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The impact of ISO/TS 16949 on automotive industries and created organizational capabilities from its implementation

Bakhtiar Ostadi, Mohammad Aghdasi, Reza Baradaran Kazemzadeh

Department of Industrial Engineering, Faculty of Engineering, Tarbiat Modares University (IRAN)

bostadi@modares.ac.ir; aghdasim@modares.ac.ir; rkazem@modares.ac.ir

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Abstract: ISO/TS 16949 is an ISO Technical Specification. ISO/TS 16949 achieves the objectives which are continually to improve the production of automobile parts and related services, and to strengthen the international competition for the automotive industry and its suppliers. By applying this quality system standard, automotive manufacturers could offer superior products and good services to customers. The more the companies know about the benefits if quality management systems such as ISO/TS 16949, better they can seek interest and determine indices of these systems. So, this standard has been implemented in companies considering a number of benefits. In this paper, we carry out an empirical study in order to verify the importance these benefits and ranking them based on the value of importance. Finally, the study tends to provide a reference guide considering benefits assessment and created organizational capabilities from this standard for the automotive industry in pursuing ISO/TS 16949 and procuring maximum benefit from the results.

Keywords: ISO TS/16949, quality management system, assessment, organizational capabilities

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1 Introduction

1.1 ISO/TS 16949:2009

In recent years, the importance lent to quality management, both in Total Quality Management (TQM) models and in ISO 9000 normalization and certification, has been overwhelming in the business world (Easton & Jarrel, 1998; Lee & Palmer, 1999; Koc, 2007; Ahire & Ravichandran, 2001). This has led to a numerous researchers to concentrate their efforts on studying the quality movement.

Currently, there are several quality management strategies or philosophies that an organization can apply to maintain and improve quality of its processes, products, services and overall business performances. The most important of them are:

- total quality management (TQM);
- the Malcolm Baldrige Criteria for Performance Excellence;
- the EFQM Excellence Model; and
- the standard ISO 9001.

ISO 9000 can be considered to be a subset of TQM. ISO 9000 mainly deals with quality management systems (QMSs) for the design, development, purchasing, production, installation, and servicing of products and services. The literature does not have unanimous agreement on the effects of ISO 9000 registration on organizational performance. Some of the previous studies found that ISO registration did not necessarily improve companies' performance (Sila, 2007). On the other hand, according to the International Organization for Standardization, ISO 9000 can increase customer satisfaction, provide cost and risk-management benefits, and result in improved competitiveness (Sila, 2007). In fact, Rao, Raghunathan and Solis (1997) found that ISO-registered companies had better quality management practices and quality results than those companies that were neither ISO-registered nor interested in obtaining registration. Ismail and Hashmi (1999) also reported better performance for ISO-registered companies compared to non-ISO-registered companies.

ISO 9000 provides the opportunity to evaluate suppliers' goods and services consistently. Many independent third parties or registrars are now using the ISO

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9000 series standards to evaluate suppliers' quality systems. When a supplier's quality system conforms to the appropriate ISO 9000 standards, the registrar issues the supplier a certificate. The supplier is also listed in directories of registered suppliers (Lee & Palmer, 1999; Koc, 2007; Rao et al., 1997).

ISO/TS 16949 is a standard for QMS. This standard outlines the specific requirements for the application of ISO 9001:2008 to automotive production and relevant service part organizations. It contains recommended automotive industry practices and examples. ISO 9001:2008 specifies requirements for a QMS that can be used for internal application by organizations, or for certification, or for contractual purposes. Both standards use the "process" approach, referring to the application of a system of processes (numerous linked activities) that allows the transformation of inputs into outputs, such as in the manufacture of cars and related parts. ISO/TS 16949 is developed by the International Automotive Task Force (IATF) for global recognition; it has become a mandatory set of requirements of many automotive Original Equipment Manufacturers (OEMs) in North America and Europe (ISO/TS 16949:2009; Lin, Liu, Hsu, & Lai, 2004).

This standard recognizes the uniqueness of every automotive supplier's process, while providing critical tools to help your company better meet customer-specific requirements. Rather than using the "element" or checklist method of the QS-9000 standard, ISO/TS 16949:2009 is based on the process approach. It provides an organized way for business to document and codify specific work practices in ways that best serve customer needs (ISO/TS 16949:2009).

