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A Novel Excellence Model of the Information and Communications Technology Industry: Case Study on Telecommunications Backbone Network of Iran

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ABSTRACT

Todays, Information and Communications Technology (ICT), as one of the most effective factors of the advancement in all the aspects such as governance, security and risk, economics and technology, which is among the industries rapidly growing and developing. This paper examines the specific criteria and standards of ICT area for improving the quality of the services of the Telecommunications Backbone Network of Iran (TBNI). The research was done through the two methods of data collection, library and the field study. European Foundation for Quality Management Excellence Model (EFQM) was selected as the base model and with full attention to the specific requirements of ICT industry and due to adapt this model from the viewpoints of the security and risk, governance and economic, a novel integrated excellence model of TBNI was developed and customized. To achieve the highest level of reliability and internal coherence of each criterion, based on expert opinion polls, sub-criteria was categorized and analyzed in several stages using the factor analysis approach. The causal relationships and the influence of the criteria of this model on each other were investigated and the weights of each criterion and sub-criteria, using the structural analysis and shannon entropy methods, were determined. The self-evaluation of TBNI was systematically carried out and major opportunities for the improvement had been identified. Results showed that the establishment of this model had led to an improvement in a quality of services provided by this network and the products of all organizations that use any services of TBNI.

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1. INTRODUCTION AND LITERATURE REVIEW

The ICT industry as a very important driver of the international economy, is the backbone of the modern business era, the pillar of the development of the countries and a benchmark for other leading industries and organizations. Government sector as an upstream authority plays a critical infrastructural role in ensuring an efficient, agile and sustainable ICT industry. All the communication tools used in human daily life benefit from a communication platform regarded as the backbone of the telecommunication network. In Iran, the Telecommunications Infrastructure Company (TIC) is solely in charge of the backbone of the telecommunication network of Iran (TBNI) and the only governing authority of the Ministry of ICT. Therefore, due to the role of this network in sustainable development

and in order to meet the regulatory requirements and ever-growing beneficiaries' expectations, continual improvement of the service quality is of vital importance. One of the main purpose of this research is to provide a novel integrated excellence model for TBNI to achieve this ultimate goal.

TBNI provides the long-distance and the international remote traffic, supports and manages any type of voice, image and data traffic required by Iran for the operators, the government and non-governmental applicants, the natural and the legal entities and so on in the inter-provinces areas [1]. TBNI consist of three layers, i.e. the media layer, the transmission layer and the service layer [2].

The quality management and the excellence management approaches both have begun to develop and progress scientifically and practically in the 1960s [3].

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The performance appraisal is an essential part of the measurement and learning process which engages the employees in the self-assessment and enables the organizations to systematically monitor and identify the strengths, the opportunities for improvement as well as the progress of the excellence programs [4–6]. The organizations of the private and the public sectors have adopted the use of the self-assessment methodology as an independent strategy [7]. There is a general agreement that a systematic framework or approach is needed to operate comprehensive quality management. However, there is no single universally accepted frame work [8]. National Quality Awards and Business Excellence Awards are a framework for recognizing the efforts of organizations that make significant progress and achieve world-class performance based on a set of quality and excellence management principles and criteria [9, 10]. There are several other national awards, formed based on their programs to improve the quality in various industries [11, 12]. Many companies have also encountered problems due to various weaknesses of these models such as the sophisticated evaluation criteria, the excessively administrative formalities, the rigid procedures, and the lack of concentration, limiting their use in practice [13]. Researchers have concluded that quality of products and customers satisfaction are the most important criteria in project planning and supply chain network [14–16]. The Customer satisfaction depends on product quality, price and customers' preferences and demand [17–19].

