to scale 1.

As seen in Table III, all items except item 12, have high correlations with the scales to which they were assigned relative to all other scales. Accordingly, item 12 was dropped from questionnaire and it was concluded that approximately all items had been appropriately assigned to scales.

Table II Scale's reliability (Saraph et al. study's reliability), corrected item-total correlation and coefficient alpha when item is deleted from the scale

No	Corrected Item-Total Correlation	Alpha if Item Deleted	No	Corrected Item-Total Correlation	Alpha if Item Deleted	No	Corrected Item-Total Correlation	Alpha if Item Deleted	No	Corrected Item-Total Correlation	Alpha if Item Deleted
1	,7227	,9258	14	,7613	,8837	20	,8182	,9475	30	,6903	,9008
2	,7534	,9244	15	,6721	,8965	21	,8161	,9477	31	,7090	,8991
3	,7641	,9242	16	,7761	,8815	22	,8226	,9474	32	,6491	,9042
4	,6437	,9282	17	,7719	,8820	23	,7975	,9486	33	,7345	,8971
5	,5310	,9318	18	,7506	,8854	24	,8392	,9465	34	,6973	,9001
6	,6637	,9275	19	,6985	,8933	25	,8521	,9458	35	,7483	,8956
7	,7806	,9234				26	,8334	,9468	36	,7831	,8926
8	,7381	,9257				27	,8281	,9472	37	,6695	,9024
9	,5685	,9307				28	,7058	,9532			
10	,7475	,9246									
11	,6963	,9264									
12	,6465	,9281									
13	,7376	,9250									
Alpha	-	,9319	**Alpha**	-	,9043	**Alpha**	-	,9534	**Alpha**	-	,9105
Saraph	-	,9400	**Saraph**	-	,8300	**Saraph**	-	,8700	**Saraph**	-	,7100
Badri	-	,9670	**Badri**	-	,0970	**Badri**	-	,9081	**Badri**	-	,9533
Motwani		,7991	**Motwani**	-	,8766	**Motwani**	-	,7984	**Motwani**	-	,8151
Quazi	-	,9500	**Quazi**	-	,8977	**Quazi**	-	,9486	**Quazi**	-	,8564

No	Corrected Item-Total Correlation	Alpha if Item Deleted	No	Corrected Item-Total Correlation	Alpha if Item Deleted	No	Corrected Item-Total Correlation	Alpha if Item Deleted	No	Corrected Item-Total Correlation	Alpha if Item Deleted
38	,6490	,9022	48	,7673	,9322	61	,8005	,9411	70	,7958	,9279
39	,7106	,8988	49	,6249	,9375	62	,7385	,9446	71	,7810	,9290
40	,6307	,9032	50	,7371	,9332	63	,8442	,9388	72	,7609	,9304
41	,7578	,8956	51	,7177	,9338	64	,8839	,9369	73	,8316	,9259
42	,7478	,8962	52	,7048	,9342	65	,8491	,9385	74	,8230	,9259
43	,6807	,9007	53	,7865	,9320	66	,8240	,9398	76	,7887	,9285
44	,6075	,9055	54	,6469	,9361	67	,6971	,9465	77	,7952	,9280
45	,6979	,8995	55	,6719	,9353	68	,7295	,9449	78	,6625	,9374
46	,6599	,9015	56	,6977	9346	69	,7818	,9421			
47	,6283	,9041	57	,7262	,9336						
			58	,7493	,9328						
			59	,7187	,9338						
			60	,7409	,9331						
Alpha	-	,9098	**Alpha**	-	,9388	**Alpha**	-	,9477	**Alpha**	-	,9375
Saraph	-	,8100	**Saraph**	-	,7600	**Saraph**	-	,8800	**Saraph**	-	,8500
Badri	-	,8893	**Badri**	-	,9432	**Badri**	-	,9477	**Badri**	-	,9171
Motwani	-	,7991	**Motwani**	-	,9072	**Motwani**	-	,8499	**Motwani**	-	,8598
Quazi	-	,8228	**Quazi**	-	,8711	**Quazi**	-	,9134	**Quazi**	-	,8921

ASSESSMENT OF VALIDITY

High reliability and consistent factor structure of an instrument provide support for its trait validity. However while high reliabilities and internal consistencies are necessary conditions for a scale's construct validity – the extent to which a scale fully and unambiguously captures the underlying, unobservable, construct it is intended to measure – they are not sufficient. To be considered as having good construct validity, the scale must satisfy certain other conceptual and empirical criteria.

