



Identification and comparison of structural factors of innovation capability in ESCO with desirable status

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ABSTRACT

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The present study describes the identification and comparison of structural factors of innovation capability in Esfahan Steel Company (ESCO). Innovation is a crucial factor in growth, success, and survival of organizations. Since the innovation for organizations is not possible without the level of innovation capabilities and the need for steel products and imports of goods from developed countries has greatly increased, this study intends to investigate the factors affecting the subject that may be able to increase the production and reduce the need to import it. Evaluation of the innovation capability factors of ESCO compared with its desired status in industry can help companies develop innovative strategies and also achieve organizational goals. Statistical analysis methods and mean comparison test by examining the structure of the innovation capability in the form of a standard questionnaire was employed. The findings suggest that the innovation capability in the existing situation of ESCO in comparison with the desired situation is significantly different.

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Introduction

Khalil (2013) believes that innovation involves various information, imagination, and initiative to provide a new product, service, or process to the market through the creation of new applications of existing technologies or the creation and commercialization of new technologies. In a similar vein, he argues that innovation is a kind of competitive weapon.

Innovation capability is the ability to use the technology and scale of innovation in organizations, companies, and various agencies. Since innovation can be very large and complex, reviewing it in separate parts can result in better outcome. In this study, we investigated one of the innovation infrastructures including innovation capability and its indexes in the steel industry and specifically in ESCO.

Assessing Innovation Capability

The process of globalization has influenced every aspect of competing, resulting in more competitions over resources and markets. Organizations compete for intangible assets such as human resources. It is evident that competition for the market by using supply of high quality products has increased. Simply put, innovation is the process of taking what is outdated, reviving it as a form of improvement, and renewing the organization's products or services in external environment. In fact, the innovation capability is a prerequisite for realization of innovation in enterprises. Assessing the innovation capability provides unique opportunity to analyze the situation, the potential of each firm, and comparison with the competitors for making strategic decisions.

In assessment, as a literal means to determine the value of something, there is an agreement that assessment does analyze the efficiency and cost of the project after its implementation. If assessment is performed within the scope of the implementation plan, its aims will be improvement and management of the programs or decision making to continue, extend, or revise the plan. Assessment also means the realization of the value and cost of things. Innovation capability and its assessment can help us find the place of our organization in different environmental conditions and today's complex market.

Since the innovation capability refers to the ability of domestic firms for industrial innovation systematically and follows it to achieve or increase a competitive advantage, innovation capability assessment might play a key role in the growth and survival of organizations. Accordingly, many of the rapid changes occurring in the economic systems are now understood by assessing new technologies and innovations (Kroll & Schiller, 2010).

Nowadays, scientific and industrial communities have come to the conclusion that organizations with a focus on innovation, fostering, promoting innovation and innovative activities within their own, can maintain their long-term honors in competitive field. Also, they can be known as the main aspects and means of transforming an idea into an opportunity to solve the problems ahead (Saunila, Ukko, & Rantanen, 2014).

In the past centuries, Iranians discovered how to obtain iron and steel. Also, in the last three centuries, the speed of the development in technology and in steel production in industrialized countries has increased, so we have more demand for steel products.

As shown by the vision and plans of the industry, market, and companies, it seems that we need more and more company products and also we are in need of upgrading the technology used in industry. So, innovation, as an essential factor, can be taken into account in this sector. Besides, the innovation capability refers to ability of domestic firms for industrial innovation systematically and follows it to achieve or increase a competitive advantage, and according to the explanation given and evaluation of innovation capability in organization, the ability is considered as a core of strategy of innovation and technology. Therefore, investigating this topic and discovering the strengths and weaknesses of the organization in this case can be very helpful in management decisions related to the topic.

Literature Review

Tidd and Bessant (2009) argues that innovation is more than just good ideas; it is the process of nurturing ideas and changing them to practical forms which could be used to take advantage of them. He believes that although different words are used in the definitions of innovation, but they all emphasized the need for completing the development and exploitation of new knowledge. Potential of a firm's innovative activities have called "innovation capability", including new products and services, processes or procedures, and new ideas about the organization (Arasti, Karamipour, & Quraishi, 2009). Understanding the innovation capability and assessing its productive and affecting factors in organization can be used in the development and exploitation of existing and available knowledge and technology and then develop the appropriate strategy. Based on the studies conducted to date, the following table is extracted which can be used for recognizing the productive factors of innovation capability.