To develop the framework of the excellence models based on the specific requirements of each organization and industry is critical to achieve the organizational perfection [20, 21]. Metaxas and Koulouriotis [13], in a study conducted to bridge the gap in the researches ran between the years 1990 to 2016, found out today, the organizations, moving towards the excellence, perfection and improvement of their service quality, more than before get involved with the leaders of the respective fields. The highlight of this study was that the ability to adapt to a turbulent environment only existing in a limited number of the frameworks, thus the development of the models of the existing business excellence to allow the flexibility in the industries and the key sectors such as telecommunications, transportation and so on through the case studies and the empirical studies are essential [13]. By applying the ISO 9001 standard, the organizations have been on the path to success, so top organizations in the world must be able to identify the quality engineering tools correctly and focus their approaches on the active approaches instead of reactive ones, achieve the sustainable success and the equal satisfaction of the beneficiaries, using the Excellence Model framework [22]. The specific standard designed for the ICT industry is the Telecom Quality Management System (TL 9000), which provides the ICT suppliers and service providers with Information Navigation and enables them to have a global standard specific to this industry. In addition, according to the recommendations of International Telecommunication Union (ITU) [23], the enhanced Telecom operations map (eTOM) model is a framework for conducting the business processes in the ICT industry and is commonly used for the telecommunications business management. eTOM usually brings up along with IT Infrastructure Library (ITIL) and the frameworks of both eTOM & ITIL as a part of the comprehensive quality management in ICT industry and follow a customer-oriented pattern. One of the eTOM's strengths as a business process framework, belongs to Next Generation Operations Support System (NGOSS) program in the telecommunication's management society and its relationship with the other activities in process [24]. Pereira et al. [25] Using the pragmatic perspective and the value management professional frameworks, namely Control Objectives for Information and Related Technologies (COBIT 5) and Value from IT (Val IT 2.0) introduced a capability model for the value management of ICT [25]. Eskildsen et al. [26], in a study of Danish companies using the EFQM model for self-evaluation, found no relationship between the weights of the model criteria and the score of those criteria. Eskildsen et al. [27], examined the weights of the criteria of excellence in private and public organizations, and observed the differences between Danish public and private organizations, with greater emphasis on employees in the public organizations and on the systems in the private organizations. The results indicated that the private organizations placed more weights on the leadership, policy, and strategy criteria than the government organizations [27]. In an applied research, Zare et al. [2] also investigated the control and the promotion of the service quality management and excellence of ICT in TBNI through an experimental and case study. The results indicated that using a customized excellence model in this network would lead to the improvement of the control, service quality and the excellence of ICT industry in Iran [2].

In this research, after taking the principles of total quality management into consideration, the various business excellence models, as well as exclusive standards of ICT industry, as listed in Table 1, have been scrutinized. This paper first summarizes the criteria in different models of excellence and, by focusing on developing a scoring model, makes it possible to identify areas for improvement and evaluate the expected results in an integrated and structural manner. Our exploratory studies showed that to improve the quality of the service and flexibility in national ICT industry, the criteria of security and risk, governance and economy must be taken into account to achieve a comprehensive and customized domestic evaluation model. Therefore, one of the objectives of this research is to present a novel TBNI

excellence model, which requires a careful study based on a scientific methodology validated by the viewpoints of university as well as industry experts.

2. METHODOLOGY

This research had two stages, i.e. the structure of the TBNI excellence model, the causal relationships and the influence of the criteria of this model on each other. Accordingly, to evaluate the TBNI, three hypotheses (hypotheses 1-3) were presented in the model structural stage and 18 hypotheses (hypotheses 4-21) in the causal relationships section of the TBNI excellence model:

To evaluate the TBNI:

1. The governance factor should be added as an effective criterion to the benchmarks of the basic excellence model.

2. It is necessary to add the Security and Risk factors as the effective criteria to the benchmarks of the basic excellence model.

3. It is necessary to add the economic factor as an effective criterion to the benchmarks of the basic excellence model.

For the causal relationships and the influence of the criteria of TBNI excellence model on each other:

4. Governance criterion influences the leadership criterion.

5. Leadership criterion influences the strategy criterion.

6. Leadership criterion influences the partnerships and resources criterion.

7. Leadership criterion influences the economic criterion.

8. Strategy criterion influences the people criterion.

9. Strategy criterion influences the partnerships and resources criterion.

10. Leadership criterion influences the security and risk criterion.

11. People criterion influences the processes, products and services criterion.

12. Partnerships and resources criterion influences the processes, products and services criterion.

13. Economic criterion influences the processes, products and services criterion.

14. Processes, products and services criterion influences the society results criterion.

15. Processes, products and services criterion influence the customer results criterion.

16. Security and risk criterion affects the society results criterion.

17. People criterion influence the people results criterion.

18. Economic criterion influences the criterion of the business results.

19. Criterion of the society results influences the criterion of the business results.

20. Criterion of the customer results influences the criterion of the business results.

21. Criteria of processes, products and services influences the criterion of the people results.

TABLE 1. Criteria of Excellence Models and Standards

Model/ Standard	Leadership	Strategy	People	Partnership & Resource	Process, Product & Service	Customer Results	People Results	Society Results	Business Results	Security & Risk	Governance	Economic
FQM (2013)	✓	✓	✓	✓	✓	✓	✓	✓				
MBNQA	✓	✓	✓	✓	✓	✓	✓					
Deming	✓	✓	✓	✓	✓	✓	✓		✓			
eTOM	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PRINCE 2	✓	✓	✓		✓							
IMS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NTQAC* surveyed	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
TL 9000	✓	✓	✓	✓	✓	✓	✓	✓				✓
ISMS	✓	✓	✓	✓	✓	✓		✓		✓		✓
COBIT 5	✓	✓	✓						✓		✓	✓
ITIL	✓	✓	✓		✓		✓			✓		✓
Val IT	✓	✓			✓						✓	✓
Xerox	✓	✓		✓	✓	✓	✓		✓			✓
The proposed model	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

* National Telecommunications Quality Awards Countries

To test the first and the second hypotheses, the experts' opinions about the need to add or not to add the governance, security and risk criteria to the basic excellence model were asked, and to test the third hypothesis, the experts' opinion about the overlap or non-overlap of the economic sub-criteria and the sub-criteria of the basic excellence model were questioned.

