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EFFECT OF ALIGNMENT OF TECHNOLOGY STRATEGY AND BUSINESS STRATEGY ON PERFORMANCE OF ENTERPRISE (CASE STUDY: ONE OF THE INDUSTRIAL GROUPS AFFILIATED WITH AEROSPACE ORGANIZATION)

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ABSTRACT

Based on literature of technology management, success of enterprises depends on coordination (alignment or integrity) of the technology strategy with enterprise and business strategies. In literature of management theories, three types of alignment models can be identified. Rational, natural, and strategic reference points models. Based on theory of strategic reference points, organizations can select reference points for alignment and align their systems with it. Considering this theory, in case strategies are designed and executed based on strategic reference points, they are expected to be coordinated with each other. In this research, flexibility of the enterprise and attention of the enterprise to the outside /inside environment were selected as strategic reference points and a hypothesis indicated that alignment of technology strategies and enterprise around these points can lead to higher performance of the enterprise. This hypothesis was studied through survey in 10 enterprises affiliated with Aerospace Organization and it was specified that special types of coordination (alignment) between technology strategy and enterprise strategy led to higher performance.

Keywords: Enterprise Strategy, Technology Strategy, Strategic Reference Points, Performance, Alignment

INTRODUCTION

Technological changes in recent decades led to technology as a main concept in progress of economic, social, political and defensive goals of the country. On the other hand, enterprises play unique role in realization of technological goals as the centers which acquire and apply technology. What makes enterprises successful in progress of their goals is the strategy which it selects as the path of progress (Khalil, 2000). Business strategy is a long-term project which specifies actions of the enterprise in realization of its goals and technology strategy indicates the decisions which the enterprise adopts in acquisition, development and application of technology to realize business goals. For this reason, it is necessary to align technology strategy with business strategy. Literature emphasizes on this alignment. In fact, alignment means alignment between business strategy and technology strategy so that these two strengthen each other (Porter, 1988).

However, this subject has been studied less despite emphasis of the literature on necessity of alignment of technology strategy, business and enterprise strategies. According to Zahra & Covin (1993), most of the previous writings about relationship between business strategy and technology strategy had prescriptive, conceptual or anecdotal nature. Limited number of studies has focused on practical relationship between technology policy and business strategy.

In the desired industrial group, type of technology strategies and enterprise strategies has not been studied and determined. Relationship between alignment and non-alignment of these strategies and their effect on performance of enterprise has not been studied. It seems that there is no clear relationship between the said subjects and their relationship with performance for managers in some enterprises. The question is that when these strategies will be coordinated with each other and what the effect of this alignment on performance of enterprise is. Enterprises can choose strategies of enterprise and technology among

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different options. Now, the question is what options are more coordinated with each other and can cause higher performance (Phaal *et al.*, 2001).

Therefore, the researcher intends to study effect of alignment of technology strategy and business strategy on performance of enterprise in one of the industrial groups affiliated with Aerospace Organization.

Theoretical fundamentals and history of research

The present research has been designed to clarify concept of strategic alignment between technology strategy and enterprise strategy and study effect of these alignment on performance of enterprises. Considering the above facts, independent variable of this research is alignment of technology strategy and enterprise strategy and dependent variable is performance of enterprise. Figure 1 shows the research model and the said variables.