Table 1
Literature Review

Dimensions	Studies	Indexes
Individual	Khalil (2000)	Personal knowledge
	Roman, Gamero, & Tamayo (2011), Forsman (2011)	
	Kroll and Schiller (2010), Akman and Yilmaz (2008)	
	Yang (2012), Roman, Gamero, & Tamayo (2011)	Personal talent
	Hull and Covin (2010), Kroll and Schiller (2010)	
	Nematolahi (2011), Roman, Gamero, & Tamayo (2011)	Ability and effort for innovative ideas
	Hull & Covin (2010), Akman & Yilmaz (2008), Kroll & Schiller (2010)	Staff Information of the status of innovation in organizations
Roman, Gamero, & Tamayo (2011), Forsman (2011), Akman & Yilmaz (2008)	Education Level	

Team	Bertland (2009)	Communication between colleagues in team Communication between the teams Conformity of people in a team
Organizational	Yeşil (2013), Roman, Gamero, & Tamayo (2011)	The orientation towards innovation strategies
	Yang (2012)	Promotion and reward systems
	Yang (2012)	Punishment systems
	Bertland (2009), Akman & Yilmaz (2008),	Leadership and performance of managers
	Nematollahi (2011), Bertland (2009)	The support of innovators
	Akman & Yilmaz (2008)	Speed of managers in the process of innovation
	Yeşil (2013), Forsman (2011)	Dependence on other sources
	Nematollahi (2011)	
	Roman, Gamero, & Tamayo (2011)	Organizational structure
	Roman, Gamero, & Tamayo (2011)	Organizational goals
	Yeşil (2013), Yang (2012)	Learning
	Roman, Gamero, & Tamayo (2011), Hull & Covin (2010)	
	Yeşil (2013), Pakzad and Tabatabaeian (2005)	Internal R&D spending and their nature
	Yeşil (2013), Nematollahi (2011)	R&D budget
	Pakzad and Tabatabaeian (2005), Kroll & Schiller (2010),	
	Elmqvist (2009)	
	Bertland (2009)	
Nematollahi (2011)	Rules and regulations	
Roman, Gamero, & Tamayo (2011)	Organizational culture	
Roman, Gamero, & Tamayo (2011)	Growth and maturity of organization	
Nematollahi (2011), Roman, Gamero, & Tamayo (2011)	Resource	
Forsman (2011), Bertland (2009)		
Roman, Gamero, & Tamayo (2011)	Knowledge management	
Arasti, Karamipour, & Quraishi (2009)	Individual and team performance evaluation systems	
Arasti, Karamipour, & Quraishi (2009)	System performance evaluation based on goals	
Yeşil (2013)	Creativity in methods of operation	
Shekarchizadeh (2011)		
Yeşil (2013), Forsman (2011)	Number of patents	
Nematollahi (2011), Bertland (2009)	Time allocated for innovative ideas	
	Resources allocated to the process of innovation	
National	Shekarchizadeh (2011)	National standards
	Nematollahi (2011)	
	Shekarchizadeh (2011)	Public laws and regulations protecting
	Shekarchizadeh (2011), Bertland (2009), Akman and Yilmaz (2008)	Customer affect
	Shekarchizadeh (2011)	Supplier affect
	Bertland (2009), Akman and Yilmaz (2008),	
	Shekarchizadeh (2011)	Cooperation with other companies
	Bertland (2009), Akaman and Yilmaz (2008)	
	Shekarchizadeh (2011), Bertland (2009)	Economic conditions in the community
	Shekarchizadeh (2011), Bertland (2009)	Political conditions in the community
Forsman (2011), Bertland (2009)	Using the previous knowledge and experience	
Pakzad and Tabatabaeian (2005)		

According to the studies to date, structural determinants of innovation capability and index for each of them were obtained. The validity of the obtained structure through the use of exploratory factor analysis was determined. Then, the associated conceptual model was approved. In sum, this study is an attempt to evaluate the factors and criteria in the relevant company.

Research Question and Hypotheses

The following research question guided this study:

At which level is each of innovation capability factors located?