To test hypotheses 4-21, the experts were asked to find out the amount of the impact of the customized excellence model of the TBNI on each other for extract the causal relationships of excellence model.

Two methods of data collection were used in this study. A library method was used to collect the information on the subject literature, the research backgrounds, and the related theories from the libraries and the specialized articles and the field method along with the questionnaire distribution among the experts was used to collect the information to test the research hypotheses. Also, the structural equation modeling and Shannon entropy were used which are the main new approaches for solve the complex models and enabling the researchers to show the simultaneous effects of the variables on each other with an emphasis on the measurement errors [28–30].

3. THE POPULATION AND STATISTICAL SAMPLE

This research is based on the data collection of the telecommunication backbone network of all 31 provinces of Iran. Using the previous studies for the first stage of the research, an analytical model was developed to prepare two questionnaires; the questionnaire was distributed amongst 110 experts and 97 questionnaires were collected. The components of the questionnaires related to this stage of the research are presented in Tables 2 and 3. The validity of the research questionnaires is the content validity type prepared based

TABLE 2. Components of the first questionnaire related to stage one

Criterion Model\Framework	Security & Risk	Governance
eTOM, IMS, ISMS, ITIL, COBIT 5& Val IT	Items 1~ 20	Items 21~ 25

TABLE 3. Components of the second questionnaire related to stage one

Model\ Standard	Criterion
EFQM 2013, eTOM, IMS, ISMS, ITIL, COBIT 5, Val IT, TL 9000, Xerox & National Telecommunications Quality Awards of the countries surveyed	Items 1~ 62

on the theoretical principles and approved by the academic and organizational experts familiar with the models of excellence. The statistical population of the study consisting of the experts and managers of TIC, the academic professors and the experts of the governance sector related to the ICT industry, were selected for the compiling and reporting the models of excellence.

For the second stage of the research, two questionnaires were distributed among 168 ICT experts, and all the questionnaires were collected. A part of the questionnaires prepared was shown (see Appendix Table 11). The questionnaires were systematically distributed via the paperless system available at the TIC for the experts of the TBNI, working in 31 provinces of Iran as shown in Table 4 and their responses were received by the same way.

4. DATA ANALYSIS

Based on the results of the test for first questionnaire related to stage one (see Appendix Table 12), the P-value for all 25 items is less than 0.05 and is equal to zero, so, the non parametric test value was significant for all the items. The value of the test statistics is significantly large for all the items. Therefore, it can be concluded that in all the cases, the experts agreed to add the relevant items under the security, risk and governance criteria.

The results of the evaluation and the reliability analysis of the questionnaire showed that items (sub-criteria) which their deletions increased the Cronbach's alpha, were excluded from the questionnaire. Among the 1st to the 20th item which were related to the security and risk criterion, Cronbachs' alpha of 4 items, i.e. the first, second, fourth and eighth items were greater than 0.8857. As a result, deleting them increased the Cronbach's alpha. Therefore, the said four items were excluded from the security and risk criterion, and the other items remain. Cronbach's alpha in all the twenty-one to twenty-five items of the governance criterion was less than 0.777, so, deleting them made no change in Cronbach's alpha [31]. Therefore, they were acceptable and were not be eliminated.

The second questionnaire examined the experts' opinions on the items identified by the models of the organizational excellence and the performance management in the field of ICT as well as the manner of the items classifications in the formats of the different criteria. To this end, the latest edition of the EFQM was selected as the basic model and the economic criterion was added to its nine criteria. To define and consider the manner of the items classification of each criterion, the data of the survey were analyzed, and the addresses were asked to comment on the appropriate dimension for each item. Then, it was assessed whether at least 50% of the survey respondents agreed to add the relevant items. The

results indicated that the P-value was less than 0.05, and it was equaled to zero for all the items. Therefore, the non parametric test was significant for all the items. The result was presented (see Appendix Table 13). Based on the above analysis, the reliability of the questionnaire criteria was shown (see Appendix Table 14).

Given that in a number of the criteria, the high number of the items could be problematic for the applicability of the model in practice, the next step was using the factor analysis to summarize the number of the sub-criteria (items). Accordingly, on the security and risk, governance and economic criteria as described in Table 5, the sub-criteria having the coefficients greater than 0.7 were selected.