ISO/TS 16949 eliminates redundancy, cost and administrative burdens imposed by multiple standard formerly mandated in various geographic regions. It will ultimately replace QS-9000 and European quality management standards for most North American and European Quality Environment Modules (QEMs) by the end of 2006 due to mandates by major automotive OEMs (Lin et al., 2004; Bayati & Taghavi, 2007).

This paper consists of two sections. The first section comes with the statistical results of surveys of one of the biggest automotive industry in the Middle East that have failed and succeeded in ISO/TS 16949. Furthermore, the performances after executing ISO/TS 16949 were evaluated by assessment formula which it has been developed based on the refined benefits and defined factors. This formula can be

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used by firms to analyze their status in achieved benefits during implementing ISO/TS 16949 in their organizations. Despite the importance of quality managements systems such ISO/TS 16949, research on created organizational capabilities form benefits and results of these systems is not yet firmly established or well structured. Nonetheless, it is difficult to say what the organizational capabilities are which QMSs such as ISO/TS 16949 created (discussed). Therefore, the second section establishes and examines created organizational capabilities from this quality management system.

1.2 QMSs in Iran: historical perspective

Quality tendency and movements can be seen in the majority of Iranian companies, and the preference is to acquire ISO 9000 certification (Bayati & Taghavi, 2007). The main reason for companies to get this certification is to compete in trade and achieve better sale through inducing products quality. Quality management initiatives did not start in Iran until the end of the 1980's. The first five-year economic development program, which began in 1989, was the main driver for emphasis on quality in the country. The initiatives began by presenting workshops on quality management and quality assurance in a governmental institution, the Industrial Management Institute (IMI). Also, economic relationships with certain European countries (such as Germany, France, Italy) were key reasons for the application of ISO 9000 standards in Iran. This movement urged companies to practice quality management through the implementation of ISO 9000 standard (Amiran, 2000; Mellat Parast, 2006).

The first movement in this regard, started with collaboration with Peugeot (Citroen). The two corporations, Iran Khodro and Citroen, signed a contract to produce Peugeot in Iran. Along with that, KIA Motors Company, from South Korea, established a production line in Iran. It was during that period that QS-9000 standards were developed and internalized in the automotive industry in Iran. This trend encouraged consulting firms to seek more business opportunities for the automotive part makers, to the extent that some of them changed their business strategy and mainly focused on the consulting industry (Bayati & Taghavi, 2007; Amiran, 2000; Mellat Parast, 2006).

The second movement toward quality management began around 1993, having its origin in the automotive industry. The automotive industry in Iran was established

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around 1960, but its technological capacity was not developed far beyond assembly and maintenance. There was a national interest (mostly among the policy makers) for further developing of this industry. The government decided to restructure the automotive industry, which was mainly integrated. The strategy was to disintegrate it, to provide the required infrastructure for it, and finally to develop the national automobile. Thus, the government began to invest in the automotive industry (labor, capital), collaborating with a few European countries (France, Germany), and provided financial/technical support for the automotive part makers (Bayati & Taghavi, 2007; Amiran, 2000; Mellat Parast, 2006).

2 Design and method of experiment

In order to explore the effects of ISO/TS benefits on Iran corporations, a survey questionnaire was mailed to 57 registered companies. The questionnaires are design with reference to Lin et al. (2004), Shih, Huarng, and Lin (1996) and Lou (1997), as well as some advice from the project leaders of several interviewed companies and consultants from some consulting companies. In order to measure all items, a five-point Likert scale has been used. The scale ranged from 1 to 5, indicating [1] = Very Low, [2] = Low, [3] = Medium, [4] = High, and [5] = Very High.

Due to the structure of the study, SPSS 13.0 for Windows is used in all the statistical analysis. The analysis methods include: t-test (for independent samples was used to evaluate the statistical significance of the difference), factor analysis, and cluster analysis.

3 Results and discussions

3.1 Demographic information

In order to explore the effects of ISO/TS 16949 motivations and benefits in Iran corporations, a survey questionnaire was mailed to 57 registered companies. In the sample 100% of the participants were male. This gender homogeneity was not unusual since most managers and consultants at that level in Iran are male. The average age for the respondents was 49 years. All respondents have been in the automotive industry for at least five years.