The basic conceptual criterion pertaining to construct validity is content validity. (Does the scale appear to measure what it is supposed to?) Assessing a scale's content validity is necessarily qualitative rather than quantitative. It involves examining two aspects: (1) the thoroughness with which the construct to be scaled and its domain explicated and (2) the extent to which the scale items represent the construct's domain. As discussed earlier sections, the procedures used in verification of an instrument satisfied both these evaluative requirements. Therefore the instrument can be considered to possess content validity.

One way to assess the scale's validity empirically is to examine its creation-related validity. This validity method is concerned with the extent to which a measuring instrument is related to an independent measure of the relevant criterion. In the current study, the criterion-related validity of the combined set of eight measures of quality management is evaluated by examining the multiple correlation coefficients computed for the eight measures and a measure of business unit quality performance. In order to obtain such a measure of a business unit's quality performance, two measures of quality measures of quality performance were first obtained from the managers in the sample firms.

Each manager was asked to rate on a five-point scale the quality performance of his/her division/unit and customer satisfaction with the quality, for the past three years. These two ratings then averaged to form a single composite measure of quality performance. This objective measure was chosen, as in the Saraph et.al. study, over an subjective measure that would be appropriate for the different types and sizes of firms in the sample.
The multiple correlation coefficient of quality performance measure and eight measures of quality management is 0.78 (Saraph et al., r = .80, Bedri et al. r = .80, Quazi et al, .73) From this multiple correlation coefficient, it can be concluded that the eight measures of quality management have an acceptable degree ($p < 0.05$) of creation related validity when taken to gather.

REFINEMENT OF THE STUDY

Table II shows the component and total reliabilities of Saraph et al.' instrument for our sample. While the reliabilities are consistently high across all dimensions, the total-scale reliability is also close .9. Results of Nunnally's detailed item analysis are summarized in Table III. Except Item 12, all items have high loadings only on their assigned factors.
It is worth noting that the iterative procedure used to refine the Saraph et al.' initial instrument was guided by empirical criteria and by the goal of obtaining a concise scale whose items would be meaningful to variety of Turkish firms. The reliabilities and factor structures indicate that the final 75-item scale and its eight dimensions have sound and stable psychometric properties.

APPLICATIONS OF INSTRUMENT

This survey instrument can be used to monitor the quality related performance of given firm on a continuous basis. It can provide a measure for each of the eight quality dimensions. By the use of the instrument significant differences between years can be addressed by top management. It can also be used by multi-unit firms to track and compare the quality performance of each unit or store. Comparisons between different units could be made to help to prioritize quality management efforts. Quality performance scores can also be a factor in manager performance appraisals and compensation, among other uses. It can also help in pinpointing areas requiring managerial attention and action to improve product or service quality.

CONCLUSION

The current study examined the Saraph et al. instrument by using data from 84 manufacturing and service firms in Turkey. Reliability, construct validity and creation related validity were tested. It was concluded that the results of consistency and criterion related validity analyses were very similar to those of Saraph et al., Bedri et al. and Quazi et al. On the other hand some differences was seen in construct validity results. Of the eight critical factors of quality management, Saraph et al. found

Table III Item to scale correlation matrix for the critical factors of quality management