To test the hypotheses related to second stage of this research (hypotheses 4–21) and to prepare the information to derive a model to find out the impact of the indigenous model of the TBNI as well as to extract the causal relationships and the influence of the criteria of this model on each other by the academic professors in the field of the quality management, the technical experts of this field, and the consultants of implementing the models of excellence. They offered their suggestions on the type of the relationship between the organizational excellence criteria based on their technical knowledge and experience at the numerous meetings; the sessions were run in a brainstorming manner. Finally, after discussing and exchanging their opinions, they proposed

TABLE 4. Questionnaire distribution

A set of responses to the received questionnaires	Respondents					Number of questionnaires sent	Location of the province	Network location
	Experts & University Professors	Responsible experts	Heads of Departments	Deputy General Manager	General Managers			
168	168	33	35	31	31	168	31 provinces of Iran	TBNI (All over the provinces of Iran)

TABLE 5. Items on security and risk, governance and economic criteria

Criterion	sub-criteria
Security & Risk	Ensure senior management and board that processes and controls are in compliance with accepted standards.
	Emergency Preparedness and Response.
	Risk assessment to determine appropriate controls to achieve acceptable levels of risk.
	Avoidance and dynamic identification of information security incidents.
	Continuous assessment of information security and appropriate corrections.
	Planning for security management in line with required services and policies.
	Perform security control activity.
	Assessment and Audit of Infrastructure Security Support.
Governance	Ensure the organization complies with all existing governments regulations.
	Ensures the firm complies with all relevant legal requirements.
	Legal Requirements and Other Requirements.
	Compliance of IT services with external laws and regulations.
	Establish an effective governance review.
Economic	Ensuring that the company earns money through billing and receivables.
	Manage customer billing query.
	Receiving and evaluating a bill.
	Customer Assets.
	Create value for the customer and the organization.
	Optimizing the cost of business processes.
	Determine the way to access financial resources.

a model in accordance with Figure 1. The mentioned model used the acronyms was shown (see Appendix Table 15).

According to the experts and using the specific questions related to the self-evaluation, an analytical model was developed to prepare two questionnaires. The questionnaire contained 48 questions concerning the enabler criteria and 25 questions related to the results criteria. The variables of this research were the criteria of the excellence model of the TBNI. These variables were included in a causal model.

The confirmatory factor analysis was used in this study; as the name implied, the factors and the relationship of them with each other as well as the other variables were determined, and the purpose of the test was to validate it with the real data.

In the confirmatory factor analysis model, the calculations were the first step in providing a factor model in relation to the structural relationship of the variables. The model was generally expressed by Equation (1):

$$X = \Lambda_x \xi + \delta \qquad (1)$$

In this research, x vector was 12×1 criteria of excellence, ξ was the variable of excellence, Λ_x was the coefficient matrix, and δ was the error vector.

The present study used the maximum accuracy approach which was one of the most common estimations methods [34] as shown in Equation (2)

$$F_{ML} = \log|\Sigma| + tr(S\Sigma^{-1}) - \log|S| - q \qquad (2)$$

In this function, Σ was the parametric covariance matrix, S was the covariance matrix of the sample, and q was the number of the explicit variables which its value in this model was 12.

The function used for estimating the factor score regression was achieved using Equation (3):

$$\hat{\xi} = \hat{\Phi}\hat{\Lambda}' \hat{\sum}^{-1} x \qquad (3)$$

The coefficient x in the above equation was indeed, the regression coefficient between the latents and the explicit variables resulted from the least squares ordinary method.

First, the normality of the data should be checked. Ignoring this case can lead to the skewed results in the study. There were several ways for examining the normality of a variable. One of these methods was to draw the histogram of that variable, using spss software. This method might not work correctly in the small samples. Another way for examining the normality was to use the skewness and the kurtosis indices. Usually, the (-2,2) value for the skewness and the kurtosis indices indicated that the distribution was normal.
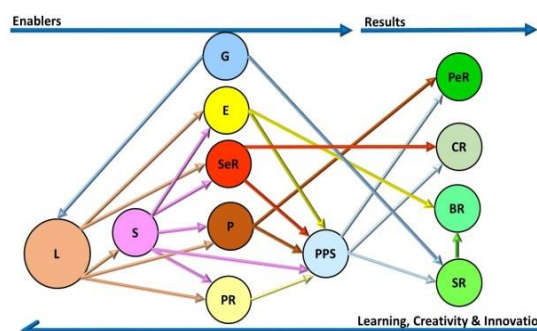

Figure 1. Initial Proposed Model

The proposed model was analyzed through the structural equations by Amos software. According to Table 6 obtained from the structural equation analysis, the proposed model was modified and validated as shown in Figure 2.