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The questionnaire was designed and pre-tested by two academicians and three ISO managers of certified companies. The managers who are responsible for implementing ISO/TS 16949 are asked to answer subjectively questions about the degree of benefit from certification and the motivations of their companies to certification.

3.2 T-test

All data were collected. Thirty-five questions about the benefits of ISO/TS 16949 implementation are measured in Likert scale of five points. Writing a 5 means that the ISO manager agrees great benefits from ISO certification, and writing a 1 means little help from ISO certification. Of 57 mailed questionnaires, 39 were returned by respondents for about a 68% rate of return. Three of the 39 returned questionnaires were incomplete. This study, therefore, is based on 36 completed questionnaires. Table 1 presents the distribution of the respondents by firm size.

Number of employee	Number of company	%	% Cumulative
0 ≤ No. ≤ 25	17	47.2	47.2
25 ≤ No. ≤ 50	15	41.7	88.9
50 ≤ No. ≤ 75	2	5.55	94.4
75 ≤ No. ≤ 100	2	5.55	100

Table 1. “The distribution of the respondents by firm size”.

Table 2 shows companies’ motives for implementing ISO/TS 16949:2002. Most of the companies choose “improve company quality image” (78%), “strengthen quality management system” (69%), “upgrade product, service & market share” (42%) and “Integrates ISO/TS 16949 with TQM” (47%) as their motivation for implementing ISO (51%).

Motives	Percentage
Improve company quality image	0.78
Upgrade product, service & market share	0.42
Strengthen quality management system	0.69
Integrates ISO/TS 16949 with TQM	0.47

Table 2. “Motives for implementing ISO/TS 16949”.

The null hypothesis of H0 is assumed, that the average score of degree of benefit is 3, and the alternative hypothesis of H1 is assumed to be that the average score of degree of benefit is greater than 3. The t- test is used for testing H1, and the results of t-tests for each item are shown in Table 3. All tests were performed at a 90% confidence level (alpha = 0.1). The value of Cronbach coefficient alpha for

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those 36 items is 0.977. According to Guieford (1965), a reliability coefficient (Cronbach's α) greater than 0.7, indicates a high reliability; while values between 0.35 and 0.7 are considered fair. Thus, the reliability of the results from the questionnaire is highly stable and consistent.

Item name		Standard deviation	t value	Sign.
Q1	Jobs assign are clear and reasonable	0.9063	4.987	Y
Q2	Authorities and responsibilities are committed to paper	0.9568	7.647	Y
Q3	Higher level managers are clearer with the internal operation	0.9422	4.684	Y
Q4	Base employees are clearer with the internal operation	0.9718	5.987	Y
Q5	Managing of the laboratory is more specific after implementation of ISO/TS.	0.8764	6.244	Y
Q6	Managers support the process and idea of their subordinate employees	0.9942	5.648	Y
Q7	Executive level encourage their employees to express their	0.9718	3.540	Y
Q8	ideas	0.8863	4.173	Y
Q9	High loyalty to the company among colleagues	1.0397	0.637	N
Q10	Reducing management cost	0.9557	1.463	N
Q11	Reducing quality cost	0.9435	-0.98	N
Q12	Decrease in purchasing cost	0.9449	1.571	N
Q13	Reduction of production cost	0.9195	4.528	Y
Q14	Decreasing the defect rate of production	1.0151	2.877	Y
Q15	Trust and care among colleagues	0.9627	2.062	Y
Q16	Manager and subordinates are related happily	0.9476	6.837	Y
Q17	Increase the morality of the organization	1.0309	6.499	Y
Q18	Increase of communication between departments	0.9381	4.053	Y
Q19	Improvement of communication between departments and higher level	1.0108	5.550	Y
Q20	Improvement of communication and cooperation between	0.9442	1.967	N
Q21	department and colleagues	0.8930	2.619	Y
Q22	Decrease of stock inventory	0.9664	2.654	Y
Q23	Increasing production capacity	1.0673	2.729	Y
Q24	Reduction of cycle time	1.0237	8.149	Y
Q25	Significant improvement on the efficiency of a job	0.9270	0.742	N
Q26	Increase of customers satisfaction	0.9860	1.866	N
Q27	Increase of profits	0.9559	6.247	Y
Q28	Increasing orders	0.9656	7.126	Y
Q29	Everyone is clearer to the internal information transfer and	1.0003	3.039	Y
Q30	changes	0.9940	4.514	Y
Q31	Documentation is complete and reasonable	1.0496	3.786	Y
Q32	Less backlog of missive and related document Less un-integrated related documents between departments	1.0166	6.244	Y
Q33	Smoother transaction due to simplified and integrating document	0.9654	1.430	N
Q34	More advantageous than disadvantageous of the simplified and	0.8943	2.618	Y
Q35	integrating document.	0.9023	4.328	Y
	Sufficient people in understanding related information about ISO/TS.			
	Sufficient understanding of quality related statistical techniques.			
	Training programs are held frequently			

