

Relating Organizational Knowledge with ISO 9001: 2015: An Empirical Approach

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Abstract: In a business market environment highly marked by competition, standardisation has proven distinctive in answering continuous challenges. Thus, organisations have been investing in obtaining ISO certifications, being "ISO 9001 – Quality Management System" among the most popular. The present empirical study aims to discover what is, in the opinion of managers expressed by their answers to the questionnaire, the relationship between the implementation of Knowledge Management practices, the Quality System and Organizational Performance while verifying if the introduction of Knowledge Management principles in the Standard ISO 9001 has affected the company's overall organisational performance. The proposed analysis methodology is supported by applying a questionnaire to 36 Portuguese Small and Medium Enterprises sample. The investigation results allowed us to infer that, in the managers' opinion expressed by the answer to the questionnaire, Knowledge Management acts as a mediator between the Quality System and performance while not directly influencing organisational performance. Within the companies studied, holders of the certification ISO 9001, through the application of Knowledge Management practices, show improvements in the management of the Quality System, with a consequent increase in organisational performance.

Keywords: Knowledge Management, Quality Management, ISO 9001, Organizational Performance

1. Introduction

The recent implementation of ISO 9001:2015 (ISO, 2015) represents a significant change expressed by enhancing knowledge management as a quality and enterprise performance factor.

The objective of this exploratory work is to study the perceptions of managers of Portuguese Small or Medium-sized companies (SMEs) involved in the implementation of quality systems, based on ISO 9001:2015, about relationships between the Performance (P) of these companies and their Quality Management System (Q) and Knowledge Management (KM).

Specifically, it aims to discover if those perceptions are compatible with a theoretical model such as Performance = f (Quality, Knowledge), associating those three variables, in which f represents a linear or non-linear relationship.

This figure is a graphical expression of the main scientific hypothesis in this study. More specifically, it is intended to discover if underlying the opinions expressed by the managers of 36 Portuguese SMEs seem to present the perception that there are relationships or causal influences between those three variables represented by the model presented in Figure 1. In this figure, arrows " a " mean that the variable at its left-hand side influences the variable at its right-hand side.

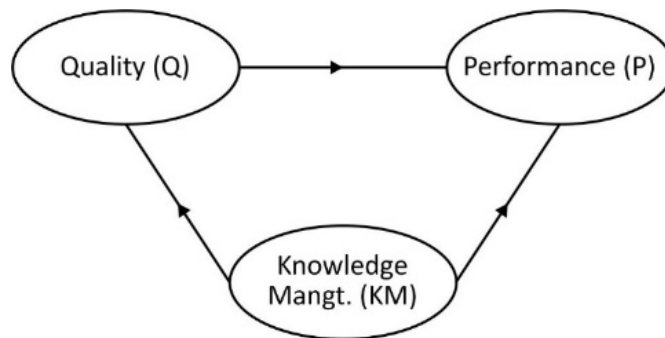


Figure 1: Hypothesis to be investigated

Q-Quality; KM-Knowledge; P-Performance

2. Theoretical Considerations

Although some authors (Duran, Çetindereb and Şahanc, 2014; Zakeri, Goudarzi, Atamanesh and Koochaki, 2014; Honarpour, Jusoh and Nor, 2012; Moballeghi and Galyani Moghaddam, 2008) have previously explored the relevance of combining quality practices with knowledge management, only since 2015 with the new version of ISO 9001 (ISO, 2015), the organisations started to see knowledge management as a necessity to obtain market advantages.

The first version of the ISO 9001 Standard (ISO, 2015), published by the International Organization for Standardization (ISO), dates from 1987. It was inspired by the theories developed by authors, such as Deming (1986), Juran and Godfrey (1998), and Ishikawa and Lu (1985), among others.

The ISO 9001: 2015 follows the seven principles of Quality Management (ISO, 2015): (1) Focus on the customer; (2) Leadership; (3) Employee commitment; (4) Process approach; (5) Continuous improvement; (6) Decision-making based on facts; and (7) Relationship management.

The ISO 9001:2015 replaced the previous version dated 2008. The most notable change concerns the structural organisation since the new version follows the same general structure of the remaining standards of management systems, known as the "High-Level Structure (HLS)" (ISO, 2015).