According to Table 7, the amount of the skewness and the kurtosis of the most observations was in the range (i.e. -2,2). Therefore, it could be deduced that the research data followed the normal distribution. In accordance with Table 6, p-value for the model relationships were all reported at 95% confidence level.

One of the main goals in using the structural equation modeling was to identify the degree of the compatibility between the experimental data with the conceptual and theoretical models. To identify the consistency of the experimental data and the conceptual model, the indicators and criteria were used, which were called "the goodness of fit of the model". In the structural equation modeling, the different indices were used to ensure the goodness of fit of the model. With regard to Table 7, the P-value obtained for chi-squared Index (CMIN) was equaled to zero which was less than 0.05, therefore, it could have deduced that the research model based on this indicator was properly desirable. According to Table 7, the value of Normed Chi-Square (CMIN/DF) index was 2.511. Therefore, the model proposed in this study had a suitable desirability from the viewpoint of this index. The value of RMR index was equaled to 0.118 and the value of RMSEA index was 0.0951. Therefore, the model proposed in the study was acceptable.
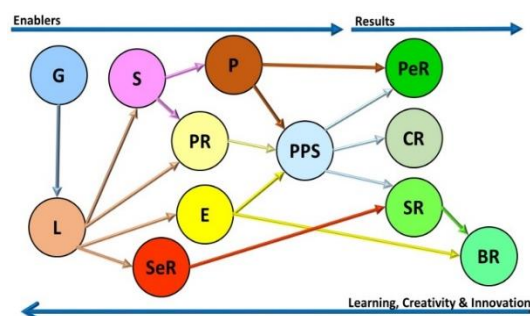

Figure 2. Modified Proposed Model

TABLE 6. Structural equation analysis

	Relationship		Estimate	S.E	C.R	P-VALUE	Label
L	<-	G	0.908	0.139	6.51	000	Par-4
S	<-	L	0.899	0.098	9.19	000	0.902
PR	<-	L	0.445	0.231	1.93	0.054	Par-5
E	<-	L	0.710	0.104	6.80	000	Par-6
P	<-	S	0.928	0.135	6.89	000	Par-7
PR	<-	S	0.394	0.249	1.58	0.113	Par-8
SeR	<-	L	0.984	0.114	8.63	000	0.194
PPS	<-	P	0.178	0.096	1.86	0.063	Par-9
PPS	<-	PR	0.282	0.158	1.78	0.075	Par-11
PPS	<-	E	0.718	0.215	3.33	000	Par-12
SR	<-	PPS	1.592	0.329	4.83	000	0.799
CR	<-	PPS	0.619	0.111	5.57	000	Par-14
SR	<-	SeR	-0.888	0.277	-3.20	0.001	Par-78
PeR	<-	P	0.302	0.167	1.81	0.070	Par-10
BR	<-	E	0.222	0.103	2.15	0.032	Par-13
BR	<-	SR	0.353	0.072	4.89	000	Par-15
BR	<-	CR	0.735	0.158	4.64	000	Par-77
PER	<-	PPS	0.550	0.175	3.14	0.002	Par-79

4. 1. Weights of The TBNI Excellence Model Criteria

To obtain the relative weights of each criterion and sub-criteria related to the developed and customized excellence model of the TBNI, we divided its coefficient by the total coefficients, and then, we multiplied the result by 1000; the results obtained from the structural analysis method as described in Table 8.

The Shannon entropy was another method to obtain the weights of each criterion and sub-criteria of the excellence model. The results obtained based on this method was presented (see Appendix Table 16). The results obtained from the paired T indicated there were no significant difference in the confidence level of 95% weights obtained by two methods of structural analysis and Shannon entropy (see Appendix Table 17).

5. THE TBNI EXCELLENCE MODEL

The TBNI excellence model, was designed as per Figure 3. The model's facade was a wheel as a symbol of the movement. The model had twelve criteria, eight of which were enablers, and the other four was the results. First criterion of the enablers placed in the middle of the model, was the leadership criterion. The other seven criteria from the enablers group were respectively the criteria of the governance, economy, people, strategy, processes, products & services, partnerships & resources

and security & risk. The four results criteria were the Customer Result as the most important beneficiaries of the company, the Society Result and Business Result including the financial, non-financial and People Result as the most important part of the company's investments.

TABLE 7. chi-squared Index (CMIN)

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	164	6369.184	2537	0	2.511
Saturated model	2701	0	0		
Independence model	73	11599.557	2628	0	4.414

TABLE 8. Weights of the Enablers & Results criteria of TBNI Excellence Model Obtained from the structural analysis Method

Criteria (Enablers)	Weights	Criteria (Enablers)	Weights	Criterion (Results)	Weights
G	59	S	58	CR	95
L	67	PPS	63	BR	100
E	104	PR	69	SR	105
P	67	SeR	108	PeR	105

Figure 3. The TBNI Excellence model

The rotational force of the model began with learning from the results, continued with the creativity and innovation of the enablers towards the expected results. This movement along with the appropriate leadership role would never stop.

