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Investigation of the Effect of Information Technology on Agility Using Fuzzy Method (Including Case Study)

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Abstract:

Nowadays, along with the increase in competition and unpredictable changes in the business field, organizations should be agile to gain competitive advantages in order to achieve the organizational goals. Various factors are effective on the organizations' agility and one of them is the utilization of information technology in order to adapt with the environmental changes and satisfy the customers' demand. The present study has been performed aiming at the investigation of the effect of information technology on agility using the fuzzy method in Tehran's private schools. In this research, the organizations' guidelines to achieve agility through the information technology in the organization have been investigated by reviewing the agility literature and determining the relationship between using the information technology and its impact on the agility capabilities. The statistical population of the study consists of 140 persons that by using Morgan sampling table, it was estimated to include 103 persons. The questionnaire tool was utilized for data collection. The gathered data were analyzed by using SPSS software. The results of the research demonstrate that there is a significant relationship between the information technology and the agility indices and show the approximate 97% effectiveness of technology on flexibility. This has affected respectively the flexibility, speed, responsibility and competence and also by using Young test based on the fuzzy method, it was revealed that the private high schools equipped with the information technology are at agile level that leads the organization to progress more quickly toward the predetermined objectives; better service and more prompt instruction.

Keywords:

Agility, Information Technology, Agility Capabilities, Fuzzy Method

1. Introduction

Change is the most stable index that can be introduced for the current business world [1]. The ability of quick accountability against the market changes is called agility which is considered the main factor of the agencies survival [2].

In the different presented models of agility, three main parts of agility motives, enablers and capabilities are obvious. One of the agility enablers is the information technology which is the maturity grade of the information system, communication network and the staff and processes utilization of information systems and networks [1].

Researchers have tried to present appropriate ways to achieve agility and proceeded with identifying some of the agility dimensions and the organizations' agility constructive factors. But regarding the generality and universality of these researches, it is suitable that the industrial macro-planning in the countries identify the appropriate factors by completely investigating the current situation and their autochthon conditions and create a shortcut path for their industries to be agile according to the existing facts. Here, one of the most important unavoidable parameters to achieve agility is the mentioned technology. Keed argue that the agility bases are the organization, individuals and technology. Furthermore some researchers in a similar statement mention the technological abilities as the main motives of agility [3,4].

Doubtlessly today and regarding the emergence of topics such as the electronic organizations which have created different electronic concepts in all fields such as electronic city, electronic government, electronic citizen, electronic banking and electronic health, the dependence of organizations, staff and people on the information technology tool has been significantly increased. If this tool is not utilized for any reason or there would be a problem in using this technology, various organizational interactions will be defected. On the other hand, today, the information technology is a main facilitator factor in the organizations' business activities. Almost more than half of the modern organizations' capitals are based on the information technology. Hence, using the information technology is an organizational advantage and in order to achieve success, the organizations should be effectively managed in using its related opportunities and threats [5].

While there have been many literatures and discussions about the agility nature and the organizations' agility manner, there has been a little effort and work considering the agility evaluation of an institute. It is necessary and essential to evaluate for the strategic planning and determine how much agility is available in the organization, how much agility is needed and then assess the existing gap and prepare a strategy for filling this gap and overcome any specified drawback [6].

2. Technology Definition

Various definitions of information technology have been presented. For example, below definitions can be mentioned. Information technology is a branch of technology which allows the data study and application and its processing in storage, manipulation, transfer, management and automatic data processing by using hardware, software and network ware [7].

Information technology is a branch of technology that appertains to the investigation and utilization of data and its processing including the data automatic

reception and collection, changes (data format change), data management, data transfer and movement, data control, data display, data exchange, data transfer and reception [8].

Agility:

The word agile in the dictionary means a rapid, adroit and active movement and agility is the ability of moving rapidly and easily and the ability of thinking promptly by an intellectual method [9].

