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Determinants of quality management systems implementation in Tunisian firms

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Abstract. This research explores the impact of the firm's internal and external attributes on its degree of implementation of quality management according to the ISO 9000 standard. This econometric study, based on the data gathered from a sample of Tunisian companies certified or in the course of certification in ISO 9001: 2000, reveals that the application of quality management depends on the organizational and environmental context of the company: a motivation rather internal than external to be certified, the application of ISO 9004 standard recommendations, the adhesion of the company to the leveling program, size, investment in new technologies of information and communication and in technologies of analysis and measurement and the importance of innovation and quality criterion for customers.

Keywords. Quality management, NTIC, ISO 9000, Seemingly unrelated regressions.

1 Introduction

In an agitated environment of globalization and to deal with the increased competition in a market where the challenges and issues have become multiple, firms worldwide have adopted new modes of intangible investment and management strategies. Particular attention is given to the model of Quality Management (QM) according to ISO 9000 because it offers the organization a set of best practices allowing the elimination of systemic malfunction risk by appropriate management of resources and processes, monitoring results and promoting continuous improvement of the internal organization. In fact, more and more customers require their suppliers to be certified by this standard. Henceforth, the number of companies certified according to ISO 9001 in the world has increased, dramatically. In Tunisia, the latest statistics from the Agency of Industry Promotion has recorded more than 800 certified companies.

This growing interest devoted to the concept of quality is the result of many economic studies showing the evolution of the quality approach from a simple product characterization to an approach taking an organizational dimension (Gomez, 1996; Debruyne, 2001; Mazé, 2003; Hajjem, 2011). Several empirical studies showed that quality is a key factor of competition between firms (Scotto, 1996; Solis and al, 1997; Duane and al., 2009; Legros and Galia. 2011). Others analyzed the relationship between innovation and quality and indicated that for great innovation performance improvement well established quality system is needed inside the firm (Sanja, and Galia. 2009).

However, little work has been done to show that the adoption of QM practices depends

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on the organizational context and the firm's environment (Fahmi, 2000; Wardhani, 2008; Anand and Prajogo, 2009;Prajogo, 2011). Our study is in this research field. It specificallyconcentrates on the impact of the firm's internal and external attributes on the level of QM implementation. Our paper is organized as follows: First, the theoretical assumptions from the literature review are presented. Then, our econometric method based on simultaneous equation model are explained. Finally, the different results and the prospects for future research are presented and discussed.

2 Conceptual framework and research hypotheses

The interest by the QM model according to ISO 9000 and the growing number of companies seeking certification have led many researchers to make contributions on the empirical determinants of this new type of strategic management adoption. Thus, several studies have been conducted to examine the effect of motivation to get certified. Others have studied the impact of environmental and organizational context of the firm (internal and external factors) on the achievement of quality management practices and business performance in general.

2.1 The challenges and limitations of the certification ISO 9001: 2000

Several studies have been conducted to identify the motivations that may induce firms to engage in a process of ISO 9001 certification. For example, Solis and al. (1997) indicated that certified firms registered a higher degree of leadership, information analysis, quality strategic planning, human resource development, quality assurance, good customer-supplier relationships and quality results. Others have studied the effect of certification on business performance. Thus, it turned out that the ISO 9000 adoption positively affects customer satisfaction (Avery and Babel, 1996; Duane and al., 2009), competitiveness, profitability (Scotto, 1996; Hajjem, 2011) and product and service quality (Zelealem and Solomon, 2002).

Indeed, the certification founds the company's reputation by improving the market transaction thanks to the trust built between buyers and sellers. It aims to reduce the quality uncertainty for both the buyer confident in the reliability of the service offered and the seller assured of reliable and regular finding (Debruyne, 2001). So, in addition to the assurance of maintaining the product or service intrinsic quality, ISO 9001 ensure customer satisfaction by his positive evaluation regarding all the contacts that he may have (home phone, on-time delivery, customer service). It also helps to develop a quality management system eliminating the failure risk by a suitable management of resources and processes, monitoring results and promoting continuous improvement of the internal management.

Other studies have revealed that certification should not be a finality in itself. Gongxu (1999) concluded based on extensive investigations in 10 Chinese companies, that being ISO 9001 certified implies only that the degree of Total Quality Management (TQM) has reached a new starting point. Thus, Hongyi (2000) made the recommendation that ISO 9001 should be incorporated with the philosophy and methods of TQM. In addition, Rahman and Sohal (2002) showed that, except the process control factor, there is no significant difference between the impact of total

quality management practices on organizational performance of Australian SMEs with and without ISO 9001 certification.

In fact, certification has also several deficiencies related as much to its inclusion in the firm's competitive evolution, as to the difficulty of its socio-organizational implementation (Debruyne, 2001). The commitment of a company in a certification approach may be encouraged by rational mimetism: the company is obliged to adhere to the standard to deal with the increased competition. Moreover, in the race for ISO certification, it is very difficult for the final consumer to evaluate the benefit he may take from a certified product or service against another that is not certified.

Certification can also be a factor of rigidity and an obstacle to innovation because the internal organizational radical change encourages the lack of questioning about the new structure by the direction. Thus, anticipatory and adaptive capacity of the firm maybe impaired face to the market permanent evolution. In addition, the introduction in the company of too many and detailed written procedures inhibits creativity and personal initiative. The certification in this case is a source of disqualification and return to Taylorism.