The analysis of each of the levels or steps of the maturity of the TBNI was as per Figure 4.

6. SELF ASSESSMENT OF THE TBNI

The self-assessment of the TBNI at the company level and 31 provinces of Iran were accomplished by the approach of stimulating the model based on RADAR Logic in 2019, by a team of experts including the university professors in the quality management fields, the ICT technical experts, the consultants specializing in the systematic implementation of the excellence models separating each of the twelve criteria of the model. With regard to the results and the consensus of the evaluation team, the TBNI achieved a score of 667 out of a total of 1000 points as per Table 9.
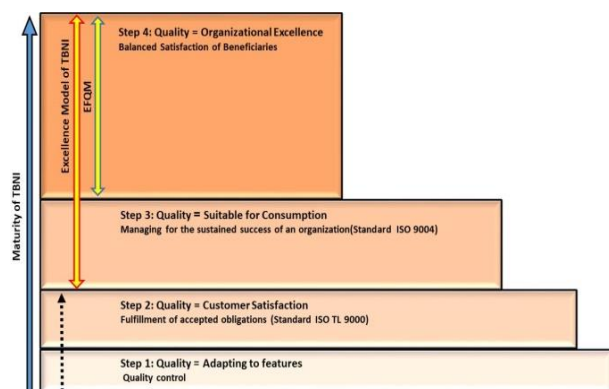

Figure 4. Steps of the maturity of the TBNI

6. 1. Improvement Opportunities   According to the results of the evaluation, the major areas and projects to address improvement opportunities are identified and described in Table 10.

7. RESEARCH ACHIEVEMENTS

Some of the most important achievements of this research in the industry of ICT in Iran were as follows:
• To improve the quality of service of the TBNI.
• To improve the quality of service in the field of ICT industry of Iran.
• To operate and evaluate the communication networks based on the standard logic and techniques.
• To analyze the reports and to perform the field supervision in applying the priorities of the new technologies in conformity with the current requirements of the country through identifying the customer's needs and outsourcing the services.
• To explain and formulate big goals and strategies based on the national and international standards.
• To reconsider the approaches using the results of the content analysis based on the information sources to optimize the performance of the indicators.
• To increase the productivity.
• To identify the factors of creating the process values to the continual improvement of the service quality.
• To enhance the satisfaction of all the beneficiaries.
• To enhance the level of the quality of the services and products of all the organizations using in some ways the ICT services such as improvement of information security, enhancement of the national security, improvement of national health, enhancement of educational services, banking etc, across the country.

TABLE 9. Self-evaluation score of the TBNI

Criterion		Weights of model criteria Based on SEM method	Earned points
Enablers	L	67	41
	G	59	42
	SeR	108	75
	E	104	74
	P	67	41
	PPS	63	44
	S	58	40
	PR	69	47
Results	SR	105	64
	CR	95	67
	BR	100	64
	PeR	105	64
Total points		1000	667

TABLE 10. List of improvement opportunities

Item No.	Opportunities for Improvement
1	Revision of strategic document in line with governance tasks.
2	Development of communication infrastructure and fiber network in line with the role of governance in smart cities.
3	Futurology of cyber environment with preventive passive defense cyber approach.
4	Investigating the Role of Passive Economic Defense in Resistance, Economics.
5	Revision of the "Economic Justification of Projects" Executive Procedure.
6	Reviewing the performance of the supplier evaluation methodology in line with the organization's strategies.
7	Reviewing the Executive Process Management using the e-TOM Framework.
8	Development of process capability tools in network operations and management.
9	Development of information security management system on the backbone network.
10	Enterprise Risk Management (ERM) system deployment.
11	Developing Task Strategies in the Field of "Technology Management".
12	Reviewing the BSC-based strategic planning.
13	Developing a systematic approach to persuade partners and suppliers to develop company service processes.
14	Establishing a Customer Experience Management system (CEM) and revising the customer survey system.
15	Revise the "Staff Survey" method and analyze its results with the possibility of segmenting the results.
16	Development of comprehensive system of employee participation by modeling successful companies.
17	Develop a workflow approach and re-employ staff.
18	Reviewing the Method of Measuring Effectiveness of Informing Organizational Goals.
19	Revise the "Comprehensive Employee Information Program" based on the strategic needs of the organization.