Dynamic agility accepts changes and is offensive and grower. Agility aims at victory and success in profit, market share and attracting the customers in competitive markets. Many companies are afraid to enter these markets because of the disturbance of them. No limit is assumed for agility and there isn't a point which the company has completed the travel to agility with one person. Agility always pays attention to the staff and organization performance, product and service value and permanent change in the field of opportunities obtained from the customer attraction and needs permanent preparation to face the fundamental and superficial changes and agile companies are always ready to learn every new thing which increases the profitability due to the exploitation of new opportunities. The implicit concepts of the agile competition are dependent on the competitive fields that especially act in a company. Agile companies face the changes offensively. For agile competitors, change and the unreliability of opportunities regeneration resource are among the methods of permanent success. Thus, to face the changes without previous history, agility relies on creativity, skill, human knowledge and people access to the information. Agility is a comprehensive response to the modern competitive environment that is formed by the forces which have decreased the domination of the mass production [9,10].

As Olson has stated, it is the ability to effectively respond to the events which are changing rapidly and unexpectedly [11].

And according to Keed 1 and Dav 2 opinions, it includes two essential concepts: [4].

Response to changes (expected and unexpected) by appropriate methods and at a suitable time;

Exploiting changes and gaining change advantages as opportunities.

Agility concept model

There are different models to develop agility:

1- Sharp et al. model, Zhang and Sharifi model, Yousef et al. model. Below figure represents Zhang and Sharifi conceptual model for agility establishment in the organization. Agility providers, Agility enablers, Agility motives, Practical procedure tool, Organization, Technology, People, Innovation, Responsibility, Flexibility, Competence, Speed, Need to become agile, Strategic effort to become agile, Agility strategy.

The first part is the agility motives which include the changes and pressures of the commercial environment that force the company to search for new methods of implementing its business in order to protect its competitive advantages. The second part is the agility capabilities which include the essential capabilities that the company needs to response appropriately to the changes. These capabilities lead to the following items:

a. Responsibility power (reaction): the ability to identify the changes and quickly response to them and proactive or pre-proactive action and using these changes.

b. Competence: includes a wide set of abilities that satisfy the essential goals of the organization effectively and profitably.

c. Flexibility/acceptability: the ability of processing different processes and achieving various goals with same facilities.

d. Speed/agility/acuity: the ability to perform the activities in the shortest possible time [4]

And the third part is the agility providers that include tools, people, innovation and technology.

Fuzzy logic:

Classic mathematics and logic essentially have a divalent attitude to problems: existence or absence and correct and incorrect. In the classic logic, we cannot imagine a case in which a thing is present and absent or correct and incorrect at the same time. Especially in the set theory, an element either pertains to a set or doesn't pertain. There is no intermediate case. Such a divalent classification absolutely is in need for defining a specified borders based on which the evidences can be delimited. But fuzzy logic doesn't include such a definite delimitation. In the fuzzy sets, each element belongs to all sets and only different sets don't differ; thus despite the classic sets in which the membership degree of an element to a set is either zero or one, in the fuzzy logic, the membership degree can be any number between zero and one [12]. In modern mathematics, fuzzy set is a set in which the element relatively belong to the set. The major distinction between the fuzzy method and the multi-valued logic is that in the fuzzy logic, the reality and even the nature of subjects can also be inaccurate. In the fuzzy logic, we are allowed to state terms such as "completely correct" or "somewhat correct" and even inaccurate probability such as "almost impossible", "little" and "rarely". In this order, the fuzzy logic provides a completely flexible structure for the natural language [12].

Information technology and its effect on agility:

In a performed research, organizational staff and experts presented the effective fields of information technology for agility as below:

Product and services improvement by providing after sale services or product diversity or quality change

Effective communication with the environment inside and outside the organization by the ability in appropriate gain, distribution and management of knowledge, facilitation of communication with the commercial partners, customers and providers, facilitation of communications in the organization internal departments.

Capability of developing the organizational resources by dynamism in employment and selection of favorable employees, capability of developing the knowledge level of organizational staff, developing the performance and incentive of the human resource.

Prompt responsibility to market and environment changes by products marketing/ new services, reducing the time of applying changes in methods and applying changes in methods, equipment and machines, decreasing the cost of applying the changes in methods, equipment and machines [13].