As for knowledge management, although its presence was implicit in previous versions, it is now explicit under the term "organisational knowledge", with an entire section dedicated to the theme. Knowledge management is now assumed to be a key element in competitive success, with knowledge being addressed as an organisational resource comparable to any other and must be managed (Ribièrè and Khorramshahgol, 2014, Aldanondo, 2015, Aimran et al., 2016, Dücker, 2016, Wilson and Campbell, 2016, 2020, Demir et al., 2021).

In the ISO: 9001: 2015, a new clause (7.1.6) introduces Organisational Knowledge knowledge as a resource: "The organisation shall determine the knowledge necessary for the operation of its processes and to achieve conformity of products and services. This knowledge shall be maintained and be made available to the extent necessary. When addressing changing needs and trends, the organisation shall consider its current knowledge and determine how to acquire or access any necessary additional knowledge and required updates."

Among the main changes in the new version, the authors (e.g. Murray, 2016; Wilson and Campbell, 2020, Demir et al., 2021) highlighted the accentuated emphasis given to the commitment of the top management of the organisation to the management system; the emphasis placed on the organisational context; the focus on risk-based thinking; greater flexibility in documentation; and the decrease in prescriptive requirements. This version of the Standard is less focused on documentation, more focused on management processes, less prescriptive, and more performance-oriented.

This new version does not present a clear definition of organisational knowledge, allowing auditors and companies to have different interpretations. However, the idea of making tacit knowledge explicit as a factor in organisational development and gain of competitive advantages seems to be underlying.

3. Methodology and Data Sources

3.1 Sampling

The Target Population for this research is the set of Portuguese SMEs. A convenience sample was extracted from an available sampling frame formed by the list (publicly available) of 212 enterprises affiliated with COTEC Portugal – Business Association for Innovation, considered in the SME Innovation COTEC Network list (COTEC Portugal, 2021)

A questionnaire aimed to verify SMEs leaders' perceptions of SME Innovation COTEC Network about implementing ISO 9001:2015 was developed. This questionnaire was sent to those 212 affiliated enterprises, and 36 answers were obtained.

Given the limitations of the available data frame, sample dimension, and reply rate, it is assumed that the results obtained cannot be generalised to the Target Population. The present study is seen as a pilot study to support future research.

The questionnaire comprises 55 questions expressed by Likert scales with 5 points. The questions were grouped, according to their meanings, into three groups or blocks corresponding to Quality (Q), Knowledge Management (KM) and Performance (P). These groups are shown in Tables 1,2 and 3.

The questions were labelled using labels Qi (i = 1 to 27); KMj (j = 1 to 24) and Pk (k =1 to 4).

Table 1: Variables related to Quality Management practices

Label	Question meaning
Q1	Your company's performance is analysed
Q2	The characteristics of the sector of activity in which your company is located are analysed in the process of defining strategies
Q3	Your company's target customers are identified
Q4	The social impacts (including environmental impacts) of your products and services are identified
Q5	Value aggregation processes are identified
Q6	Currently, the needs of your customers are always met
Q7	Internal environment information (degree of satisfaction, performance, commitment to employees – regardless of hierarchical level) is used to analyse your company's performance
Q8	The internal environment of your company is analysed in the process of defining strategies
Q9	The needs of your customers are understood
Q10	The requirements applicable to your company's core processes are determined by the
Q11	External environment information is used to analyse your company's performance
Q12	Organizational strategies are evaluated
Q13	Information about products and services is disclosed to customers
Q14	The social impacts (including the environmental impact) of your company's products and services are shared with society
Q15	The occupational health hazards of employees are identified
Q16	The scope of the company's strategies is evaluated
Q17	Indicators are defined to evaluate the implementation of the company's strategies
Q18	Cao
Q19	Risks related to the occupational health of employees are addressed
Q20	Customer needs are identified
Q21	Factors affecting employee satisfaction are identified
Q22	Performance analysis is used by management to make decisions aimed at increasing
Q23	Actions implemented as a result of the analysis of complaints are shared with customers
Q24	Factors affecting employee satisfaction are addressed
Q25	Customer satisfaction is assessed
Q26	The degree of satisfaction of the communities in relation to the company is evaluated
Q27	Employee satisfaction is assessed