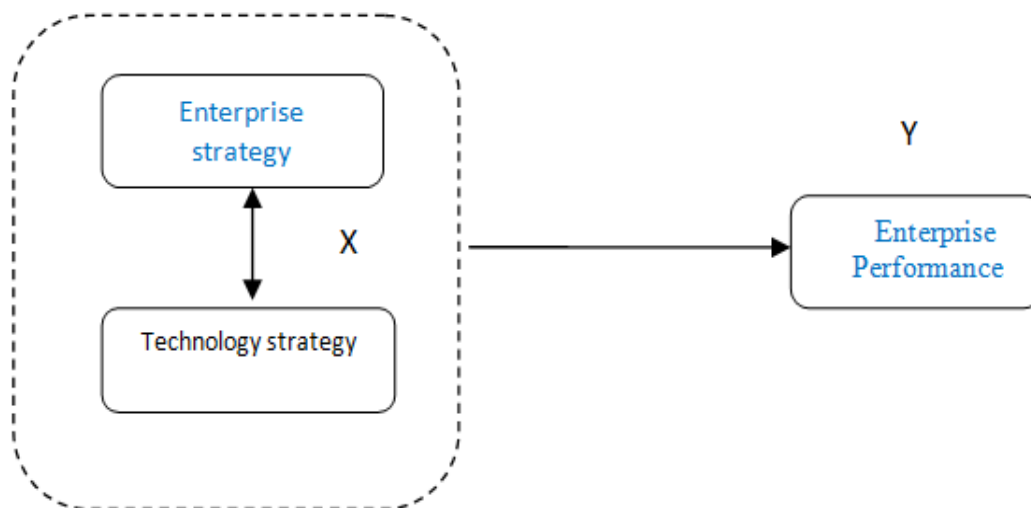


Figure 1: Research model

Literature Review

One of the foreign researches is study by Adler *et al.*, (1989). In their study, they concluded that bilateral flow of information between marketing and research and development sections is necessary to formulate technology and enterprise strategies. Business managers should have full understanding of technological subjects and they should focus not only on technology but also on business and market.

One of the other studies is a study which has been conducted by Hamid Reza Agha Poor for formulation of technology strategy in drilling parts and equipment manufacturing industry (Esbati *et al.*, 2008). In this research, the model of Hax and Majluf (1991) has been used.

A research was conducted by Amir for formulation of technology strategy in one of the fields of aviation industries. In this research, Hax & No's model has been regarded as basis with little change and the researcher has formulated the technology strategy by forming attractiveness and capability matrix.

Another research entitled "alignment model of knowledge management strategies for promotion of performance of research centers" was conducted by Moosavi (2008). Based on quantitative analysis of data, it was specified that there was significant relationship between degree of research centers and their score with some coordinated cases in knowledge management system strategies and with alignment index. In this research, the significant relationship between alignment indices and point of research centers has been proved. Similar results have been obtained for qualitative analysis of data. This research shows that there is significant relationship between strategic alignment of knowledge management strategies and its subsystems and performance of research centers.

One of the researches relating to subject of this research is the experimental study of relationship between technology strategy and business strategy and performance in electronic industries of Iran which has been conducted by LaayaOlfat *et al.*, (2009). The obtained results show that technology strategy supports

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business strategy and provides necessary competitive capabilities particularly for business strategies and in case technology strategy has no necessary adjustment and strength for playing this role, performance of companies will be weak.

Research questions

- Considering the above facts, goal of the research is to determine type of major strategies and technology of different enterprises considering Hall's model and compare performance of the enterprises which have coordinated strategies with the enterprises which have non- coordinated strategies. considering that technology and enterprise strategies have different types , the research questions are as follows:

- How is performance of the desired enterprises?
- What are the dominant major strategies in each of the enterprises?
- What are the dominant technology strategies in each of the enterprises?
- How is the relationship between major enterprise strategy and key performance results?
- How is the relationship between enterprise technology strategy and key performance results?
- Is there significant difference between type of enterprise strategies in terms of quarters 1 to 4 of the matrix and their performance?
- Is there significant difference between performance of coordinated enterprises and non- coordinated enterprises?
- Does alignment of technology strategy with enterprise strategy promote performance?

MATERIALS AND METHODS

The present research is of descriptive type in terms of goal or research design and is of applied type in terms of result or achievement. Considering the conducted studies, there are about 95 enterprises in the country which firstly perform technology management activities and secondly perform performance evaluation as EFQM excellence award.