Foreign researches:

There are many literatures about the dimensions and concepts of organizational agility but none of them has completely mentioned the important role of information technology. Nevertheless, some researchers have provided some recommendations for the application of information systems in the agile production. For example, Goldman et al. 1993 stated among the agile competitors and organizations that comprehensive and pervasive information and communication are among the key and valuable elements that progress toward the organizational evolution and agility [14]. has emphasized on this point that information technology is very worthy and advanced information systems finally will be required to establish an agile institute.

Gonaskaran (1999) has recommended that information systems for agile production should mostly include software decision support systems for the planning and control of inventories such as material requirements planning, product design, resources planning, production planning and scheduling [15].

demonstrated that technology admittance has a positive effect on the organization agility. In the presented model in their research, it is assumed that the tendency toward using the new information system or technology through the actual utilization of the information technology or system affects the organization agility. Tendency toward using the new system is a function of profitability and perceived utilization ease. The research results proved that profitability and perceived utilization ease affect the organization agility by actual use of information technology and tendency toward using technology. The research showed that from the six external variables (user participation, user's job features and experience system, top management support and demographics features) only two variables of job and system features had important effect on the organization agility.

Lee et al. 2006, in another research under the title "agility improvement by apropos sharing of information" which they have performed in China, concluded that the apropos sharing of information improves the organization agility by improving stability and the performance of the production chain.[16]

Domestic researches:

Khoshsima (1381) in a research under the title "presenting a model for measuring the agility of the manufacturing organizations using fuzzy logic" which he had performed in Iran's electronic industry concluded that every organization should have two abilities (responsibility and flexibility) and one competence (quick sampling) in order to become an agile organization [17].

The summary of Fathian's field investigations results (1384) under the title "information technology role in Iran's small and medium agencies agility" implies that the organizational staff and experts have presented the effective fields of information technology for agility: a. improvement of products and services through providing after sale services or products diversity or quality change b. effective communication with the internal and external environment of the organization through ability in appropriate achievement, distribution and management of knowledge, facilitation of communication with commercial partners, customers and providers, facilitation of communication among the organization internal departments, c. Capability of developing the organizational resources by dynamism in employment and selection of favorable employees, capability of developing the knowledge level of organizational staff, developing the performance and incentive of the human resource,

d. Prompt responsibility to market and environment changes by products marketing/ new services, reducing the time of applying changes in methods and applying changes in methods, equipment and machines, decreasing the cost of applying the changes in methods, equipment and machines [13]. Furthermore, Fathian et al. 1385 in a research under the title "Agility approaches in manufacturing organizations" that they performed in Mega Motors Company concluded that there is a gap between the available agility and the studied company required agility [18].

Shahaie and Rajebzadeh (1384) in their study under the title "investigation of agility evaluation dimensions in governmental organizations and a glance on the information technology effect on the organizational agility" have mentioned the dissatisfaction of information technology users' expectations as one of the most important and essential problems related to the information technology application for the organization agility. They have mentioned this point that the users of information technology expect that using the information technology, on the one hand reduces human faults and on the other hand increases the operations' speed and proceed in reacting against the organizations' variable requirements, while in fact, it wasn't always such that [19].

Abdi Hevelayi et al.[20], studied Predicting Entrepreneurial Marketing through Strategic Planning (Including Case Study).

Haj Abukahaki et al.[21], studied Identificaion and prioritization of effective indicators on optimal implementation of customer reiationship management in the insurance industry(including case study).

Taghipour et al.[22], studied Risk analysis in the management of urban construction projects from the perspective of the employer and the contractor.

Rezvani Befrouei MA et al.[23], discussed Identification and Management of Risks in Construction Projects.

Alamdar khoolaki et al.[24], studied Effect of integrated marketing communication on brand value with the role of agency's reputation .

Taghipour et al.[25], studied Supply Chain Performance Evaluation in IN The IT Industry.

Taghipour et al.[26], studied the Study of the Application of Risk Management in the operation and Maintenance of Power Plant Projects

Mahboobi et al.[27], discussed Assessing Ergonomic Risk Factors Using Combined Data Envelopment Analysis and Conventional Methods for an Auto Parts Manufacturer. occupational injuries are currently a major contributor to job loss around the world.