Table 2: Variables related to Knowledge Management practices

Label	Question meaning
KM1	Your company's information needs for decision support are identified
KM2	The training needs of your employees are identified
KM3	Knowledge about the social impacts (including environmental impact) of your company's products and services is used to address those impacts
KM4	Knowledge about information needs is used to make this information available to employees
KM5	Knowledge about the training needs of employees is used to carry out training programs
KM6	Relevant comparative information needed to improve your company's results are identified
KM7	Knowledge about product and service requirements is used to plan key work processes
KM8	Customers' level of knowledge about your company's products and services is assessed
KM9	Issues related to organisational strategy are shared with employees
KM10	The decisions taken after performance analysis are shared with employees
KM11	Company strategies are shared with employees
KM12	Information on relationship channels is shared with customers
KM13	Comparative information is used to improve your company's results
KM14	Knowledge about product and service requirements is used to manage work processes
KM15	Knowledge about the company's performance is used to formulate strategies
KM16	Knowledge about the needs of neighbouring communities is used to carry out social projects
KM17	Intangible assets that add value to the business are identified
KM18	Knowledge about the performance of key processes is captured through analysis performed regularly
KM19	Knowledge about intangible assets is used to develop them
KM20	Knowledge about the performance of core processes is used to improve and add value to customers
KM21	Information obtained from customers is used to enhance customer satisfaction
KM22	Knowledge about your company's image with customers is used to improve this image
KM23	Knowledge about intangible assets is used to protect those same assets
KM24	Knowledge about employee satisfaction is used to improve employee satisfaction.

Table 3: Variables related to Organizational Performance Management practices

Label	Question meaning
P1	The current satisfaction of its employees is high
P2	The current degree of community satisfaction with your business is high
P3	The number of work processes that have improved in the last twelve months is high
P4	Your company's current level of innovation is high

The 36 answers obtained allow obtaining a table (36X55) with the structure illustrated in Table 4.

Table 4: Data Set structure (partial view). Columns (variables) are answers to questions answered by all 36 top managers, and each row represents the answers of a single top manager.

SME_ID	Q1	Q2	...	Q27	KM1	KM2	...	KM24	P1	P4
2638942	5	5		5	5	5		5	5		4
2375816	4	3		4	3	4		3	3		3
1909475	5	4		3	4	5		4	4		5
1896941	4	4		5	4	5		5	5		5
1896694	5	5		5	5	5		5	5		5
1896293	5	5		5	5	5		5	4		4
1896278	5	5		2	4	5		2	3		4
1896240	5	5		5	5	5		5	5		5
1831708	4	5		5	4	5		5	4		5
1829608	5	5		4	5	4		4	4		5
1820392	5	5		4	4	4		4	3		4
1799714	5	4		5	5	5		4	4		4
1798374	5	5		5	5	5		4	4		5

3.2 Methods and Modeling

In methodological terms, the first question to be addressed is to show that the answers to questions in each group/block can be replaced by a single scale that approximates or summarises the set of answers in that group. In other words, it should be shown that there is empirical evidence supporting the idea that, subjacent to each group of answers, there is a latent variable that explains the observed answers. This can be obtained using Cronbach alfa or Principal Components Analysis (PPC) by the per cent of Variance explained by each group's first

principal component of variables. When this per cent is very high, that means that the variables in the group can be roughly approached by a single empirical variable such as the mean of variables in the group or its first principal component.

If this is justified by the available data, Q_m , KM_m , and P_m are the labels for those three new variables representing the blocks in tables 1,2 and 3. If there are significant correlations between those three new variables, that would suggest that Q , KM , and P , of which Q_m , KM_m , and P_m , are rough approximations, are also associated. Linear regression can now be used to obtain approximations of eventual relationships between Q , KM and P and predict P as a linear function of Q and KM . Specifically, if the regression $P_m = a + b_1 * Q_m + b_2 * KM_m + \text{Error}$ has a large R^2 , that would suggest that a similar relation could exist between P , Q and KM .

If the previous empirical analysis results find support in data, it would be interesting to discover if data also suggests eventual influence relations between the variables Q , KM , and P , as stated by the investigation hypothesis expressed in Figure 1. Now, Q , KM , and P represent latent variables whose indicators are the variables containing data with the managers' answers. The result is expressed in Figure 2, where all manifest variables are of a reflective type and shown by rectangles labelled using the variable labels in Table 1,2,3 (See: Sarstedt et al., 2019, Monecke et al., 2012, Rosseel Y., 2012; Skrondal et al., 2004).