Table 3. "Benefits of ISO/TS 16949".

As shown in Table 3, "Authorities and responsibilities are committed to paper", "Increase of customers' satisfaction" and "Documentation is complete and reasonable" are the three factors that have the most effect on efficiency after the

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implementation of ISO/TS 16949. On the other hand, factors such as "Decrease in purchasing cost", "Reducing management cost", "Increase of profits", "Reducing quality cost", "Sufficient people in understanding related information about ISO/TS", 'Reduction of production cost', 'Increasing orders' and 'Decrease of stock inventory' are the least significant factors after the t-test.

The results show that the t-tests fail to reject the null hypotheses for items Q9, Q10, Q11, Q12, Q20, Q25, Q26 and Q33. In other words, the benefits of these items are not significant. The benefits of the remaining 27 items are recognized to be significant. Hence, a lot of beneficial items are obtained by ISO/TS implementation. These benefits are quite obvious.

3.3 Factor analysis

The 27 beneficial items were reorganized into six common factors using factor analysis. The principle component analysis method was employed. Six common factors are chosen to explain the 74.82% of the variances of the 27 items since each of their corresponding eigen values is greater than one. Interpreting based on the factor loading pattern of the unrotated factor matrix would be difficult.

Item	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
Q19	0.718	-	-	-	-	-
Q18	0.721	-	-	-	-	-
Q17	0.699	-	-	-	-	-
Q16	0.651	-	-	-	-	-
Q27	0.479	-	-	-	-	-
Q24	0.477	-	-	-	-	-
Q22	-	0.786	-	-	-	-
Q23	-	0.683	-	-	-	-
Q29	-	0.646	-	-	-	-
Q4	-	0.347	-	-	-	-
Q14	-	-	0.722	-	-	-
Q7	-	-	0.714	-	-	-
Q15	-	-	0.687	-	-	-
Q6	-	-	0.579	-	-	-
Q34	-	-	0.519	-	-	-
Q21	-	-	0.449	-	-	-
Q5	-	-	-	0.768	-	-
Q1	-	-	-	0.708	-	-
Q2	-	-	-	0.678	-	-
Q3	-	-	-	0.612	-	-
Q32	-	-	-	-	0.794	-
Q31	-	-	-	-	0.658	-
Q35	-	-	.-	-	0.479	-
Q30	-	-	-	-	-	0.737
Q8	-	-	-	-	-	0.548
Q28	-	-	-	-	-	0.487

Table 4. "Equamax rotation component analysis factor matrix".

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The equamax rotation method is used to obtain easier explanations of six factors. The equamax rotation component analysis factor matrix is shown in Table 4. Those factor loadings whose values are lower than 0.4 are ignored. Note that the total amount of extracted variance is the same in the rotated solution as it was in the unrotated one. The variance explained by each factor ranges from 4.53 to 3.80. The explanatory power has been distributed more evenly owing to the rotation. The name of each common factor is given on the basis of the factor loading.