Taghipour et al.[28], studied Assessment and Analysis of Risk Associated with the Implementation of Enterprise Resource Planning (ERP) Project Using FMEA Technique.

Taghipour et al.[29], studied Construction projects risk management by risk allocation approach using PMBOK standard.

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Taghipour et al.[39], studied Evalation of Tourist Attractions in Borujerd County with Emphasis on Development of New Markets by Using Topsis Model.

Abdollahzadeh & Taghipour [40], studied Identify and Priorize Suitable Area for Ecotourism Development using Multi-criteria Analysis for Development of the Tourism Market in Iran (Nathanz City).

Mirzaie et al.[41], studied The Relationship Between Social Bearing Capacities with Conflict as a Result, in the Perception of the Visiting Historical Sites.

Abdi et al.[42], studied the relationship between strategic planning with entrepreneurial marketing in the saderat bank of north tehran.

Abbasi & Taghipour,[43], studied An Ant Colony Algorithm for Solving Bi-Criteria Network Flow Problems in Dynamic Networks.

Taghipour et al.[44], studied discussed Insurance Performance Evaluation Using Bsc-Ahp Combined Technique.

Taghipour et al.[45], studied Investigating the Relationship between Competitive Strategies and Corporates Performance.

Taghipour et al.[46], studied The identification and prioritization of effective indices on optimal implementation of customer relationship management using TOPSIS, AHP methods.

Habibi Machiani et al.[47], studied THE RELATIONSHIP BETWEEN SOCIAL RESPONSIBILITY AND BRAND OF COMPANIES LISTED ON THE TEHRAN STOCK EXCHANGE.

Taghipour and Azarian.[48], studied The Impact of Extensive Quality Management on Human Relations (Case Study: Education).

Taghvaee yazdi et al.[49], studied The Impact of Intellectual Capital on Organizational Entrepreneurship (Case Study: Mazandaran Science and Technology Park).

Azarian and Taghipour .[50], studied The Impact of Implementing Inclusive Quality Management on Organizational Trust (Case Study: Education).

Azarian et al.[51], studied The Effect of Implementing Total Quality Management on Job Satisfaction (Including Case-Study)

Ghadamzan Jalali et al.[52], studied Explain the Relationship Between Intellectual Capital, Organizational Learning and Employee Performance of Parsian Bank Branches in Gilan province.

Taghvaee yazdi et al.[53], studied The Relationship between Implementation Principles of Implementation with Organizational Accelerations, Ethical Leadership and Empowerment of Managers (Case study: Employees of national banks in Sari, District 1).

Hoseinpour et al.[54], studied The Problem Solving of Bi-objective Hybrid Production with the Possibility of Production Outsourcing through Meta-Heuristic Algorithms.

Taghipour et al.[55], studied Investigation of the Effect of Information Technology on Agility Using Fuzzy Method

Habibi Machiyani et al.[56], studied Using Business Intelligence to Provide a Model for Smartening the Management of Iranian Chain Stores.

Habibi Machiyani et al.[57], studied Designing a smart model for managing Iranian chain stores based on business intelligence (case study of proma chain store).

Mohammadi et al.[58], studied Investigating the role and impact of using ICT tools on evaluating the performance of service organizations.

3. Research Methodology

The research methodology is of survey type because the variables control has not been verified in control. In the present study, the library methodology including books, papers, documents and internet relevant and creditable sites was used for the theoretical and literature.

Our statistical population consists of all the head masters and employees of Tehran's private schools that were 140 persons. The sample size in this group is determined based on Morgan sampling table. Hence, the sample size includes 103 persons and also the sampling method is in the simple random class employees group. To evaluate agility, two questionnaires are prepared based on Esmaili and Sharifi recommended model, one for the measurement of the relationship between the information technology application with the sub-indices and the other for the measurement of the organization agility indices regarding this effect.

The utilized software in this research is SPSS that is capable to test the hypotheses and present descriptive and inferential analyses.