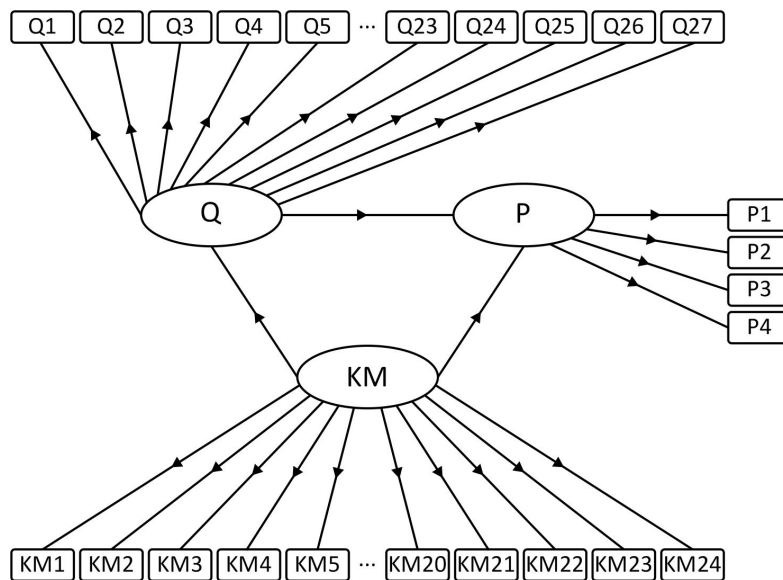


Figure 2: Structural model corresponding to the hypothesis under investigation. Latent variables: Q - Quality; KM – Knowledge Management; P - Performance.

The estimation of the model in Figure 2 can be performed using *R* packages "PLS-PM" by Gaston Sanchez (2013) or *semPLS*, Monecke, et al. (2012). Both packages implement the PLS method and are especially useful given the rectangular data set (36 X 55). The results of this study were obtained using package *semPLS* (Monecke, et al., 2012). Similar results can be obtained with the two packages.

The global goodness of fit for this model was $gof = 0,63$

4. Data analysis

4.1 Statistical Summarization of Variable Groups.

Table 5 shows Cronbach alfa and the percentage of Variance associated with the principal components 1 and 2 in each group of variables. The large values of Cronbach alfa and large value of per cent of Variance of First Principal Component suggest that those groups of variables are replaceable by just one (latent) variable.

Table 5: For each group, the Cronbach Alfa value and the Variance explained by the first two main Principal Components (PPC)

Group	Cronbach Alfa	% of Variance	
		1st PPC	2nd PPC
Table1 (Q)	0.951	48.2	10.2
Table 2 (KM)	0.956	54.2	7.7
Table 3 (P)	0.716	56.9	22.9

These variables underlying the groups of observations can be roughly approximated either by the mean value (a simple linear combination) or by the first PPC of observed variables of each group (a weighted simple linear combination). Both are linear combinations of group variables, the simple mean being more easily interpretable.

4.2 Regression Study of Relationships between Variable Groups.

If the choice is to use the means of each set of observed variables in each group, let these new empirical variables be labelled by Qm, KMm and Pm, representing now crude estimates of the corresponding -non observable. The three models summarised in Table 6, can be used to fit Qm, KMm, Pm data:

Model 1: $Pm = 1.01 * Qm$ ($R^2 = 0,79$)

Model 2: $Pm = 0.83 * KMm$ ($R^2 = 0,74$)

Model 3: $Pm = 0.053 * KMm + 0.96 * Qm$ ($R^2 = 0,79$)

Table 6: Regression models for Pm. N.S – Nonsignificant; S – Significant

Model	Explanatory		Cte.	b ₁	b ₂	R ²
	KMm	Qm				
1	-	x	(NS)	1.01 (S)	-	0.79
2	x	-	(NS)	0.83 (S)	-	0.74
3	x	x	(NS)	0.053 (NS)	0.96 (S)	0.79

In summary, both Qm and KMm, when considered in isolation, are good explanations for Pm with significant values (S) for corresponding coefficients and high values of $R^2 = 0.79$, when considering only the explanatory variable Qm and $R^2 = 0.74$ when considering only the variable KMm.