Henceforth, some studies (Lee and Palmar, 1999; Pytlak, 2002; Wardhani, 2008) have conditioned the positive impact of certification by the nature of the company's motivation to become certified. The three main cited reasons are direct pressure from customers, indirect pressure from competition and the desire to conquer new markets. In fact, when the leader's motivations to certification are internal (process improvement, work organization, product and service quality, preserving the know-how), not external (direct pressure from customers and / or group, indirect pressure from competitors), the company is more likely to subsequently implement a quality management system at an advanced level (Pytlak, 2002, Anand, and Prajogo, 2009;Prajogo, 2011). All these studies and findings lead us to formulate our first hypothesis:

> *H1: The internal motivations for the certification decision have a significant positive effect on the QM implementation degree.*

Another line of research is to study the effect of the firm's internal and external attributes on the adoption degree of QM practices.

2.2 Impact of the firm's characteristics

Some original research works have shown that the quality management does not generate the same value for all firms and that its implementation depends on organizational context and the firm's environment (Wruck and Jensen, 1994; Fahmi, 2000; Wardhani, 2008, Prajogo, 2011). In the light of these studies, we will formulate our research hypotheses concerning the internal and external factors determining the implementation degree of quality management practices.

Effect of size. Lee and Palmer (1999) have shown that unlike large companies, the use of ISO 9001 certification by small businesses is due more to external than internal factors, and they have little intention of making an extension of their quality program beyond the certification.

Furthermore, the examination of small (<50 employees), medium (50-200 employees) and large (> 200 employees) firms showed significant differences in the contribution

of certification on the implementation degree of QM items especially for human resources management, process management, relationship with suppliers and customers (Gotzamani and Tsiotras, 2002). The improvement of these practices was significantly lower for large firms. The authors explained this result by the fact that these companies have a higher level of quality management even before certification. In fact, unlike large firms, small and medium enterprises have limited managerial skills, ambitions and resources. Quazi and Padibjo (1998) showed that the lack of managers' experience and knowledge, human and financial resources and time required for the implementation of quality management are the major problems faced by SMEs when adopting a quality approach.

Indeed, Quality Management is an approach enabling efficient use of specific information. It gives more autonomy and power to the organization's lower levels and increases their direct responsibilities. This value is generated through timely and appropriate treatment of information and better use of specific knowledge. Therefore, the QM is economically profitable for large firms with significant informational challenges, and where over-centralization would lead to making sub-optimal decisions (Wruck and Jensen, 1994).

Increasing the company size generates the complication of its organization which makes the efficient decision-making impossible in a limited time or in a centralized manner. In addition, the production process requires a lot of information and specific skills, widely distributed among staff which requires employee involvement and teamwork. Moreover, the larger the size, the greater the communication costs are high. Crossing the hierarchy, the transmitted orders can be disturbed and an offset may exist between the implementation of corrective actions and the perception of problems and malfunctions. Under these conditions, if large companies cannot find efficient solutions to these issues of information overload and organizational costs, their performance will inevitably decrease (Fahmi, 2000). The optimal way to organize the activity of these companies is therefore to decentralize responsibilities and to encourage better human knowledge management through the adoption of QM practices. Hence our hypothesis 2:

> *H2: The increase of the firm size has a positive effect on the quality management adoption.*

Role of Investment in New Information and Communication Technologies and in Technologies of Analysis and Measurement. To facilitate the implementation of QM, the firm must establish appropriate means allowing the consistent treatment of information available to agents located at different levels of the hierarchy and making the right decisions at appropriate times. In this regard, the use of new information and communication technologies (ICT) is essential to promote the flow of information and enable the development of more decentralized organizational structures (Harris, 1995; Wardhani, 2008, Prajogo, 2011). Indeed, the role of ICT consists in the compression of time, reducing response deadlines of the company, improving the capacity of information processing and of employees' control.

On the other hand, decentralization of decision making can lead to opportunistic behavior among some employees who are assigned new responsibilities. They will rationally try to benefit from their informational advantage and pursue their own interests instead of the maximization of corporate value. The existence of analysis and

measurement technologies (AMT) facilitates the control of these agents and the coordination of decisions. Thus it is a principal determinant of the QM implementation (Wruck and Jensen, 1994; Fahmi, 2000). This is because these technologies allow reducing control costs related to the decentralization of decision making and the reduction of uncertainty and asymmetric information existing between agents (internal and external partners). These arguments allow us to formulate our third hypothesis:

> *H3: Investment in new information and communication technologies and in measurement and analysis technologies has a positive effect on the implementation degree of QM.*

Role of the interdependence between units. The QM provides continuous improvement across all interdependent units of a company (Fahmi, 2000). In fact, the recourse to quality improvement teams encourages sharing of information regarding quality and malfunctioning. Besides, this promotes cooperation links and communication between the firm's different units. Thus, there is a decrease in internal conflicts and a limitation of individualistic practices. Henceforth, more units are interdependent, more the incentive to mutual control is high, since a low level of effort (high) at a unit may penalize (improve) the performance and the reward for all units (Barua, Lee and Whinston, 1995).