In the present research, 10 enterprises which are dependent on one of the industrial enterprises affiliated with Aerospace Organization have been considered as statistical population. The sampling method of this research is purposive sampling method. Generally, the respondents to the questionnaire have been 95 persons and the sample size has been 76 persons and the questionnaire has been sent to 76 persons but 6 persons didn't respond and 4 persons didn't respond perfectly. Therefore, 66 cases of data were inserted in the computations.

Research Instruments

In this research, three questionnaires have been used to determine type of major strategy and technology strategy in different enterprises.

These questionnaires were compiled by the researcher based on theories and literature and include two sections including type of enterprise strategy –type of technology strategy. Criteria for questions are attention to environment and control intensity. Cronbach's alpha is 0.931 indicating suitable reliability of the questionnaire.

In this research, descriptive and inferential statistical methods (mean comparison, ANOVA, correlation and regression) have been used to analyze the collected data.

RESULTS AND DISCUSSION

Findings

In this Section, we present the research findings based on inferential analysis. On this basis, we explain the research findings considering the research questions as follows:

Analyzing the Research Questions

2-1 How is the performance of the desired enterprises?

In Table 1 performance of the desired enterprises along with position of the enterprises is specified based on major strategy and technology strategy. It is clear that there is direct relationship between mean of the responses to each of the major and technology strategies and key performance results.

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Table 1: Condition of enterprises based on strategies and key performance results

Key performance results	Mean of technology dimension	Mean of strategy dimension	Alignment of strategies	Technology strategy	Major strategy	Enterprises
50	2.71	3.86	Noncoordinated	4	1	First enterprise
34	3.01	2.52	Noncoordinated	4	3	Second enterprise
63	3.82	3.91	Coordinated	1	1	Third enterprise
35.5	2.94	2.36	Noncoordinated	4	3	Fourth enterprise
65	3.77	4.05	Coordinated	1	1	Fifth enterprise
59	3.33	3.59	Coordinated	1	1	Sixth enterprise
51	3.23	2.38	Noncoordinated	1	3	Seventh enterprise
57.5	3.4	3.34	Coordinated	1	1	Eighth enterprise
60.5	3.4	3.52	Coordinated	1	1	Ninth enterprise
34.5	3.03	2.96	Noncoordinated	4	3	Tenth enterprise

2-2 What is the dominant major strategy in enterprises?

As shown in Table 2, 6 out of 10 enterprises had the first quarter strategy (attention to outside environment, high flexibility) and 4 enterprises had the third quarter major strategy (attention to inside environment-low flexibility) in their policy. There was no case in other states.

Table 2: Major strategy of the studied enterprises

Major strategy	Strategy	Quarter
6	Attention to outside environment –high flexibility	1
0	Attention to inside environment –high flexibility	2
4	Attention to inside environment –low flexibility	3
0	Attention to outside environment –low flexibility	4

2-3 What is the dominant major strategy in enterprises?

As shown in Table 3, 6 out of 10 enterprises had the first quarter strategy (attention to outside environment, high flexibility) and 4 enterprises had the fourth quarter major strategy (attention to inside environment-low flexibility) in their policy. There was no case in other states.

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Table 3: Major strategy of the studied enterprises

Major strategy	Strategy	Quarter
6	Attention to outside environment –high flexibility	1
0	Attention to inside environment –high flexibility	2
0	Attention to inside environment –low flexibility	3
4	Attention to outside environment –low flexibility	4

2-4 What are the relationship between major strategy of enterprises and key performance results?

To study relationship between strategies of enterprises and key performance results more accurately, mean of the mentioned responses for each of the dimensions was used and to analyze their data, Pearson Correlation test was used in terms of interval data. For this purpose, in the first question (how is the relationship between major strategy and key performance results studied?), the relationship between mean of attention to environment and key performance results was studied in the first stage and relationship between flexibility and key performance results was studied in the second stage and considering relativity of data scale, Pearson correlation test was used.