Six common factors were named: (a) Communication; (b) Integration; (c) Status of organization; (d) Managing Aspect; (e) Documentation; and (f) Managing efficiency. Thus, the answers given by respondents to the 35 benefits of ISO/TS implementation a more manageable and significant six-factor structure, showing six dimensions of the benefits created by a this quality management system. The most important part is documentation. The least important benefit is managing efficiency, whereas managing aspect and integration have an average importance. This proves that ISO generate mainly documentation and many certified firms have to improve employee involvement through enhancing the communication.

3.4 Cluster analysis

Cluster analysis is a group of multivariate techniques whose primary purpose is to assemble objects based on the characteristics they possess. Cluster analysis classifies objects, so that each object is similar to the others in the cluster with respect to a predetermined selection criterion. The resulting clusters of objects should then exhibit high internal (within-cluster) homogeneity and high external (between clusters) heterogeneity. By applying this analysis, we use the factor scores in previous analysis and we group corporations according to their benefits of ISO/TS.

According to the theory of task motivation and incentives of Locke (1968) and Locke, Shaw, Saari and Latham (1981), this survey is conducted to verify how motivations affect Iran corporate performances, which are the benefits of the ISO/TS 16949 implementation. Based on their motivation, the 36 sample corporations are classified into four clusters using cluster analysis. Table 5 shows the number of corporations which choosing each motivation in each group. Multivariate analysis of variance (MANOVA) is used to test the effects of different patterns of motivation on benefits of the ISO/TS 16949 implementation. The six

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factors from Table 4 are chosen as dependent variables, and the patterns of motivation form the independent variable.

Motives	Group 1 (2)	Group 2 (3)	Group 3 (8)	Group 4 (23)
Improve company quality image	2	0	7	19
Upgrade product, service & market share	2	2	0	15
Strengthen quality management system	3	0	8	12
Integrates ISO/TS 16949 with TQM	0	0	4	18

Table 5. “The number of corporations choosing each motivation in each cluster”.

The results of the MANOVA are shown in Table 6. Since the *p*-value of Wilks's lambda is less than 0.1 (alpha is set to 0.1), the global benefits of the ISO/TS 16949 implementation are different among different patterns of motivations. Specifically, the benefits on “*Communication*” and “*Managing efficiency*” are different (the *p*-values of factor 1 and factor 6 are both less than 0.1).

Duncan's multiple range test is used to compare the means of benefits on “Communication” and “Managing efficiency”. The average scores on factor 1 are 3.79, 2.21, 3.23 and 3.69 for each group respectively. The average scores on factor 6 for each group in ascending order are 4.00, 2.79, 3.64 and 4.01. The results show that group 1 and group 4 obtained stronger help on both “Communication” and “Managing efficiency” than group 2 did.

Item	F-value	P-value
Factor 1	2.78	0.413
Factor 2	1.92	0.159
Factor 3	1.04	0.4132
Factor 4	0.71	0.643
Factor 5	0.12	0.899
Factor 6	2.61	0.045
Statistic	F-value	P-value
Wilks's lambda	1.6498	0.0231
Pillai's trace	1.4997	0.0331
Hotelling-Lawley trace	1.7923	0.0144
Roy's greatest root	5.8769	0.0002

Table 6. “The results of MANOVA”.

The effects of incentives are statistically significant. Group 2 is the most passive; the employees of group 2 just acted on order without any pressure from their customers. Hence, the benefits of ISO/TS implementation are least for group 2. In other words, the companies in group 2 might just want to obtain the ISO/TS certification without the intention of achieving continuous quality improvement.

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4 Assessment of ISO/TS 16949 implementation considering its benefits

The extracted benefits can be used for the assessment and comparison of auditing of the considered organizations with measurement of the indicators and applying their weights and also dimensions' weights. For achieving this goal, we can set a question which it is titled "please assess the strength of each benefits which achieved form implementing of ISO/TS 16949 in your company and assign a number between 1 to 10 to them".