On the other hand, organizational change engendered by the company commitment in a QM calls the establishment of horizontal coordination between units. The process of communication and information exchange are therefore accelerated which allows units to react and quickly find solutions to problems that arise. Furthermore, the implementation level of this approach would be more advanced if staff is polyvalent which promotes flexibility and interchangeability of employees between the units.

Given these arguments, we conclude that the QM return will be more interesting in firms characterized by a high level of interdependence between the units. Hence our hypothesis 4:

> *H4: The degree of interdependence between units has a positive effect on the quality management adoption.*

Impact of the firm's environment. Due to the constant change and uncertainty of the environment, firms are obliged to be informed about changes in customer needs, competition and situations of all their external partners in order to better manage these changes (Cyert and Kumar, 1996; Wardhani, 2008, Prajogo, 2011). This aim requires operating a large amount of information difficult to obtain and manage and developing new skills to interpret and process the data.

Milgrom and Roberts (1988) reported that under such conditions, a company must either increase the amount of information to treat or reduce the need to process information. In fact, a centralized firm may face some incompleteness of data due to the multiplicity of sources and the difficulty to collect everything. QM guidelines such as the decentralized modes of organization promoting skill sharing, teamwork, methods of problem resolution and encouraging employees to respond independently to new situations, all these elements increase organizational capacity to adapt to unpredictable fluctuations in the market and new technologies (Hackman and Wageman, 1995).

Moreover, the importance of innovation for customers is seen as another external factor favoring the adoption of QM. Indeed, the relationship between innovation and quality

has been the subject of several empirical research (Galia and Legros, 2003; Prajogo and Sohal, 2006). The main conclusion of these studies supports a positive relationship between these two constructs. In fact, according to evolutionary theory, the QM can promote competencies and encourage initiative and creativity. Hence, the adoption of QM in this case is encouraged by the willingness of the company to strengthen its innovation capacity in order to follow the evolution of customer expectations (Benezech and al., 2001; Reverdy, 2005).

In addition, the importance of the quality criterion for customer is also an external factor encouraging firms to review and rationalize their internal processes in order to satisfy the needs of their customer increasingly demanding. All these findings lead us to state our fifth hypothesis:

> *H5: The adoption of quality management is positively related to the increased uncertainty of the environment and the importance of innovation and quality criterion for customers.*

Thus, we identified the factors determining the implementation degree of QM practices. We will test these research hypotheses in the following thanks to a survey among a sample of Tunisian firms certified or undergoing certification according to ISO 9001: 2000.

3 Econometric study

3.1 Data collection

Data were collected through a questionnaire addressed in 2006 to Tunisian firms certified or undergoing certification according to ISO 9001: 2000, since we are interested in the QM model according to this standard. The design of the items was made on the basis of the literature (Saraph and al. 1991; Wruck and Jensen, 1994, Solis and al. 1997; Fahmi, 2000; Pytlak, 2002). Finally, the questionnaire was sent to 115 companies and we have received 47 usable returns (a response rate of 40.87%).Industrial companies present 83% of our sample; the majorities are chemical (25.53%) and electrical (21.27%) companies. The percentage of service companies is much lower (17%) as there are still a minority of Tunisian companies in this sector that are engaged in a quality management process.

3.2 Operationalization of variables and model design

Given the increasing number of items related to our issue, we first performed a principal component analysis (PCA) to construct variables measuring QM practices. In fact, this method is the most appropriate to deal with an increasing number of ordinal variables in front of a small number of observations (Evrard and al., 1997). Thus, we have built seven quality management practices: communication of quality policy and direction commitment (P_1), taking into account the clients' needs (P_2), employee involvement (P_3), process control (P_4), developing close relationships with suppliers (P_5), involvement of suppliers (P_6) and integration of environmental requirements (P_7). We note an equivalence between these practices and principles of QM according to ISO 9000 (*Customer-Focused Organization, Leadership, Involvement of People, Process*

Approach, Continual Improvement, Factual Approach to Decision Making and Mutually Beneficial Supplier Relationships) which shows the validity of our factor analysis. We used these constructed variables to determine the factors explaining their level of implementation in Tunisian companies. On the other hand, based on the literature and our research hypotheses, we considered the following firm's internal and external attributes as determinants of the QM implementation degree:

Table 1: List of variables[1]

Variable	Label	Measure
Type	Firm type	Nominal variable (manufacturer / service)
PMN	Involvement in the leveling program	Binary variable (yes / no)
Ann_lance	Starting Year of the quality approach	Ordinal variable (less than 5 years, 5 to 10 years, more than 10 years).
Cert_94	Certification ISO 9000 : 1994	Binary variable (yes / no)
Type_94	Type of the ISO 9000 :1994 Certification	Nominal variable (ISO 9001/ 9002/ 9003)
ISO_1994	Implementation of the l'ISO 9004	Binary variable (yes / no)
I_NTIC	Investment in new technologies of information and communication	Binary variable (yes / no)
I_TAM	Investment in analysis and measurement technologies	Binary variable (yes / no)
F_motiv	Motivation factor that most influenced certification	Nominal variable (competitors, customers, group, financial performance, internal organization, product quality).
Size	Size	Number of employees in 2005
Conce	Intensity of competition	Likert scale from 1 to 5
Chg_socio	Environmental uncertainty	3 items (socio-cultural, technological, legal and regulatory changes). Likert scale from 1 to 5
Chg_tech		
Chg_regl		
Innov_clt	Importance of innovation for customers	Likert scale from 1 to 5
Q_clt	Importance of quality criterion for customer	Likert scale from 1 to 5
Interdep	Interdependence between units[2]	Likert scale from 1 to 5

For the model specification explaining the adoption of each QM practice, we conducted a stepwise forward multivariate regression (Stata software).