Also, the following research hypotheses were postulated:

H₀: Each factor of innovation capabilities in ESCO is in desirable level.

H₁: Each factor of innovation capabilities in ESCO is not in desirable level.

However, the gap between existing and desired status was investigated by the following hypothesis.

$$\begin{cases} H_0: \mu_{existing} = \mu_{desired} \\ H_1: \mu_{existing} \neq \mu_{desired} \end{cases}$$

Table 2 contains the results of the comparison test between the two statuses. (t-test)

Table 2
Paired t-test Analysis of Innovation Capability

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	8.99	.00	-15.32	492	.00	-2.05	.13	-2.31	-1.78
Equal variances not assumed			-15.32	477.05	.00	-2.05	.13	-2.31	-1.78

Therefore, it can be argued that the innovation capability has a significant difference in the existing situation to desired situation. Due to the lower limit (-2.31) and upper limit (-1.78) it can be argued that the existing situation is unfavorable.

To this end, this study evaluates the existing status of innovation capability's factor with desired to find the gap between them. The results of the comparison test between two statuses are shown in Table 3. At first, we examined the equality of two population variances.

Table 3
Comparative Analysis of Innovation Capability Indexes

	Levene's Test for Equality of Variances		t-test for Equality of Means							
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower	Upper	
x1	Equal variances assumed	14.27	.000	-8.03	484	.000	-1.38	.17	-1.72	-1.04
	Equal variances not assumed			-8.06	460.90	.000	-1.38	.17	-1.72	-1.04
x2	Equal variances assumed	27.59	.000	-8.16	491	.000	-1.50	.18	-1.86	-1.14

Comparative Analysis of Innovation Capability Indexes

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper	
x3	Equal variances not assumed			-8.17	452.81	.000	-1.50	.18	-1.86	-1.14
	Equal variances assumed	17.00	.000	-9.27	490	.000	-1.75	.18	-2.12	-1.38
x4	Equal variances not assumed			-9.28	465	.000	-1.75	.18	-2.12	-1.38
	Equal variances assumed	19.66	.000	-4.35	491	.000	-.77	.17	-1.13	-.42
x5	Equal variances not assumed			-4.36	4.38	.000	-.77	.17	-1.13	-.42
	Equal variances assumed	8.10	.005	-5.74	485	.000	-1.09	.19	-1.47	-.72
x6	Equal variances not assumed			-5.76	473.79	.000	-1.09	.19	-1.47	-.72
	Equal variances assumed	14.23	.000	-10.66	488	.000	-2.16	.20	-2.56	-1.76
x7	Equal variances not assumed			-10.67	469.14	.000	-2.16	.20	-2.56	-1.76
	Equal variances assumed	4.70	.031	3.30	488	.001	.82	.24	.33	1.31
x8	Equal variances not assumed			3.30	478.03	.001	.82	.24	.33	1.31
	Equal variances assumed	.35	.551	-8.83	489	.000	-1.77	.20	-2.17	-1.38
x9	Equal variances not assumed			-8.83	487.98	.000	-1.77	.20	-2.16	-1.38
	Equal variances assumed	3.04	.081	-8.56	489	.000	-1.59	.18	-1.95	-1.22
x10	Equal variances not assumed			-8.56	483.55	.000	-1.59	.18	-1.95	-1.22
	Equal variances assumed	15.72	.000	-7.51	491	.000	-1.29	.17	-1.62	-.95
x11	Equal variances not assumed			-7.51	459.901	.000	-1.29	.17	-1.62	-.95
	Equal variances assumed	2.71	.100	-7.02	492	.000	-1.28	.18	-1.64	-.92
x12	Equal variances not assumed			-7.02	486.30	.000	-1.28	.18	-1.64	-.92
	Equal variances assumed	22.26	.000	-9.25	490	.000	-1.78	.19	-2.16	-1.40
x13	Equal variances not assumed			-9.26	462.78	.000	-1.78	.19	-2.16	-1.40
	Equal variances assumed	13.60	.000	-13.44	488	.000	-2.75	.20	-3.16	-2.35
x14	Equal variances not assumed			-13.46	477.30	.000	-2.75	.20	-3.16	-2.35
	Equal variances assumed	33.29	.000	-14.04	487	.000	-2.89	.20	-3.29	-2.48
x15	Equal variances not assumed			-14.07	463.88	.000	-2.89	.20	-3.29	-2.48
	Equal variances assumed	11.92	.001	-12.36	489	.000	-2.54	.20	-2.95	-2.14