Simple statistical calculations were used for evaluating the benefits (indicators). Elements were scored in the range of ten to one. Each significant element had equal weight. We can use equation 1 to measure the ISO/TS 16949 implementation and achieved benefits within each organization. Here W shows weight of factors (Wd) and the BENdi is average value of each benefits. After calculating the above formula for each company we will have:

$$ISO/TS\ Assesment = \sum_{d=1}^{6} \sum_{i=1}^{i_d} W_d . BEN_{di} \quad (1)$$

5 Discussion and conclusions

5.1 Theoretical implications

The objectives of this paper are as follows:

- to extract the most important benefits and motives of ISO/TS implementation;
- to establish managerial factors for 35 listed benefits by factor analysis;
- to propose a assessment framework that can be used by firms to analyze the value of achieved benefits in their organization after implementing ISO/TS;
- to introduce created organizational capabilities from implementation of quality management system in accordance with ISO/TS 16949;
- to map the six managerial factors into COC-QMs.

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In measuring the ISO/TS 16949 benefits, firstly, we asked the respondents to choose the motivations of their companies to ISO/TS 16949 certification among the 4 listed motives for implementing ISO/TS 16949. Secondly, we asked respondents to rate the effect ISO/TS 16949 had on the 35 listed benefits on a five-point scale, ranging from 1 to 5. The rating did not say anything about whether the respondent regarded his organisation as being strong or weak in the 35 proposed areas (an assessment framework for measuring the state of organization, as being strong or weak in the 35 proposed benefits, has been proposed in section 4). It aimed at assessing the achieved benefits of ISO/TS 16949 regardless of the organization's previous level of performance.

The findings of the study also show a statistical relation between many of the ISO/TS efforts and benefits. The empirical results indicate that adopting ISO brings registered Iran plants significant help in enhancing status of organization, systemization with good documents and data, better quality control, increased competing ability in sales, verifying the internal auditing system and clear managing aspect and efficiency. The effects of incentives on the benefits from ISO are also statistically significant. With more positive attitudes, implementing ISO could bring companies more help in enhancing status of organization and clear managing aspect and efficiency (See Table 3).

Having the results of the analysis, we can conclude that (1) the highest motive of the implementation of the ISO/TS 16949 quality system is the requisition of the higher executive level, which means that the attitude to implementation of the ISO/TS 16949 quality system is highly positive; (2) There is no relative increase of employees' understanding about ISO/TS 16949 quality system after the approval of ISO/TS 16949 quality system certification; (3) The higher the internal efficiency level, the higher the level of satisfaction to the internal efficiency after the implementation of ISO/TS 16949; (4) The higher the managing efficiency level, the higher the level of satisfaction to the internal efficiency after the implementation of ISO/TS 16949.

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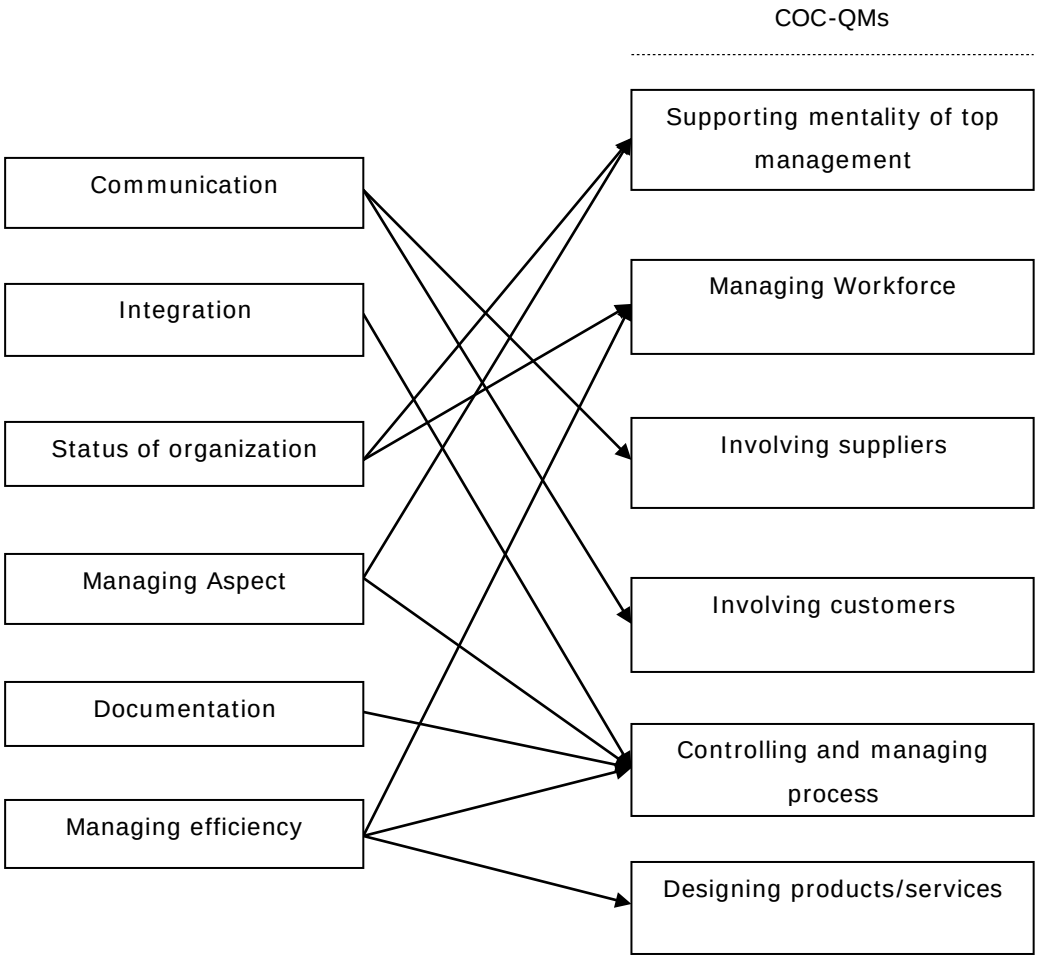