		SCALE							
Factor	**Item**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Role of divisional top management and quality policy (Scale 1)	**1**	*0,77*	0,50	0,51	0,62	0,45	0,46	0,44	0,43
	2	*0,80*	0,62	0,59	0,66	0,59	0,64	0,55	0,60
	3	*0,80*	0,63	0,52	0,66	0,54	0,58	0,56	0,56
	4	*0,70*	0,52	0,41	0,54	0,45	0,50	0,49	0,46
	5	*0,60*	0,35	0,38	0,37	0,35	0,32	0,32	0,41
	6	*0,72*	0,51	0,54	0,49	0,39	0,48	0,42	0,50
	7	*0,82*	0,65	0,66	0,63	0,57	0,71	0,58	0,60
	8	*0,78*	0,53	0,51	0,61	0,56	0,49	0,50	0,61
	9	*0,64*	0,40	0,51	0,52	0,53	0,42	0,47	0,62
	10	*0,80*	0,60	0,66	0,62	0,63	0,69	0,61	0,70
	11	*0,75*	0,66	0,73	0,63	0,64	0,70	0,63	0,68
	12	*0,70*	*0,58*	*0,61*	*0,75*	*0,56*	*0,54*	*0,50*	*0,51*
	13	*0,79*	0,66	0,74	0,70	0,66	0,73	0,67	0,66
Role of quality department (Scale 2)	**14**	0,70	*0,84*	0,66	0,61	0,63	0,74	0,63	0,62
	15	0,58	*0,77*	0,44	0,57	0,37	0,50	0,41	0,36
	16	0,62	*0,86*	0,63	0,56	0,54	0,74	0,61	0,51
	17	0,62	*0,85*	0,60	0,58	0,62	0,64	0,54	0,57
	18	0,62	*0,83*	0,55	0,65	0,56	0,63	0,55	0,55
	19	0,56	*0,78*	0,61	0,66	0,54	0,62	0,52	0,50
Training (Scale 3)	**20**	0,59	0,53	*0,86*	0,50	0,53	0,66	0,55	0,53
	21	0,60	0,57	*0,85*	0,52	0,57	0,63	0,49	0,56
	22	0,65	0,57	*0,85*	0,55	0,52	0,65	0,57	0,55
	23	0,73	0,67	*0,83*	0,69	0,58	0,73	0,65	0,66
	24	0,73	0,71	*0,88*	0,60	0,66	0,76	0,67	0,70
	25	0,69	0,64	*0,87*	0,61	0,70	0,69	0,62	0,69
	26	0,69	0,62	*0,87*	0,65	0,67	0,70	0,67	0,67
	27	0,59	0,53	*0,85*	0,53	0,63	0,62	0,60	0,63
	28	0,68	0,61	*0,80*	0,57	0,57	0,63	0,69	0,70
Product/service design (Scale 4)	**30**	0,64	0,55	0,63	*0,77*	0,61	0,60	0,53	0,56
	31	0,59	0,63	0,54	*0,79*	0,67	0,63	0,52	0,57
	32	0,72	0,61	0,64	*0,74*	0,68	0,64	0,51	0,64
	33	0,65	0,54	0,52	*0,80*	0,56	0,56	0,44	0,55
	34	0,53	0,50	0,37	*0,77*	0,41	0,45	0,37	0,37
	35	0,68	0,59	0,53	*0,82*	0,56	0,58	0,58	0,56
	36	0,64	0,64	0,59	*0,84*	0,62	0,65	0,68	0,61
	37	0,61	0,51	0,45	*0,75*	0,54	0,51	0,48	0,51
Supplier quality management (Scale 5)	**38**	0,57	0,55	0,50	0,56	*0,72*	0,61	0,47	0,55
	39	0,55	0,60	0,56	0,57	*0,77*	0,70	0,65	0,60
	40	0,51	0,56	0,44	0,58	*0,70*	0,63	0,51	0,48
	41	0,59	0,57	0,57	0,61	*0,81*	0,68	0,62	0,61
	42	0,64	0,58	0,58	0,64	*0,80*	0,67	0,61	0,68
	43	0,51	0,45	0,51	0,54	*0,74*	0,55	0,50	0,60
	44	0,52	0,39	0,55	0,43	*0,70*	0,51	0,51	0,64
	45	0,53	0,45	0,63	0,51	*0,77*	0,57	0,51	0,67
	46	0,48	0,46	0,38	0,55	*0,73*	0,51	0,36	0,56
	47	0,49	0,39	0,52	0,54	*0,72*	0,55	0,45	0,56

(continued)

seven to be uni-factorial and the other bi-factorial. The Badri et al. study found all eight factors to be uni-factorial. Quazi et al. study found three of the factors to be uni-factorial and the five others multi-factorial. Our study like Bedri et al.' found that all eight factors to be uni-factorial.