2-5 how is the relationship between attention to environment and major strategy of enterprises and key results of their performance?

As shown in Table 4, there is significant relationship between key performance results and attention to environment considering significance and it can be found that there is direct relationship considering the positive value.

Table 4: Correlation of key performance results and mean of attention to environment

Correlations		efqm	mohits
efqm	Pearson Correlation	1	.732*
	Sig. (2-tailed)		.016
	N	10	10
Mean of attention to environment	Pearson Correlation	.732*	1
	Sig. (2-tailed)	.016	
	N	10	10

*. Correlation is significant at the 0.05 level (2-tailed)

2-6 How is the relationship between flexibility of major strategy of enterprises and key results of their performance?

As shown in Table 5, there is significant relationship between key performance results and flexibility considering significance value and it can be found that there is direct relationship considering the positive value. Therefore, relationship between attention to major strategy environment and key performance results is more significant than relationship between flexibility of major strategy and key performance results in enterprises.

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Table 5: Correlation of key performance results and mean of flexibility of major strategy

Correlations		efqm	Enetafs
efqm	Pearson Correlation	1	.696*
	Sig. (2-tailed)		.025
	N	10	10
Flexibility	Pearson Correlation	.696*	1
	Sig. (2-tailed)	.025	
	N	10	10

*. Correlation is significant at the 0.05 level (2-tailed)

At the end, considering relationship between dimensions of major strategy and key performance results of enterprises, relationship between major strategy and performance results can be studied. As shown and predicted in Table 6, relationship between mean of major strategy of enterprises and key performance results was significant and considering positive significance value, it should be added that the more the enterprises paid attention to external environment and high flexibility in their major strategy, the more their key performance results will be.

Table 6: Correlation of key performance results and mean of major strategy

Correlations		efqm	Sz
efqm	Pearson Correlation	1	.774**
	Sig. (2-tailed)		.009
	N	10	10
Mean of data relating to major strategy	Pearson Correlation	.774**	1
	Sig. (2-tailed)	.009	
	N	10	10

** Correlation is significant at the 0.01 level (2-tailed)

2-7 How is the relationship between technology strategy of enterprises and key performance results?
 In this analysis, relationship between mean of attention to environment and key performance results was studied in the first stage and relationship between flexibility and key performance results was studied in the second stage like the previous question to study relationship between technology strategy of enterprises and key performance results and Pearson correlation test was used considering relativity of data scale.

Table 7: Correlation of key performance results and attention to technology strategy environment

Correlations		efqm	mohitt
Efqm	Pearson Correlation	1	.856**
	Sig. (2-tailed)		.002
	N	10	10
Attention to technology strategy environment	Pearson Correlation	.856**	1
	Sig. (2-tailed)	.002	
	N	10	10

** Correlation is significant at the 0.01 level (2-tailed)

2-8 How is the relationship between dimension of attention to environment in technology strategy of enterprises and key results of their performance?

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As shown in Table 7, there is significant relationship between key performance results and attention to environment considering significance value and it can be found that there is direct relationship considering the positive value. On the other hand, considering correlation coefficient value (0.856), it can be found that there is strong relationship between key performance results and attention to technology environment.

2-9 How is the relationship between flexibility in technology strategy of enterprises and key results of their performance?

As shown in Table 8, there is significant relationship between key performance results and flexibility considering significance value and it can be found that there is direct relationship considering the positive value. Therefore, relationship between attention to technology strategy environment and key performance results is more significant than the relationship between flexibility of technology strategy and key performance results in enterprises.