In fact**,** the difficulty in multivariate regression is to construct a regression model with high explanatory power and at the same time having the smallest number of explanatory variables as possible. So, the choice of variables to consider is usually done using heuristic methods for selecting variables based on sequential procedures such as the

[1] All the variables are considered based on the literature review and our research hypotheses presented in section 2. Almost of them are binary (yes/no) or nominal variables obtained directly from the response of the frims'quality managers to the questionnaire items.
[2]A unit may correspond to the company headquarters, division, subsidiary,department, office, factory, workshop, service, institution etc.

stepwise forward method that starts from the regression including all variables then successively removes each variable less decreasing the explanatory power of the model, until getting a model composed of significant variables (Hamilton, 1992).

The results of a regression are valid unless there are significant correlations between these variables. This is to avoid the phenomenon of multicollinearity that appears when one or more variables are linear combinations of other variables. Multicollinearity is detected by studying the tolerance (equal to the inverse of the variance inflation factor) of each variable in the regression, means its part of variance not shared with other explanatory variables. In practice, the tolerance of each variable must be greater than 0.20 to obtain acceptable results (Hamilton, 1992).

The required criteria for valid results (Hamilton, 1992; Evrard and al, 1997) are:

1. Residues should be distributed according to a normal distribution with zero mean.
2. The variance of the residuals should be constant for all levels of the dependent variable. When this is not the case, heteroscedasticity will be detected.
3. Residues should be independent of each other (no autocorrelation phenomenon).

Moreover, the model significance is determined using a test based on the F statistic of Fisher-Snedecor. Its explanatory power is measured by the square of the multiple correlation coefficient R^2 (determination coefficient) and the adjusted coefficient of determination R^2_{aj} which is a correction of the R^2 coefficient performed to take into account the sample size opposed to the number of variables . We should ensure that it is near the R^2.

After performing for each regression (Appendix) the tests of global (F statistic) and individual (Student t) significances of variables and tests of heteroscedasticity (Breusch-Pagan test) and normality of residuals (Skewness / Kurtosis test), the equations retained are as follows:

$$P_1 = \beta_{10} + \beta_{11}\,\text{type} + \beta_{12}\text{Innov\_clt} + \beta_{13}\text{ann\_lance} + \beta_{14}\text{Conce} + \beta_{15}\,\text{ISO\_9004} + \beta_{16}\,\text{size} + \varepsilon_1.$$

$$P_2 = \beta_{20} + \beta_{21}\text{F\_motiv} + \beta_{22}\,\text{I\_TAM} + \beta_{23}\text{Innov\_clt} + \beta_{24}\text{chg\_socio} + \beta_{25}\,\text{ISO\_9004} + \varepsilon_2.$$

$$P_3 = \beta_{30} + \beta_{31}\,\text{type} + \beta_{32}\text{Conce} + \beta_{33}\text{ann\_lance} + \beta_{34}\text{Innov\_clt} + \beta_{35}\text{ISO\_9004} + \beta_{36}\text{F\_motiv} + \beta_{37}\,\text{I\_TAM} + \varepsilon_3.$$

$$P_4 = \beta_{40} + \beta_{41}\text{F\_motiv} + \beta_{42}\text{Q\_clt} + \beta_{43}\text{ann\_lance} + \beta_{44}\,\text{I\_NTIC} + \beta_{45}\,\text{ISO\_9004} + \varepsilon_4.$$

$$P_5 = \beta_{50} + \beta_{51}\text{ann\_lance} + \beta_{52}\text{F\_motiv} + \beta_{53}\text{size} + \beta_{54}\text{Q\_clt} + \beta_{55}\,\text{I\_TAM} + \varepsilon_5.$$

$$P_6 = \beta_{60} + \beta_{61}\text{type} + \beta_{62}\,\text{PMN} + \beta_{63}\text{Conce} + \beta_{64}\,\text{I\_NTIC} + \varepsilon_6.$$

$$P_7 = \beta_{70} + \beta_{71}\,\text{ISO\_9004} + \beta_{72}\text{chg\_regl} + \beta_{73}\text{Innov\_clt} + \beta_{74}\text{Q\_clt} + \beta_{75}\,\text{I\_NTIC} + \varepsilon_7.$$

Thus, these seven multiple regressions allowed us to clearly specify the models

explaining the implementation degree of each QM practice. However, this method does not highlight the interdependence and complementarity between these practices to form a model of consistent and interactive management. Hence, it would be interesting to estimate the system equations by the method of seemingly unrelated regressions (SUR). In fact, the correlation matrix of the equation residuals is as follows:

	P_1	P_2	P_3	P_4	P_5	P_6	P_7
P_1	1.0000						
P_2	0.6169	1.0000					
P_3	0.7436	0.6305	1.0000				
P_4	0.6481	0.6239	0.7192	1.0000			
P_5	0.3638	0.3640	0.2592	0.4225	1.0000		
P_6	0.2365	0.3291	0.3118	0.3885	- 0.0574	1.0000	
P_7	0.4091	0.3384	0.5141	0.5859	0.1726	0.6149	1.0000

Breusch-Pagan test of independence: chi2 (21) = 192,501, Pr = 0.0000

Thus, it appears that our use of SUR model is relevant since the equations of QM practices are dependent by their disturbances. Indeed, we see from the correlation matrix of the residuals and the Breusch-Pagan statistic that there is a highly significant correlation (with a risk of 0% error) between the disturbances of equations which proves their simultaneity and therefore inefficiency of the estimation by OLS equation by equation (Green, 2000).

3.3 Estimation results of the system equations by the SUR method

The matrix form of our equation system is:

$$\begin{bmatrix} P_1 \\ P_2 \\ \vdots \\ P_7 \end{bmatrix} = \begin{bmatrix} X_1 & 0 & \cdots & 0 \\ 0 & X_2 & \cdots & 0 \\ & & \vdots & \\ 0 & 0 & \cdots & X_7 \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_7 \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_7 \end{bmatrix} = X\ \beta + \varepsilon.$$

X_1 = (1, type, Innov_clt, ann_lance, Conce, ISO_9004, taille) ; $\beta_1 = (\beta_{10},..., \beta_{16})$'.

X_2 = (1, F_motiv, I_TAM, Innov_clt, chg_socio, ISO_9004) ; $\beta_2 = (\beta_{20}, \beta_{21},..., \beta_{25})$'.

X_3 = (1, type, Conce, ann_lance , Innov_clt, ISO_9004, F_motiv, I_TAM) ; $\beta_3 = (\beta_{30}, \beta_{31},..., \beta_{37})$'.

X_4 = (1, F_motiv, Q_clt, ann_lance, I_ NTIC, ISO_9004); $\beta_4 = (\beta_{40}, \beta_{41},..., \beta_{45})$'.

X_5 = (1,ann_lance, F_motiv, taille, Q_clt, I_TAM) ; $\beta_5 = (\beta_{50}, \beta_{51},..., \beta_{55})$'.

X_6 = (1, type, PMN, Conce, I_NTIC) ; $\beta_6 = (\beta_{60}, \beta_{61},..., \beta_{63})$'.

X_7 = (1, ISO_9004, chg_regl, Innov_clt , Q_clt , I_NTIC) ; $\beta_7 = (\beta_{70}, \beta_{71},..., \beta_{75})$'.

The estimation by the method of seemingly unrelated regressions (Stata) gave the following results:

Table 2. Regression by the SUR method

Equation	R^2	Chi2
P_1	0.3558	***28.75******
P_2	0.4430	***36.16******
P_3	0.4902	***55.49******
P_4	0.3618	***31.81******
P_5	0.3755	***25.85******
P_6	0.3150	***24.42******
P_7	0.3634	***31.17******

		Coefficient	S.E	z
P_1				
	type	**-.4140**	.2430	***-1.70****
	Innov_clt	**.1521**	.1091	***1.39****
	ann_lance	**.3383**	.1347	***2.51******
	Conce	**-.1874**	.0855	***-2.19****
	ISO_9004	**.6247**	.2166	***2.88******
	size	**.0002**	.0001	***2.16****
	cons	-.4128	.6817	*-0.61*
P_2				
	F_motiv	**.1017**	.0477	***2.13****
	I_TAM	**.6313**	.1767	***3.57******
	Innov_clt	**.3289**	.1018	***3.23******
	chg_socio	-.0693	.0738	*-0.94*
	ISO_9004	**.3583**	.1943	***1.84****
	Cons	**-2.0918**	.4855	***-4.31******
P_3				
	type	**-.4042**	.1768	***-2.29****
	Conce	**-.1899**	.0674	***-2.82******
	ann_lance	**.2125**	.1087	***1.95****
	Innov_clt	**.3811**	.0875	***4.35******
	ISO_9004	**.5830**	.1959	***2.98******
	F_motiv	**.0645**	.0378	***1.70 ****
	I_TAM	**.3776**	1360	***2.78******
	Cons	**-1.5093**	.5674	***-2.66******
P_4				
	F_motiv	**.1317**	.0447	***2.94******
	Q_clt	**.5276**	.1221	***4.32******
	ann_lance	**.2875**	.1144	***2.51******
	I_NTIC	.1476	.2081	*0.71*
	ISO_9004	**.3001**	.1931	***1.55****
	Cons	**-3.6630**	.6778	***-5.40******
P_5				
	ann_lance	**.4420**	.1549	***2.85******
	F_motiv	**.1640**	.0620	***2.64******
	size	**-.0002**	.0001	***-1.86 ****
	Q_clt	**.4945**	.1641	***3.01******
	I_TAM	**.3343**	.2119	***1.58 ****
	Cons	**-3.7938**	.8671	***-4.37 *****
P_6				
	type	**.6440**	.2661	***2.42******
	PMN	**.8638**	.2294	***3.76******
	Conce	**-.1753**	.0941	***-1.86****