In conclusion, the instrument developed by Saraph et al. appears to be reliable and valid for the measurement of the quality management practices of Turkish firms. Since the robustness of the instrument is high, it can also be used to monitor or compare the quality practices of any Turkish firms. In addition, we hope the availability of this instrument will stimulate much needed empirical research on TQM.

		SCALE							
Factor	**Item**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Process management/ operating procedures (Scale 6)	**48**	0,61	0,69	0,65	0,57	0,57	*0,81*	0,64	0,56
	49	0,52	0,48	0,53	0,48	0,60	*0,69*	0,61	0,52
	50	0,56	0,55	0,63	0,58	0,69	*0,78*	0,58	0,59
	51	0,52	0,47	0,62	0,45	0,62	*0,76*	0,55	0,52
	52	0,53	0,53	0,59	0,43	0,61	*0,75*	0,53	0,50
	53	0,62	0,67	0,66	0,63	0,69	*0,82*	0,68	0,62
	54	0,57	0,64	0,59	0,51	0,49	*0,71*	0,58	0,50
	55	0,49	0,59	0,53	0,53	0,54	*0,72*	0,63	0,51
	56	0,58	0,59	0,55	0,61	0,53	*0,74*	0,58	0,50
	57	0,67	0,69	0,58	0,69	0,58	*0,77*	0,60	0,58
	58	0,62	0,62	0,61	0,58	0,60	*0,79*	0,66	0,65
	59	0,63	0,63	0,66	0,65	0,73	*0,77*	0,67	0,71
	60	0,61	0,66	0,66	0,63	0,63	*0,78*	0,68	0,60
	61	0,61	0,58	0,63	0,60	0,66	0,74	*0,85*	0,70
Quality data and reporting (Scale 7)	**62**	0,48	0,49	0,52	0,47	0,44	0,58	*0,80*	0,50
	63	0,60	0,59	0,63	0,57	0,59	0,73	*0,88*	0,62
	64	0,64	0,64	0,71	0,61	0,63	0,76	*0,91*	0,73
	65	0,55	0,51	0,52	0,56	0,54	0,63	*0,88*	0,63
	66	0,62	0,63	0,67	0,52	0,61	0,72	*0,86*	0,75
	67	0,57	0,51	0,53	0,63	0,53	0,59	*0,76*	0,59
	68	0,68	0,53	0,68	0,57	0,63	0,64	*0,79*	0,74
	69	0,58	0,55	0,62	0,46	0,61	0,69	*0,83*	0,73
Employee relations (Scale 8)	**70**	0,59	0,47	0,69	0,47	0,62	0,58	0,69	*0,85*
	71	0,66	0,50	0,68	0,58	0,68	0,62	0,68	*0,83*
	72	0,69	0,55	0,59	0,59	0,66	0,66	0,69	*0,81*
	73	0,63	0,55	0,55	0,65	0,68	0,64	0,72	*0,86*
	74	0,68	0,56	0,67	0,57	0,69	0,61	0,70	*0,87*
	76	0,70	0,64	0,61	0,68	0,72	0,70	0,67	*0,84*
	77	0,68	0,51	0,56	0,61	0,70	0,63	0,58	*0,83*
	78	0,57	0,53	0,53	0,54	0,60	0,59	0,60	*0,72*

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Appendix The instrument for measuring the critical factors of quality management (Three dropped items included)

Factor 1 Role of top management and quality policy

(1) The extent to which the top executive (responsible for profit and loss) assumes responsibility for quality performance.
(2) The extent of acceptance of responsibility for quality by major departmental heads within the organization.
(3) Degree to which top management (top executive and major departmental heads) is evaluated for quality performance.
(4) Importance attached to quality by top management in relation to cost and schedule objectives.
(5) Degree to which top management considers quality improvements as a way to increase profits.
(6) Extent to which top management supports long-term quality improvement process.
(7) Degree of participation by major department heads in the quality improvement process.
(8) Extent to which top management has objectives for quality performance.
(9) Specificity of quality goals within the organization.
(10) Comprehensiveness of the goal-setting process for quality within the organization.
(11) Extent to which quality goals and policy are understood within the organization.
(12) Amount of review of quality issues in top management meetings. (Dropped)
(13) Degree of comprehensiveness of the quality plan within the organization.