Table 8: Correlation of key performance results and flexibility of technology strategy

Correlations		efqm	Enetaft
Efqm	Pearson Correlation	1	.650*
	Sig. (2-tailed)		.042
	N	10	10
flexibility of technology strategy	Pearson Correlation	.650*	1
	Sig. (2-tailed)	.042	
	N	10	10

*. Correlation is significant at the 0.05 level (2-tailed)

At the end, considering relationship between dimensions of technology strategy and key performance results of enterprises, relationship between technology strategy and performance results can be studied. As shown and predicted in Table 9, relationship between mean of technology strategy of enterprises and key performance results was significant and considering positive significance value, it should be added that the more the enterprises paid attention to external environment and high flexibility in their technology strategy , the more their key performance results will be.

Table 9: Correlation of key performance results and mean of major strategy

Correlations		efqm	tz
Efqm	Pearson Correlation	1	.777**
	Sig. (2-tailed)		.008
	N	10	10
Mean of technology strategy	Pearson Correlation	.777**	1
	Sig. (2-tailed)	.008	
	N	10	10

** Correlation is significant at the 0.01 level (2-tailed).

3- Is there significant difference between type of enterprise strategies in terms of quarters 1 to 4 of the matrix and their performance?

3-1 Studying Major Strategy of Enterprises

After studying relationship between major strategy of enterprises and technology strategy of enterprises with key performance results, in this Section, we try to evaluate if there is significant difference between different major strategies of enterprises and performance of enterprises. It means that if there is significant difference between different major strategies of enterprises and performance of enterprises. It means that if there is significant difference between different major strategies of quarters 1, 2, 3 and 4 and which of

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the quarters had better performance than other quarters. For this purpose, one-way ANOVA should be used to study significant difference of different major strategies of enterprises but since there are only two cases 1 and 3 for major strategies, independent t-test is used.

3-2 Studying Technology Strategy of Enterprises

In this Section, we try to evaluate if there is significant difference between different technology strategies of enterprises and performance of enterprises. It means that if there is significant difference between technology strategies of quarters 1, 2, 3 and 4 and which of the quarters has better performance than other quarters.

Table 10: Results of Levene's Test and test for difference of the first and fourth technology strategy Independent Samples Test

Levene's Test for Equality of Variances										
F	Sig.	t	Df	Sig	Mean Difference	Std. Difference	Error95% Confidence Interval of the Difference			
							Lower	Upper		
Equal variances assumed	1.061	.333	5.294	8	.001	20.8333	3.9352	11.7587	29.9080	
Equal variances not assumed			4.807	4.636	.006	20.8333	4.3343	9.4235	32.2432	

Now, Levene's Test for Equality of Variances can be performed. As the Table shows and considering equality of variances, significance level of T-test is 0.001 for equality of means indicating rejection of hypothesis H_0 for this reason, it can be said that there is significant difference between the first technology strategy and the fourth technology strategy in mean performance of the enterprises.

On the other hand, in case results of T test show that mean of two populations is different in terms of grouping variable, it can be concluded that grouping (independent variable) has been effective on dependent variable (Momeni, 2008).

In this regard, it can be claimed that the first and fourth major strategies have been effective on performance of enterprises.

To judge which of the groups is more effective, we pay attention to mean of two groups. Since mean of the first strategy is higher than that of the fourth strategy, it can be concluded that performance of the enterprises with the first strategy has been better than that of the fourth strategy.

$U: 59.3 > u1: 38.5$

Table 11: Comparing mean of the first and fourth technology strategies Group Statistics

strategy	N	Mean	Std. Deviation	Std. Error Mean
efqm birooni-enetaf	6	59.333	4.8956	1.9986
birooni-control	4	38.500	7.6920	3.8460

In other words, the enterprises whose technology strategy is of the first type (attention to the external environment –high flexibility) have had better performance than the enterprises whose technology strategy has been of the fourth type (attention to the external environment –low flexibility).

3-3 Is there significant difference between performance of coordinated enterprises and non- coordinated enterprises?

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As shown in Table 12, 5 out of 10 coordinated enterprises have the first alignment and other 5 enterprises have no alignment.