	I_NTIC	**.5363**	.3223	***1.66****
	_cons	**-1.2299**	.6448	***-1.91****
P_7		**.7669**	.1915	***4.00*****
	ISO_9004	**-.2229**	.0773	***-2.88*****
	chg_regl	**.2142**	.1094	***1.96****
	Innov_clt	**.3473**	.1511	***2.44*****
	Q_clt	**.5723**	.2916	***1.96****
	I_NTIC	**-2.4713**	.6814	***-3.63*****
	_cons			

* : Significant at 10 % ; ** : Significant at 5 % ; *** : Significant at 1 %

3.4 Interpretation and hypothesis testing

The results of the SUR estimation method show that the equations' R^2 are mostly average. We also note that all the system equations are globally significant ((pr> chi2) <1%). We will now analyze the effect of each factor on the adoption of QM practices which will ultimately allow us to test our research hypotheses.

Effects of the motivation to get certified and use of quality labels. We find that the motivating factor most influencing the certification decision has a significant and positive effect on the implementation degree of 4 practices: P2, P3, P4, P5. So it appears that QM is implemented at an advanced level when the most important firm motivation (as perceived by quality manager) is oriented towards improving internal organization and product and service quality. This result is very interesting since it highlights the organizational orientation of the conception of the certification role. Indeed, the strengthening in the 2000 edition of ISO 9000 in terms of process approach, continuous improvement and employee involvement leads companies to integrate more internal motivations for certification. External motivations (direct pressure from customers and / or group, indirect pressure from competitors) lead the company to assimilate the certification to a simple signal sent to external partners and not as a means of creating an internal dynamic of continuous improvement (Pytlak, 2002).

On the other side, the implementation of ISO 9004 recommendations (or "guidelines for performance improvement") has provided significant assistance to companies in strengthening the involvement of top management (P1) and staff in the quality process (P3), taking into account the needs of customers (P2), process control (P4) and the integration of environmental requirements (P7). In fact, compliance with this standard requirement enables organization to develop a quality management system eliminating the failure risk by a suitable management of resources and processes, streamlining procedures, monitoring results, and continuously improving internal management. Moreover, the interdependence of the QM practices reflects the systemic approach of the QM model according to ISO 9000 which considers the firm as a sequence of interactive and consistent processes.

Finally, the Tunisian label role is materialized by the positive effect of the leveling program participation (PMN) on the degree of supplier involvement (significant at 1%). So, this restructuring has prepared the participating companies to set up a QM system marked especially by developing mutually beneficial relationships with suppliers. Hence, government should intensify this type of consolidation program.

Effects of the company's internal attributes. According to the regression results, we

find that the firm's activity type significantly affects three QM practices: P1, P3 and P6. In fact, giving the complexity of their production processes, industrial enterprises are marked by greater involvement of direction and staff in the quality process (this variable coefficient is significantly negative in the equation of P1 and P3). While service companies tend to favor greater involvement of suppliers (P6). This can be explained by the fact that the suppliers' product and service quality and their respect of deadlines are reflected more clearly on the quality level offered by service companies. However, for the other practices, the effect of activity type is not significant. This result is in favor of the generic nature of QM i.e. that most of its practices can be applied both by service and manufacturer companies.

In addition, our study highlights the importance of time factor to establish quality culture in the organization and especially to assess the commitment of its employees and the degree of process control and development of close relations with suppliers, since the coefficient of the variable ann_lance (launch year of the quality approach) is significantly positive for these practices.

Furthermore, the effect of firm size is significant for two QM practices: P1 and P5. The coefficient of this variable is positive (low but significant at 5%) for the direction commitment to quality policy and negative (low but significant at 5%) for the development of close relations with suppliers. The QM allows large companies more efficient use of specific information widespread within the organization (Wruck and Jensen, 1994). Thus, managers of these firms are more easily convinced of the utility of a QM policy promoting decentralization of responsibilities and allowing better use of competencies. However, it appears that small firms tend more than large ones to maintain strong relationships with suppliers. Henceforth, considered by many researchers as a determinant factor (Gotzamani and Tsiotras, 2002; Quazi and Padibjo, 1998), the size seems to be a little determinant factor (but significant) of the QM implementation degree by Tunisian companies (consistent with the study of Fahmi (2000)). Thus there is mixed evidence with respect to size.Our hypothesis about the positive effect of size on the QM adoption cannot be confirmedbecause of the weakness of this coefficient and its negative sign for P5.

On the other side, it follows from the estimation by the SUR method that the impact of investment in new information and communication technologies is significantly positive on the involvement of suppliers and the integration of environmental requirements. This is due to the fact that these technologies facilitate communication between the company and its external environment and dissemination of the firm's efforts, results and planned improvements. Hence, our hypothesis about the positive effect of ICT investment on the level of QM adoption is accepted.