Factor 2 Role of the quality department

(14) Visibility of the quality department.
(15) Quality department's access to top management.
(16) Autonomy of the quality department.
(17) Utilization of quality staff professionals as a consulting resource.
(18) Amount of coordination between the quality department and other departments.
(19) Effectiveness of the quality department in improving quality.

Factor 3 Training

(20) Specific work skills training (technical and vocational) given to hourly employees throughout the organization.
(21) Team building and group dynamics training for employees in the organization.
(22) Quality-related training given to hourly employees throughout the organization.
(23) Quality-related training given to managers and supervisors throughout the organization.
(24) Training in the 'total quality concept' (i.e. philosophy of company-wide responsibility for quality) throughout the organization.
(25) Training of employees to implement quality circle type program.
(26) Training in the basic statistical techniques (such as histograms and control charts) in the organization as a whole.
(27) Training in advanced statistical techniques (such as design of experiments and regression analysis) in the organization as a whole.
(28) Commitment of top management to employee training.
(29) Availability of resources for employee training in the organization. (Dropped)

Factor 4 Product/service design

(30) Thoroughness of new product/service design reviews before the product/service is produced and marketed.
(31) Coordination among affected departments in the product/service development process.
(32) Quality of new products/services emphasized in relation to cost or schedule objectives.
(33) Extent to which implementation/productivity is considered in the product/service design process.
(34) Extent to which sales and marketing people consider quality as a saleable attribute.
(35) Extent of analysis of customer requirements in product/service development process.
(36) Clarity of product/service specifications.
(37) Quality emphasis by sales, customer service, marketing and PR personnel.

Factor 5 Supplier quality

(38) Extent to which suppliers are selected based on quality rather than price or schedule.
(39) Thoroughness of the supplier rating system.
(40) Extent to which longer-term relationships are offered to suppliers.
(41) Clarity of specifications provided to suppliers.
(42) Responsibility assumed by purchasing department for the quality of incoming products/services.
(43) Extent to which suppliers have programs to assure quality of their products and services.
(44) Amount of education of suppliers by organization.
(45) Technical assistance provided to the suppliers.
(46) Reliance on reasonably few dependable suppliers.
(47) Involvement of the suppliers in the product development process.

Factor 6 Process management/operating procedures

(48) Use of acceptance sampling to accept/reject lots or batches of work.
(49) Use of statistical control charts to control processes.
(50) Amount of preventive equipment maintenance.
(51) Extent to which inspection, review or checking of work is automated.
(52) Degree of automation in the process.
(53) Extent to which process design is 'foolproof' and minimizes the chances of employee errors.
(54) Amount of incoming inspection, review or checking.
(55) Amount of in-process inspection, review or checking.
(56) Amount of final inspection, review or checking.
(57) Importance of inspection, review or checking of work.
(58) Self-inspection by workers.
(59) Stability of production schedule/work distribution.
(60) Clarity of work or process instructions given to employees.

Factor 7 Quality data and reporting

(61) Availability of cost of quality data in the organization.
(62) Availability of quality data (error rates, defect rates, scrap rates, defects, etc.).
(63) Timeliness of the quality data.
(64) Extent of quality data collected by the service/support areas of the organization.
(65) Extent to which quality data (cost of quality, defects, errors, scrap, etc.) are used as tools to manage quality.
(66) Extent to which quality data are available to hourly employees.
(67) Extent to which quality data are available to managers and supervisors.
(68) Extent to which quality data are used to evaluate supervisor and managerial performance.
(69) Extent to which quality data, control chart, etc. are displayed at employee workstations.

Factor 8 Employee relations

(70) Extent to which quality circle or employee involvement type program are implemented in the organization.
(71) Effectiveness of quality circle or employee involvement type programs in the organization.
(72) Extent to which employees are held responsible for error-free output.
(73) Amount of feedback provided to employees on their quality performance.
(74) Degree of participation in quality decisions by hourly/non-supervisory employees.
(75) Impact of labor union on quality improvement. (Dropped)
(76) Extent to which quality awareness building among employees is on-going.
(77) Extent to which employees are recognized for superior quality performance.
(78) Effectiveness of supervisors in solving problems/issues.