Table 12: Condition of the enterprises' strategies and alignment of enterprises

Alignment of strategy	Technology strategy	Major strategy	Enterprises
Non-coordinated	4	1	First enterprise
Non-coordinated	4	3	Second enterprise
Coordinated	1	1	Third enterprise
Non-coordinated	4	3	Fourth enterprise
Coordinated	1	1	Fifth enterprise
Coordinated	1	1	Sixth enterprise
Non-coordinated	1	3	Seventh enterprise
Coordinated	1	1	Eighth enterprise
Coordinated	1	1	Ninth enterprise
Non-coordinated	4	3	Tenth enterprise

Table 13: Levene's Test for Equality of Variances and test for mean difference of performance of coordinated and non-coordinated enterprises

Independent Samples Test

Levene's Test for Equality of Variances		T-test for Equality of Means								
F	Sig.	t	Df	Sig.	Mean Difference	Std. Error	95% Confidence Interval of the Difference			
							Lower	Upper		
Equal variances assumed	25.271	.001	4.858	8	.001	20.0000	4.1170	10.5061	29.4939	
Equal variances not assumed			4.858	4.951	.005	20.0000	4.1170	9.3855	30.6145	

Now, Levene's Test for Equality of Variances can be performed. As the Table shows and considering inequality of variances, significance level of T-test is 0.005 for equality of means indicating rejection of hypothesis H_0 . For this reason, it can be said that there is significant difference between enterprises with technology strategy and major technology strategy and enterprises without this alignment in mean performance of the enterprises.

On the other hand, in case results of T test show that mean of two populations is different in terms of grouping variable, it can be concluded that grouping (independent variable) has been effective on dependent variable (Momeni, 2008:76). In this regard, it can be claimed that alignment of technology strategy and major strategy of enterprises has been effective on performance of enterprises.

To judge which of the groups has higher mean, we pay attention to mean of two groups. Since mean of the coordinated enterprises is higher than that of the non-coordinated enterprises, it can be concluded that performance of the coordinated enterprises has been better than that of the non-coordinated enterprises.

U: 59.3 > u1: 38.5

U: 61 > u1: 41

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Table 14: Comparing mean of the coordinated and non-coordinated enterprises

Group Statistics		N	Mean	Std. Deviation	Std. Error Mean
efqm	hamahangi	5	61.000	3.0208	1.3509
	nahamahang	5	41.000	8.6963	3.8891

In other words, the enterprises with alignment (coordination) between major strategy and technology strategy have had higher and better performance than the enterprises without such coordination.

For more analysis, the presence of linear relationship between variables of performance and coordination (alignment) was studied to investigate effect of coordination of enterprises on their performance:

There is no linear relationship between performance and alignment (coordination): h0

There is linear relationship between performance and alignment (coordination): h1

To explain the hypotheses based on the regression model, there are presumptions which should not be observed and studied:

1- Errors (standardized residues) should have normal distribution and mean of 0 and variance 1.

2- Errors should not be independent of each other.

To study this relationship, scatter plot of two variables should be first drawn to study if a linear relationship can be presented for explaining effect of independent variable (coordination of enterprises' strategies) on dependent variable (performance of enterprises).

As shown in Table 15, since significance of Kolmogorov-Smirnov Test is above 0.05, there is hypothesis for normality of standardized residues and one of the presumptions of regression analysis is confirmed.

Table 15: Normality of data of standardized residues

One-Sample Kolmogorov-Smirnov Test		Standardized Residual
N		10
Normal Parameters ^{a,b}	Mean	.0000000
	Std. Deviation	.94280904
Most Extreme Differences	Absolute	.132
	Positive	.132
	Negative	-.129
Kolmogorov-Smirnov Z		.419
Asymp. Sig. (2-tailed)		.995

a. Test distribution is Normal.

b. Calculated from data.

Table 16 shows summary of the model including correlation coefficient, coefficient of determination, Adjusted R², standard error and also Durbin Watson statistic.