Comparative Analysis of Innovation Capability Indexes

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
			-12.37	480.18	.000	-2.54	.20	-2.95	-2.14
x16	8.23	.004	-8.37	487	.000	-1.52	.18	-1.87	-1.16
			-8.39	468.45	.000	-1.52	.18	-1.87	-1.16
x17	.31	.577	-4.56	490	.000	-.85	.18	-1.21	-.48
			-4.56	488.10	.000	-.85	.18	-1.21	-.48
x18	3.22	.073	-7.17	492	.000	-1.27	.17	-1.62	-.92
			-7.17	485.15	.000	-1.27	.17	-1.62	-.92
x19	61.19	.000	-15.25	489	.000	-3.49	.22	-3.94	-3.04
			-15.27	456.70	.000	-3.49	.22	-3.94	-3.04
x20	65.69	.000	-18.34	488	.000	-4.07	.22	-4.51	-3.63
			-18.37	460.50	.000	-4.07	.22	-4.50	-3.63
x21	75.02	.000	-8.56	486	.000	-2.25	.26	-2.76	-1.73
			-8.58	426.61	.000	-2.25	.26	-2.76	-1.73
x22	3.50	.062	-3.48	483	.001	-.77	.22	-1.20	-.33
			-3.47	470.89	.001	-.77	.22	-1.20	-.33
x23	.74	.389	-7.48	491	.000	-1.48	.19	-1.87	-1.09
			-7.48	490.84	.000	-1.48	.19	-1.87	-1.09
x24	3.61	.058	-7.88	492	.000	-1.55	.19	-1.94	-1.16
			-7.88	480.51	.000	-1.55	.19	-1.94	-1.16
x25	1.16	.281	-4.06	486	.000	-.75	.18	-1.11	-.38
			-4.07	481.18	.000	-.75	.18	-1.11	-.38
x26	23.45	.000	-14.67	489	.000	-3.29	.22	-3.73	-2.85
			-14.68	474.82	.000	-3.29	.22	-3.73	-2.85
x27	.85	.355	-5.98	489	.000	-1.32	.22	-1.75	-.88
			-5.98	488.11	.000	-1.32	.22	-1.75	-.88
x28	2.31	.129	-6.17	488	.000	-1.40	.22	-1.85	-.95

Comparative Analysis of Innovation Capability Indexes

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper	
	Equal variances not assumed			-6.17	487.96	.000	-1.40	.22	-1.85	-.95
x29	Equal variances assumed	31.99	.000	-18.29	487	.000	-3.94	.21	-4.37	-3.52
	Equal variances not assumed			-18.33	472.41	.000	-3.94	.21	-4.37	-3.52
x30	Equal variances assumed	9.14	.003	-17.22	483	.000	-3.79	.22	-4.22	-3.35
	Equal variances not assumed			-17.26	479.46	.000	-3.79	.21	-4.22	-3.36
x31	Equal variances assumed	15.59	.000	-19.14	486	.000	-4.22	.22	-4.65	-3.79
	Equal variances not assumed			-19.17	478.25	.000	-4.22	.22	-4.65	-3.79
x32	Equal variances assumed	20.77	.000	-18.74	488	.000	-4.14	.22	-4.58	-3.71
	Equal variances not assumed			-18.76	477.53	.000	-4.14	.22	-4.58	-3.71
x33	Equal variances assumed	9.62	.002	-1.78	489	.075	-.37	.20	-.78	.03
	Equal variances not assumed			-1.78	478.06	.075	-.37	.20	-.78	.03
x34	Equal variances assumed	.66	.416	-12.13	485	.000	-2.44	.20	-2.84	-2.04
	Equal variances not assumed			-12.14	484.66	.000	-2.44	.20	-2.84	-2.05
x35	Equal variances assumed	9.09	.003	-4.93	487	.000	-1.04	.21	-1.45	-.62
	Equal variances not assumed			-4.93	475.39	.000	-1.04	.21	-1.45	-.62
x36	Equal variances assumed	9.30	.002	-5.04	488	.000	-1.08	.21	-1.50	-.66
	Equal variances not assumed			-5.05	471.75	.000	-1.08	.21	-1.50	-.66
x37	Equal variances assumed	19.87	.000	-6.07	491	.000	-1.28	.21	-1.69	-.86
	Equal variances not assumed			-6.08	460.67	.000	-1.28	.21	-1.69	-.86
x38	Equal variances assumed	9.88	.002	-2.10	488	.036	-.46	.21	-.89	-.03
	Equal variances not assumed			-2.11	470.54	.035	-.46	.21	-.89	-.03
x39	Equal variances assumed	6.18	.013	-.92	487	.356	-.20	.22	-.63	.22
	Equal variances not assumed			-.92	471.11	.355	-.20	.22	-.63	.22
x40	Equal variances assumed	27.04	.000	-12.33	489	.000	-2.95	.23	-3.42	-2.48
	Equal variances not assumed			-12.34	473.08	.000	-2.95	.23	-3.41	-2.48