8. CONCLUSION

In this research, the principles and criteria of promoting the quality management and excellence of the TBNI were investigated through the library and the field study. After reviewing various types of excellence models, standards and specific requirements of ICT field and different articles, we found out that the models submitted were generic and general. So, with full attention to the specific requirements and standards of ICT industry and due to adapt this model from the viewpoints of the security and risk, governance and economic, the excellence model of TBNI was developed and customized. The criteria of this model consist of the enablers and results. To achieve the highest level of reliability and internal coherence of each criterion, based on expert opinion polls, sub-criteria was categorized and analyzed in several stages using the factor analysis approach. The causal relationships and the influence of the criteria of this model on each other were investigated, and the weights of each criterion and sub-criteria, using the structural analysis and shannon entropy methods, were determined. The self-evaluation of the TBNI was systematically carried out and with regard to the results and the consensus of the evaluation team, the TBNI achieved a score of 667 out of a total of 1000 points. The major opportunities for the improvement had been identified as priorities and defined regarding the improvement measures and projects.

The present study sets a new and systematic procedure for achieving the goals which ICT managers are facing nowadays. In order to verify the new proposed excellence model by the research, after implementation at the pilot level in 31 provinces of the country, its results have been confirmed by ICT managers. According to the researchers' experience, one of the problems of ICT industry has been the lack of sufficient attention to economic issues and the complex issues of security and network risk. Therefore, in this regard, this model resolves and reduces career and management problems which managers are facing. Although economic issues, security and risk and even governance issues have been emphasized by the country's ICT executives, they have not been systematically integrated into a model of excellence. The results of this study include vital and important cases in a model of customized ICT excellence for the country and presented in the form of a new integrated model. The results showed that the establishment of this customized excellence model had led to an improvement in the quality of services provided by this network and the products of all organizations that use any services of TBNI.

According to the research achievements, the specific practical suggestion for further research is to localize, verify and apply this novel integrated excellence model to other related industries.

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10. APPENDIX A. SUPPLEMENTARY DATA

TABLE 11. A part of the questionnaire related to second stage

Criterion	Sample
Governance	The organization's ICT services comply with external laws and regulations.
Security & Risk	Activities related to controlling network security are aligned effectively with the organization's overall goals.
Economic	The cost of business processes are optimized.
Leadership	Leaders define, review, control, and extract improvements to the organization's management and performance system.
Strategy	The strategy of the organization is based on understanding the needs and expectations of the stakeholders and the external environment of the organization.
People	People throughout the organization communicate efficiently and effectively.
Partnerships & Resources	Manage technology to support achieving organizational strategies.
Processes, Products & Services	Processes are designed and managed to optimize to value for stakeholders.
Customer Results	Changes in customer perceptions and performance indices are due to its effective planning and implementation in the empowerment sector.
People Results	Human resource performance and perception indicators are based on clear logic and to achieve overall goals of the organization.
Society Results	The organization assessed community perceptions through surveys or other forms of feedback, measured the organization's internal performance indicators, and had a positive and consistent trend.
Business Results	Key performance indicators of financial, non-financial perceptions and performance of a business are aligned with and identified with service quality strategies as well as the expectations and expectations of the relevant community and institutions.

TABLE 12. Assumption test results for 25 items from the set of security & risk criteria and governance criteria

Model / Framework	Item (Sub-Criteria)	Median	Q1	Q3	Min	Max	IQR	Wilcoxon Test Stat	P-Value
eTOM	1	3	2	3	2	3	1	903	0
	2	3	3	3	-3	3	0	877	0
	3	3	2	3	0	3	1	861	0
	4	3	2	3	-3	3	1	873	0
IMS	5	3	2	3	0	3	1	861	0
	6	3	3	3	2	3	0	903	0
	7	3	3	3	1	3	0	903	0
	8	3	3	3	1	3	0	903	0
	9	3	2	3	1	3	1	903	0
ISMS	10	3	2	3	-2	3	1	896	0
	11	3	2	3	1	3	1	903	0
	12	3	2	3	1	3	1	903	0
	13	3	2	3	1	3	1	903	0
	14	3	2	3	1	3	1	903	0
	15	3	2	3	1	3	1	903	0
ITIL	16	3	2	3	1	3	1	903	0
	17	3	2	3	-2	3	1	891	0
	18	3	2	3	-2	3	1	895.5	0
	19	3	3	3	1	3	0	903	0

	20	3	2	3	1	3	1	903	0
eTOM	21	2	2	3	-3	3	1	817	0
	22	3	2	3	1	3	1	903	0
IMS	23	2	2	3	-3	3	1	829	0
COBIT 5	24	3	2	3	1	3	1	903	0
VAL IT	25	3	2	3	0	3	1	861	0