When both explanatory variables KMm and Qm are considered, $R^2 = 0.79$, but only Qm contribution is significant. These results suggest that by simultaneously including the two explanatory variables (Qm and KMm) in the model, the direct explanation of KMm on Pm is not significant.

4.3 Structural Equations Estimation using PLS.

Tables 7 and 8 below summarise the estimation results of the model in Figure 2 and the confidence intervals obtained from 500 bootstrap samples.

Table 8 refers to the one-dimensionality of the groups of variables (blocks) corresponding to each latent variable, expressing to what extent it makes sense to replace the observable manifestations in each block with just one underlying latent variable.

In addition, to the previously used Cronbach Alfa, *dg.rho* (Goldstein-Dillon) indices' and the variance values of the first and second main components are now occurring, expressed by *eig.1st and eig.2nd*.

Table 7: One-dimensionality of blocks. (R means a Reflexive Manifest Variable)

	Type of Manifests	Number of Manifests	C.alpha	DG.rho	1st eig.	2nd eig.
KM	R	24	0.959	0.963	12.36	1.837
Q	R	27	0.957	0.961	13.02	2.758
P	R	4	0.738	0.838	2.27	0.917

DG.rho values ≥ 0.7 mean that the block/group is well expressed by a single variable (one-dimensional). In the present case, this occurs with the three groups.

This table confirms previous findings that a single latent variable well summarises each group of observed /manifest variables. See Table 8 for synthesis.

Table 8: Synthesis of Structural Model (NS for Nonsignificant)

Equation	Estimate
KM -> Q	0,95
KM -> P	-0.16 (N.S)
Q -> P	0.96

This table (probabilities obtained by bootstrap) means that the structural model estimated with PLS is:
 $Q = 0.950 * KM$; $P = 0.96 * Q - 0.16 * KM$

The (-0.16) estimate for KM in the second equation is nonsignificant (Bootstrap of 500 pseudo samples). Figure 3 presents the final estimated model for the relationship between the latent variables of Figure 2.
 $P = 0.96 * Q$ and $Q = 0.950 * KM$

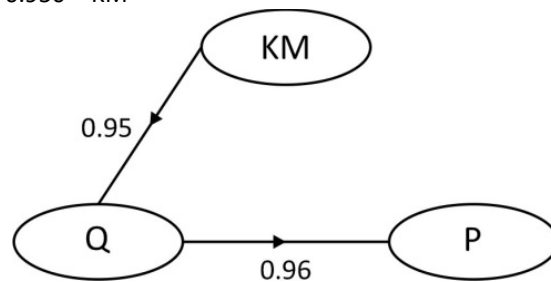


Figure 3: Estimated Structural Model

A similar result had already been obtained above, with latent variables Q, KM and P being roughly approximated by blocks, means Qm, KMm and Pm.

Figure 3 and Table 9, numerically, show the meaning of the estimated final model. NS is a nonsignificant effect.

Table 9: Total effects

	Relationships	direct	indirect	total
1	KM → Q	0.95	0.000	0.95
2	KM → P	(NS.)	0.825	0.75
3	Q → P	0.96	0.000	0.96

In summary (see Figure 3 and Tables 8 and 9), it is observed that KM has no significant direct effect on the dependent variable P. Its effect on the variable P (performance) is indirect ($0.91 = 0.95 * 0.96$) exerted through the variable Q. In other words, Quality (Q) acts as a mediation variable between KM (Knowledge Management) and Performance (P).

This finding has an interesting scientific interpretation: it expresses the idea that, according to the managers' perception, knowledge management is used to improve the organisation and technology of companies; the results on performance are not immediate but, given enough time for knowledge to spread and to act, its effects on performance manifest because of those improvements in the organisation. In our specific context, the system's quality has to do with the organisation and improvement of the methods and processes allowed by knowledge management.

5. Conclusion and Future Work

According to the results of this research, It was possible to find empirical support for the hypothesis formulated at the beginning of this research. In the opinion of high-level managers, who answered the questionnaire, knowledge management significantly directly affects quality management from the perspective of ISO 9001:2015. Quality management also has a direct effect on performance. The direct effect of knowledge management on performance is not significant, but there is an indirect effect that is manifested through quality management.

The analysis clearly illustrates that the managers' perceptions express a mediation effect of quality between knowledge management and companies' performance. In other words, according to those perceptions,

organisations that do knowledge management will improve the quality of management, which in the medium term will positively impact performance.