This Table reports summary of model for relationship between the model and dependent variable. R means multiple correlation coefficients, linear correlation between the observed values and values of the predictor of the dependent variable. Its large value shows a strong relationship which is equal to 0.864 indicating significant relationship between dependent variable and independent variable. R'square means coefficient of determination which is square of multiple correlation coefficient. This indicates that about 71% of change in key performance results has been determined with alignment (coordination) of strategies.

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Table 16: Summary of linear regression model

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.864 ^a	.747	.715	6.5096	2.328

a. Predictors: (Constant), hamahangi

b. Dependent Variable: efqm

Table 17 shows results of regression ANOVA to study certainty of the linear relationship between two variables and fitness of the regression model. Since significance value is below 0.05, the hypothesis of linear relationship between variables is accepted and indicates fitness of the regression model.

Table 17: Testing fitness of regression model

ANOVA ^b						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1000.000	1	1000.000	23.599	.001 ^a
	Residual	339.000	8	42.375		
	Total	1339.000	9			

a. Predictors: (Constant), hamahangi

b. Dependent Variable: efqm

Table 18: Linear regression coefficients

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	41.000	2.911	.864	14.084	.000
	hamahangi	20.000	4.117		4.858	.001

a. Dependent Variable: efqm

Table 18 shows regression coefficients in column B along with significance value of coefficients tests. Considering significance value of constant test which is below 0.05, we conclude that the number relating to constant (41) should be included in the model. On the one hand, since significance value of the independent variable coefficient (0.001) is below 0.05, regression variable coefficient (20) should be also applied in the regression model and null hypothesis of this coefficient is rejected.

Since significance value of test for equality of the above coefficients with 0 is below 0.05, hypothesis for equality of these two coefficients is rejected with 0 and they should not be excluded from the regression equation. In this regard, it can be said that there is a linear relationship between performance of enterprises and alignment of major strategy and technology strategy and the higher the alignment, the higher the performance will be.

At the end, it should be added that since the first type was available among all types of alignments (alignment of the first major strategy and alignment of the first technology), therefore, it is not possible to study and analyze other hypotheses relating to alignment of the second, third and fourth types.

Discussion

Although importance of alignment and integration of technology strategy with enterprise strategy has been frequently mentioned in the literature, there is limited number of field study on this subject. For this reason, the present research is unique because it has been shown with a theoretical and practical model that alignment (coordination) of enterprise strategy with technology strategy leads to promotion of performance but the most effective type of coordination was specified among four types of coordination (alignment). In other words, the enterprises which had more attention to their environment in adoption of

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major strategy and technology strategy at least in defensive section and have more flexibility in implementation of these strategies will have more desirable performance.

Recommendations

- The first enterprise(uncoordinated) : first quarter major strategy –quarter 4 technology strategy
This enterprise should reduce control over technological decisions and follow technology strategies more flexibly.

The top managers are recommended to utilize more participation of the specialists' views and more participation of decision makers (specialists) in organizational decisions.

- Second, fourth and tenth enterprises(uncoordinated) : quarter 3 major strategy –quarter 4 technology strategy

This enterprise should pay more attention to outsourcing strategy in different fields (such as design, research etc.) and reduce control over major decisions of the enterprise and technological policies and follow technology strategies more flexibly.

- Third, fifth, sixth, eighth and ninth enterprises(coordinated) : quarter 1 major strategy –quarter(area) 1 technology strategy

These enterprises have relatively suitable condition and should preserve their current situation in dimensions of attention to environment and flexibility or strengthen these characteristics.

Seventh enterprise (uncoordinated): quarter 3 major strategy –quarter 1 technology strategy

This enterprise is not aligned with the top organization's strategies and should focus more on the external environment in its major strategy and outsource some internal processes and increase flexibility by reducing control in some cases such as supervision on execution of decisions, increase of employees' participation in decisions etc.

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