As Table 3 indicates, the significance level in all cases except eighth, ninth, eleventh, and seventeenth indexes is smaller than 0.5. Therefore, the assumption of equal variances is rejected and the information contained in the second row is analyzed to measure the mean of indexes (with the exception of the eighth, ninth, eleventh, and seventeenth indexes). In all cases estimated sig is .000 and less than 0.05; hence, there is a significant difference between the existing and desired status. Also, because of the negative result of lower and higher bound in all cases except the 39th, the assessment is reported unfavorable and for the 39th index the situation is reported to be ordinary.

Results

This study aimed to examine the gaps of innovation capability factors in ESCO. To this end, Charles Cochran formula was used to calculate 247 as sample size with 0.5 per cent margin of error. The questionnaire was developed and distributed among company experts. Then, they were analyzed as shown in Table 4. To calculate the desired level, the idea of steel industry experts was used. Cronbach's alpha was 0.94 which shows the reliability of the questionnaire.

Table 4
The Frequency of the Experts

Position	Frequency	Frequency (%)	Cumulative Frequency
Change Management Expert	42	17	17
Supporting Expert	24	9.7	26.7
Human Resources Expert	23	9.3	36
BSc in Health Environmental	22	8.9	44.9
BS in Budget	23	9.3	54.3
Manufacture Expert	27	10.9	65.2
Sales Expert	28	11.3	76.5
Expert of Quality Control	30	12.1	88.7
Steel Expert	8	3.2	91.9
BS in Statistics and Accounting	8	3.2	95.1
Managements	12	4.9	100
Sum	247	100	---

Discussion and Conclusion

The aim of the study was to investigate the identification and comparison of structural factors of innovation capability in ESCO with desired situation. Evaluation of the innovation capability factors of ESCO compared with its desired status in industry can help companies develop innovative strategies and also can assist them to achieve organizational goals. Based

on the data analysis and findings of this study, it can be concluded that existing statuses of innovation capability was unfavorable against desired statuses in ESCO and all cases except the 39th were reported unfavorable.

Based on the results of this study, applications in accordance with statuses will be provided as follows. Firstly, about the most important index in the group dimension, teamwork and problem-solving mechanisms, teaching working groups for innovation and learning problem solving mechanisms is recommended. Secondly, regarding the index of promotion and reward systems and the support of innovators, it is suggested to consider supported sources in innovators and providers of innovative ideas as promotions and bonuses. In this regard, the suggestions systems can be effective. In addition to this, for the weakness of structure, leadership and performance of managers, speed management in process of innovative ideas and delegating to the respective units is recommended. Also, indexes related to problems arising from financing, such as the resources allocated to the process of innovation, research and development budget, and dependence on other sources can be suggested in the formulation of the company's research funds. In this respect, budget of this unit can be specified. Besides, according to the results, for the weakness in the index of creativity in methods of operation, number of patents and time allocated for innovative ideas, lack of awareness of staff and the system plays an important role in this matter.

Therefore, in conclusion, training and creating awareness in the company is recommended. Also, it is imperative to stress that establishing technology and innovation management unit should be taken into consideration.

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