In order to evaluate the stability, Cronbach's alpha coefficient calculation was analyzed. If Chronbach's alpha coefficient is greater than 0.7, it shows the confirmation of the questionnaire questions stability. In this research, the value of Cronbach's alpha coefficient is 0.993 that indicates the high stability of the questionnaire.

Is there a relationship between the information technology and agility?

How is the effect of information technology application on the agility dimensions in the organization prioritized?

The main assumption:

There are relationships between the information technology and Tehran's private high schools agility.

Additional assumptions:

There is a relationship between the information technology and Tehran's private high schools responsibility.

There is a relationship between the information technology and Tehran's private high schools competence.

There is a relationship between the information technology and Tehran's private high schools speed.

There is a relationship between the information technology and Tehran's private high schools flexibility.

Data analysis:

Table 1. *Model Summary.*

Model	Correlation coefficient	Determination coefficient	Adjusted determination coefficient	Standard error of estimate
Agility	.990a	.981	.981	.11206
Responsibility	0.967a	o.934	0.934	0.20387
Competence	0.964a	o.929	0.928	0.18872
Speed	o.974a	0.949	0.948	0.18610
Flexibility	0.988a	0.997	0.997	0.13956

The adjusted determination coefficient shows the effect of technology variable on the agility variable and indices.

Table 2. *Regression coefficient.*

Agility model		Non-standardized coefficients		Standardized coefficients	T	Significance level
		B	Standard error	Beta		
1	Constant value (intercept) of technology	.502	.095		5.312	.000
		.955	.025	.967	37.871	.000

The above table of coefficients indicates the line slope and intercept. As the significance level is less than 5% thus there is a regression in the model. Beta value shows that one unit of change in the technology variable leads to a 0.967 unit of change in the speed variable. The regression line equation is as follows:

0.995 (technology) =agility

Similarly, the following information was obtained:

Beta value shows that one unit of change in the technology variable leads to a 0.967 unit of change in the speed variable. The regression line equation is as follows:

Responsibility=0.502+0.955(technology)

Beta value shows that one unit of change in the technology variable leads to a 0.964 unit of change in the competence variable. The regression line equation is as follows:

0.775+0.847(technology) =competence

Beta value shows that one unit of change in the technology variable leads to a 0.974 unit of change in the responsibility variable. The regression line equation is as follows:

Speed=0.997(technology)-271

Beta value shows that one unit of change in the technology variable leads to a 0.974 unit of change in the flexibility variable. The regression line equation is as follows:

Flexibility=1.131(technology)-592

4. Conclusions

The changes of today business environments that are caused by customers' demands changes lead to uncertainty in the decision making parameters and the organizations which invest on more speed and better responsibility and flexibility are more likely to achieve their goals. Among the use of information, administrative and economic technologies for enhancing efficiency, flexibility and also improving services provision seems to be necessary in the information technology age. Regarding these subjects, it is recommended to consider mechanisms for increasing competence b using the information technology tools in the organization. Among the effective factors on this factor is the integrity of information technology in all parts of the organization that along with improving competence will enhance the speed and competence. Analyzing the results of this research shows interesting facts including the difference between the effect of the information technology tools on the organization agility, internet had the maximum and extranet had the minimum effect on the organization agility.

By using SPSS software, the following items were derived:

There is a significant relationship between the technology and agility and agility indices.

According to the linear regression test, it can be inferred that the technology has affected the agility indices in the following order:

1) Flexibility 2) speed 3) responsibility 4) competence

According to Young's opinion, the agility level of every organization can be determined by factors estimation and fuzzy evaluation. The considered organization is at the agile level.

The regression coefficients table shows the line slope and intercept.

0.995 (technology) =agility

Flexibility=1.131(technology)-592

Speed=0.997(technology)-271

0.775+0.847(technology) =competence

Responsibility=0.502+0.955(technology)

5. Recommendations for Future Researches

a. It is recommended that the other effective factors on the organization agility be investigated.

b. It is recommended that the effect of using information technology on the other variables such as productivity, performance … be studied.

c. It is recommended that the effect of using information technology on the agility be evaluated by other methods.

d. It is recommended that the effect of using information technology on the agility be investigated in different organizations.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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