Finally, we find that investment in analysis and measurement technologies is in favor of the customer focus, employee involvement and establishing mutually beneficial relationships with suppliers. In fact, these technologies enable the company to organize and control exchanges with its internal and external partners (Wruck and Jensen, 1994), for example through the establishment of customer satisfaction surveys, regular evaluation of skills and the use of scientific indicators for suppliers' selection and evaluation ,reducing control costs generated by asymmetric information. Thus, our hypothesis about the positive effect of investment in analysis and measurement technologies on the QM implementation degree is confirmed.

Nevertheless, this study using Tunisian companies' data was unable to highlight the role of the interdependence degree between units on the QM adoption as the results show that this factor was not significant for all the practices. Thus, our hypothesis about the positive impact of this interdependence is contested.

Effects of external attributes. Our results support the view according to which there is a strong relationship between innovation and quality management (Galia and Legros, 2003) since the coefficient of the variable importance of innovation for customers (Innov_clt) is significantly positive for P1, P2, P3 and P7.This factor incites the firm to enhance its innovation capacity by integrating this goal among the quality objectives in order to follow the evolution of customer expectations. In addition, the firm's ability to innovate cannot be improved without encouraging the sense of initiative for employees which has a positive effect on their reflection and creativity capacity as well as their degree of involvement in the quality process (Bénézech, Lanoux and Lambert, 2001; Lin and Wu, 2005; Loukil, 2005).

Similarly, the importance of quality criterion for customers has a significant and positive effect on the degree of process control, development of close relationships with suppliers and integration of environmental requirements. Indeed, this external motivation factor is classified second (after the improvement of internal organization) among the motivating factors most critical for the certification decision (mentioned by over 31% of respondents). This element encourages firms to review and rationalize their internal processes in order to meet their customers' needs becoming increasingly demanding in terms of quality. It also encourages them to better select their suppliers and subcontractors whose quality of products and services directly affects the company's product and service quality.

Finally, it appears that Tunisian firms are not yet able to internalize the constraints of their environment through the recourse to the QM as a competitive advantage in order to manage uncertainty and confront competition. These environmental changes represent for them factors limiting (case of increased competition and regulatory changes) the progress level of QM. Our assumption about the positive effect of environmental uncertainty on the degree of QM implementation (Cyert and Kumar, 1996; Hackman and Wageman, 1995) is thus contested.

4 Conclusions

To determine the factors influencing the adoption or the implementation degree of quality management practices by Tunisian companies, we have used a variety of analytical and econometric tools. Thus, the principal component analysis allowed us to summarize the items related to QM practices in seven consistent dimensions equivalent at a large extent to the QM principles according to ISO 9000: 2000. Next, we used stepwise forward multivariate regression for each practice which allowed us to significantly reduce the number of explanatory variables and formulate valid linear models. However, the interdependence of QM practices and the existence of a correlation between their equations' residuals led us to estimate the system of simultaneous equations using the method of seemingly unrelated regressions.

It turned out that the majority of our hypotheses are confirmed. Indeed, several internal

factors promote the QM adoption degree by Tunisian firms: implementing the recommendations of ISO 9004, an internal rather than external motivation to get certified (H1), adherence to the leveling program, firm's size (H2) and investment in new technologies of information and communication and in analysis and measurement technologies (H3). External attributes, are linked to the importance of innovation and quality criterion for the customer (H5).

We have shown that the application of quality management depends on the company's organizational and environmental context (Bénézech et al., 2001; Lin and Wu, 2005; Wardhani, 2008, Prajogo, 2011). As implications of our results, the Tunisian companies are invited to invest more in new information and communication technologies. This investment is essential to allow them promoting the flow of information between their internal and external partners and developing more decentralized organizational structures. Besides, the ICT will help those companies to implement the international QM standards by reducing their response deadlines, improving the capacity of information processing and of employees' control. In fact, those technologies allow reducing control costs related to the decentralization of decision making and the reduction of uncertainty and asymmetric information existing between agents. Thus giving the importance of such investment, the State should pursue policies to promote the adoption of quality management by providing subsidies encouraging those expenses and by modernizing local labels and leveling programs.

Moreover, the Tunisian firms are invited also to well define their internal motivations to get certified.In fact, we have found that when the leader's motivations to certification are internal (process improvement, work organization, product and service quality, preserving the know-how), not external (direct pressure from customers and / or group, indirect pressure from competitors), the company is more likely to subsequently implement a successful quality management system at an advanced level (Pytlak, 2002; Anand, and Prajogo, 2009; Prajogo, 2011). This implication is very important since in case of lack of real internal motivations certification can also be a factor of rigidity and an obstacle to innovation. In fact, anticipatory and adaptive capacity of the firm maybe impaired face to the market permanent evolution because the internal organizational radical change will reduce questioning about the new structure by the direction. In addition, the introduction in the company of numerous and detailed written procedures inhibits creativity and personal initiative. The certification in this case will be a source of disqualification and return to Taylorism rather than a source of promoting competitiveness for Tunisian companies.

The importance of our findings shows the richness of this research axis and the relevance of our model. However, our study suffers from a main limit which consists of the very small size of our sample. So,its extension will be a very interesting research perspective in order to generalize the results.

Indeed, the establishment of quality management as an organizational change is not an easy process and has often disappointing results. Hence, it is very interesting to study success factors determining the contribution of QM process to value creation and promotion of organizational performance.