TABLE 13. The binomial test results

Item (Sub-Criteria)	Mod (Criteria)	Num-mod (No. of +ve Comments)	P-Value
2	1	55	0
8	1	55	0
15	1	55	0
22	1	55	0
24	1	55	0
57	1 & 10	30	0.59
1	2	55	0
9	2	55	0
12	2	55	0
21	2	55	0
50	2 & 10	34	0.105
4	3	52	0
7	3	55	0
14	3	55	0
17	3	55	0
20	3	53	0
6	4	53	0
10	4	55	0
11	4	55	0
18	4	55	0
19	4	55	0
3	5	53	0
5	5	55	0
13	5	54	0
16	5	55	0
23	5	55	0
28	5	37	0.014
33	5	40	0.001
39	5	51	0
49	5	42	0
59	9 & 10	33	0.177
60	9	36	0.03
61	9	37	0.014

62	9	36	0.03
25	10	43	0
26	10	36	0.03
27	5 & 10	30	0.59
29	4 & 10	32	0.281
30	10	39	0.003
31	10	53	0
32	10	45	0
34	10	42	0
35	10	48	0
36	10	41	0
37	10	44	0
38	5 & 10	34	0.105
41	10	48	0
42	10	51	0
43	10	35	0.058
44	10	42	0
45	10	41	0
46	10	48	0
47	10	39	0.003
48	10	37	0.014
51	4 & 10	28	1
52	10	41	0
53	10	52	0
54	10	42	0
55	10	46	0
56	10	50	0
58	10	50	0
40	4 &10	24	0.419

TABLE 14. Cronbach's alpha dimensions

Criterion	Cronbach's Alpha
Leadership	0.9023
Strategy	0.8943
People	0.7423
Partnerships & Resources	0.8894
Processes, Products & Services	0.8533
Security & Risk	0.9177
Governance	0.7770
Economic	0.9521
Business Results	0.8166

TABLE 15. Criteria abbreviations

Criterion	Initials	Criterion	Initials
Leadership	L	Partnerships & Resources	PR
Governance	G	Processes, products & Services	PPS
Economic	E	People Results	PeR
Security & Risk	SeR	Customer Results	CR
People	P	Society Results	SR
Strategy	S	Business Results	BR

TABLE 16. Weights of the enablers & results criteria of TBNI excellence model obtained by the Shannon entropy method

Criteria (Enablers)	Weights	Criteria (Enablers)	Weights	Criterion (Results)	Weights
	69	S	42	CR	87
L	63	PPS	58	BR	87
E	149	PR	52	SR	75
P	79	SeR	111	PeR	128

TABLE 17. T-test: Paired two samples for means

Title	Variable 1	Variable 2
Mean	83.33333333	83.33333
Variance	434.0606061	1012.606
Observations	12	12
Pearson Correlation	0.780735461	
Hypothesized Mean Difference	0	
Df	11	
t Stat	0	
P(T<=t) one-tail	0.5	
t Critical one-tail	1.795884819	
P(T<=t) two-tail	1	
t Critical two-tail	2.20098516	

Persian Abstract

چکیده

امروزه فناوری اطلاعات و ارتباطات (فاوا) به عنوان یکی از تاثیرگذارترین عوامل پیشرفت در تمامی ابعاد مانند حاکمیت، امنیت و ریسک، اقتصاد و تکنولوژی، از جمله صنایعی به شمار می‌رود که به سرعت در حال رشد و توسعه است. این مقاله معیارها و استانداردهای خاص حوزه فاوا برای ارتقاء کیفیت سرویس‌های شبکه مادر مخابراتی ایران را مورد بررسی قرار داده است. پژوهش حاضر از طریق دو روش گردآوری اطلاعات کتابخانه‌ای و مطالعات میدانی انجام پذیرفته است. مدل تعالی بنیاد کیفیت اروپا به عنوان مدل پایه انتخاب و با توجه کامل به الزامات خاص صنعت فاوا و تطبیق این مدل از دیدگاه امنیت و ریسک، حاکمیتی و اقتصادی، مدل نوین تعالی شبکه مادر مخابراتی ایران طراحی و بومی‌سازی گردید. جهت دستیابی به بالاترین سطح قابلیت اطمینان و انسجام درونی هر معیار، با استفاده از نظرسنجی خبرگان زیر معیارها در چندین مرحله و با رویکرد تحلیل عاملی دسته‌بندی و مورد تجزیه و تحلیل قرار گرفته است. روابط علّی و تأثیر معیارهای این مدل بر یکدیگر بررسی و وزن هر یک از معیارها و زیرمعیارها با استفاده از روش‌های معادلات ساختاری و آنتروپی شانون تعیین گردیده است. خود ارزیابی از شبکه مادر مخابراتی ایران بصورت سیستماتیک انجام و اهم فرصت‌های بهبود شناسایی شده است. نتایج نشان داد که استقرار این مدل بومی منجر به ارتقاء کیفیت سرویس‌های ارائه شده توسط این شبکه و محصولات کلیه سازمان‌هایی است که به نوعی از سرویس‌های شبکه مادر مخابراتی ایران استفاده می‌نمایند.