Figure 1. "Created organizational capabilities from implementation of quality management system (COC-QMs)".

Capabilities, thus, refer to an organization's ability to assemble, integrate, and deploy valued resources, usually, in combination or co presence (Amit & Schoemaker, 1993; Schendel, 1994; Russo & Fouts, 1997). Capabilities subsume the notion of organizational competence (Prahalad & Hamel, 1990) and are rooted in processes and business routines. Generally, it can be concluded that these benefits can be created or enhanced the organizational capabilities. In order to assess beneficial items, assessment formula (Eq. 1) which it has been developed based on the refined benefits and defined factors, can be used by organizations to assess their status in achieved benefits and created organizational capabilities by these achievement during implementing ISO/TS 16949 in their organizations. Figure 1 are shown the organizational capabilities. It is clear that the more the value of benefits' assessment (Eq. 1) these capabilities also will be stronger.

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5.2 Managerial implications

The study has shown that (1) there is a statistical relation between ISO/TS effort and implementing benefits; and (2) successful implementation of ISO/TS lead to create some important organizational capabilities which value of this capabilities are related to the value of successful quality efforts. Thus, it seems that the most important task for quality managers and indeed for top management is to make these values permeate their organisation. The QMS literature has unanimously emphasized the importance of top management support for QMS (Beer, 2003; Yeung, Cheng, & Lai, 2005). This study once again confirms that "supporting mentality of top management", "Managing Workforce", "Involving suppliers", "Involving customers", "Controlling and managing process", and "Designing products/services" are critical capabilities which they have been achieved from implementing the QMS (such as ISO/TS) and they are also important for future improvement projects in each company.

5.3 Limitations

Several limitations of this study should be discussed in this section. First, the data collection method was based on managers' respond. Managers response to questionnaires from their own local environment, which may or may not reflect what is going on in the organization as a whole (Lakhal, Pasin, & Limam, 2006). Nevertheless, the use of manager's respond is frequently used in quality management research (Madu, 1998). Second, the study's sample size is small. Hofstede, Neuijen, Ohayv and Sanders (1990) state that a lower sample size is acceptable when this kind of stable data with high internal consistency is used. The results of this study should not be generalized beyond what is reasonable, given the nature of the sample. Future studies should consider substantially larger samples including greater representation of industries and countries.

5.4 Future research

Future research can be done to explain the barriers in adoption or the reasons why firms are reluctant to adopt the quality management standards. The relationship between the technology level of manufacturing systems and ISO/TS 16949 practices is also an interesting subject to investigate. In addition, how the commitment is achieved within the firm as well as additional tools and techniques

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that support the certification are important criteria to investigate in future research. It would also be interesting to investigate the benefits of ISO/TS 16949 in a cross-national research.

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