New research on the subject, with larger samples and a greater diversity of companies, is necessary to generalise the results obtained in this research and demonstrate to managers the importance of knowledge management practices to improve organisational performance.

References

- Aimran, A. N., Ahmad, S., and Afthanorhan, A. (2016) 'Confirming the Mediation Effect of A Structural Model By Using Bootstrap Approach: A Case Study of Malaysian 8th Grade Student' Mathematics Achievement,' *International Journal of Business, Economics and Management* 3(4), 44-51.
- Aldanondo, J. M. (2016) 'Gestión del conocimiento, calidad y la nueva ISO 9001'. Available at: http://www.catenaria.cl/km/newsletter/newsletter_116.htm (Accessed: 10 January 2022)
- COTEC Portugal (2021). Available at: <https://cotecportugal.pt/pt/> (Accessed: 15 September 2021)
- Deming, W. E. (1986) *Out of the Crisis: Quality, Productivity, and Competitive Position*. Cambridge, MA: Cambridge University Press.
- Demir, A., Budur, T., Omer H. M. and Heshmati, A. (2021) 'Links between knowledge management and organisational sustainability: does the ISO 9001 certification have an effect?', *Knowledge Management Research & Practice*. <https://doi.org/10.1080/14778238.2020.1860663>
- Duran, C., Çetindereb, A., and Şahanc, Ö. (2014) 'An analysis on the relationship between total quality management practices and knowledge management: The case of Eskişehir', 2nd World Conference On Business, Economics And Management – WCBEM. *Procedia - Social and Behavioral Sciences* 109, 65 – 77.
- Honarpour, A., Jusoh, A. and Nor, K. M. (2012) 'Knowledge Management, Total Quality Management and Innovation: A New Look', *Journal of Technology Management & Innovation*, 7(3), 22-31.
- Ishikawa, K. and Lu, D. (1985) *What is total quality control?* Englewood Cliffs, NJ: Prentice-Hall.
- ISO (2015) *Quality Management principles*. Geneva, Switzerland: ISO. Available at: <https://isotc.iso.org/> (Accessed: 10 January 2022)
- Juran, M. and Godfrey, A. (1998) *Juran's Quality Handbook*. 5th ed. Washington, DC: McGraw-Hill Companies, Inc. <https://doi.org/10.1080/01621459.2012.695640>
- Moballeghi, M. and Moghaddam, G. (2008) 'Knowledge Management and TQM: An Integrated Approach to Management', *GITAM Journal of Management*, 6(1), 45-54.
- Monecke, A. and Friedrich, L. (2012) 'semPLS: Structural Equation Modeling Using Partial Least Squares', *Journal of Statistical Software*, 48 (3), 1-32. Available at: <http://www.istatsoft.org/v48/i03/> (Accessed: 10 January 2022)
- Murray, W. (2016) 'Risk and ISO 9001: 2015', *Quality Magazine*. Available at: <http://www.qualitymag.com/articles/93103-risk-and-iso-9001-2015> (Accessed: 15 January 2022)
- Ribièrè V.M., Khorramshahgol R. (2014) 'Integrating Total Quality Management and Knowledge Management', *Journal of Management Systems*, 16(1), 39-54.
- Rosseel, Y. (2012) 'lavaan: An R Package for Structural Equation Modeling', *Journal of Statistical Software*, 48(2).
- Sanchez, G. (2013) *PLS Path Modeling with R*. Trowchez Editions. Berkeley. Available at: <http://www.gastonsanchez.com/PLS Path Modeling with R.pdf> (Accessed: 10 January 2022)
- Sarstedt, M.; Hair Jr, JF and Cheah J.H. et al. (2019) 'How to specify, estimate, and validate higher-order constructs in PLS-SEM', *Australasian Marketing Journal*. <https://doi.org/10.1016/j.ausmj.2019.05.003>
- Skrondal, A. and Rabe-Hesketh S. (2004) *Generalized Latent Variable Modeling. Multilevel, Longitudinal, and Structural Equation Models*. 1st Edition. Chapman and Hall/CRC.
- Zakeri, S., Goudarzi, H. T., Atamanesh, H., and Koochaki, H. (2014) 'Total Quality Management and Knowledge Management: A Researches Review', *Technical Journal of Engineering and Applied Sciences*, 135-142.