Finally, taking into account the evolution of QM systems over time through the use of panel data and the integration of a spatial variable to see the impact of the geographic location of the company on its level of QM implementation and organizational

performance are also attractive research opportunities.

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Appendix

Regression of P_1:

R^2	F	Chi 2 of Breusch-Pagan	Chi 2 of Skewness/Kurtosis
0.3795	***7.49******	***3.86****	3.39

P_1	Coef.	Robust S.E	t	Tolerance (1/vif)
type	**-.6135**	.2658	***-2.31****	0.7594
Innov_clt	**.2742**	.1370	***2.00****	0.9479
ann_lance	**.4260**	.2420	***1.76 ****	0.9292
Conce	**-.1974**	.1023	***-1.93 ****	0.9469
ISO_9004	**.7547**	.2923	***2.58*****	0.8965
taille	**.0003**	.0000	***3.42*****	0.7553
cons	**-.8861**	.9463	*-0.94*	-

* : Significatif at 10 %; ** : Significatif at 5 %; *** : Significatif at 1 %

Regression of P_2:

R^2	Adjusted R^2	F	Chi 2 of Breusch-Pagan	Chi 2 of Skewness/Kurtosis
0.497	0.436	***8.12 *****	*1.11*	*0.92*

P_2	Coef.	S.E	t	Tolerance (1/vif)
F_motiv	**.1689**	.0666	***2.54*****	0.8653
I_TAM	**.9495**	.2605	***3.65*****	0.7653
Innov_clt	**.4804**	.1485	***3.42*****	0.8653
chg_socio	**-.1907**	.1123	***-1.70****	0.7911
ISO_9004	**.4652**	.2432	***1.91****	0.8141
cons	**-2.8497**	.6597	***-4.32*****	-

Regression of P_3:

R^2	Ajusted R^2	F	Chi 2 of Breusch-Pagan	Chi 2 of Skewness/Kurtosis
0.540	0.4574	***6.54*****	*0.66*	*1.61*

P_3	Coef.	S.E	t	Tolerance (1/vif)

type	**-.5627**	.2984	***-1.89****	0.9178
Conce	**-.2445**	.1162	***-2.10****	0.9043
ann_lance	**.3129**	.1685	***1.86****	0.9254
Innov_clt	**.4780**	.1323	***3.61*****	0.9398
ISO_9004	**.6554**	.2515	***2.61*****	0.7326
F_motiv	**.1498**	.0661	***2.27****	0.9344
I_TAM	**.6140**	.2514	***2.44*****	0.7908
Cons	**-2.2228**	.9096	***-2.44*****	-

Regression of P_4:

R^2	Ajusted R2	F	Chi 2 of Breusch-Pagan	Chi 2 of Skewness/Kurtosis
0.439	0.371	***6.43*****	*0.13*	*0.95*

P_4	Coef.	S.E	t	Tolerance (1/vif)
F_motiv	**.2436**	.0709	***3.43*****	0.9406
Q_clt	**.7217**	.1975	***3.65*****	0.8270
ann_lance	**.4286**	.1812	***2.36*****	0.9276
I_NTIC	**.5849**	.3363	***1.74****	0.9336
ISO_9004	**.5432**	.2610	***2.08*****	0.7889
Cons	**-5.7206**	1.0702	***-5.35*****	-

Regression of P_5:

R^2	Ajusted R^2	F	Chi 2 of Breusch-Pagan	Chi 2 of Skewness/Kurtosis
0.389	0.315	***5.23*****	*0.91*	*0.41*

P_5	Coef.	S.E	t	Tolerance (1/vif)
ann_lance	**.4966**	.1844	***2.69******	0.9753
F_motiv	**.2135**	.0729	***2.93******	0.9700
taille	**- .0003**	.0001	***- 2.04****	0.9408
Q_clt	**.5461**	.1915	***2.85******	0.9576
I_TAM	**.4538**	.2537	***1.79****	0.9800
Cons	**- 4.3694**	1.0208	***- 4.28******	-

Regression of P_6:

R^2	ajusted R^2	F	Chi 2 of Breusch-Pagan	Chi 2 of Skewness/Kurtosis
0.335	0.272	***5.30******	*0.05*	*0.92*

P_6	Coef.	S.E	t	Tolerance (1/vif)
type	**.6473**	.3637	***1.78****	0.8287
PMN	**1.0624**	.3258	***3.26******	0.8706
Conce	**- .2448**	.1327	***-1.84****	0.9300
I_NTIC	**.7884**	.3746	***2.10****	0.8703
Cons	- 1.3428	.8612	*-1.56*	-

Regression of P_7:

R^2	Ajusted R^2	F	Chi 2 of Breusch-Pagan	Chi 2 of Skewness/Kurtosis
0.3887	0.3141	***5.21******	*1.35*	*0.60*

P_7	Coef.	S.E	t	Tolérance (1/vif)
ISO_9004	**.9698**	.2723	***3.56******	0.7902
chg_regl	**-.2200**	.1208	***-1.82 ****	0.8140
Innov_clt	**.2808**	.1698	***1.65****	0.7208
Q_clt	**.4766**	.2251	***2.12****	0.6941
I_NTIC	**.7316**	.3660	***2.00****	0.8594
Cons	**-3.5524**	.9790	***-3.63******	-