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Research Article

A Resilience-Based Model for Performance Assessment of Companies Listed in Tehran Stock Exchange During Economic and Environmental Crisis

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Abstract
Companies are faced with serious challenges in environmental and economic crisis. It may become a threat to their financial performance and viability. Thus, there is an urgent need for being resilient in the event of any disruption. The present study aims to assess the performance of companies listed in Tehran Stock Exchange in terms of resilience factors. A standardized questionnaire containing resilience factors is designed to collect data from managers and staff. The effect of resilience factors on performance in the crisis period is examined by data envelopment analysis (DEA) method. It is observed that performance is greatly affected by management commitment, awareness, self-organization, and competitiveness and an improvement in them enables the companies to be more resilient during environmental and economic crisis period. An integrated approach to the performance optimization of companies is first developed. It may be a useful framework for any type of company to identify the most important resilience factors in economic crisis.

Keywords: Environmental and economic crisis, Resilience, Data envelopment analysis, Iranian companies

Introduction

Our world is more technologically advanced and interdependent, therefore risks are increasingly shared across local, regional and national boundaries; in addition we are more culturally diverse than ever before. Investment choices on one side of the world can affect the cost of living on the other sides and no community has been immune to the impacts of the recent environmental and economic crisis. In addition to the events on the global and regional scales, local emergencies and crises such as power failures, can affect communities' ability to function. Community resilience, the ability of a community to cope or bounce back from adverse events or situations, is increasingly important and is critical to maintain economic and social stabilities. Organization and community resilience are two sides of a coin; if an organization is not prepared to respond to the emergencies and crises, community is not prepared too. To improve the community resilience, it is important to invest on the organization's resilience which there should be an verified way to measure it and demonstrate

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the changes and trends in this measurement over the time. On the other hand, the primary function and the most important role of the stock exchange are supporting the growth of industries and commerces in the country. That is the reason a rising and resilient stock market is the sign for a developing industrial sector and a growing economy in the country. Hereafter, in this study an approach is proposed to help the listed organizations to improve their performance in the uncertainty conditions. For this purpose, the integrated resilience engineering (IRE) method in the literature of the economic crisis is utilized which to the best knowledge of the authors, is the first study that presents an integrated framework for performance optimization of some listed companies in the economic crisis and considers the interaction of knowledge management, competitiveness forces, creativity and innovation factors with resilience engineering by data envelopment analysis (DEA) methods. The other contribution of this paper is the determination of the item(s) of resilience engineering that has the greatest influence on the three studied factors: knowledge management, competitiveness forces, creativity and innovation.

The following structure was presented in this paper: description, importance, consequences and issues of economic crisis, resilience, resilience engineering and application of organizational resilience, economic resilience and literature review. After that, the methodology in this paper was studied, by DEA model, and results were discussed.

Economic crisis

Crisis is defined as a specific, unexpected, and non-routine event creating high levels of uncertainty and threat to a system's objectives. In complex systems, it is a period under which the system has no successful operations and immediate corrective actions are warranted. Economic crisis as a broad concept is referred to a variety of situations in which financial assets suddenly depreciate in nominal value and organizational efficiency is decreased, including stock market crashes, financial bubble bursts, currency crises, sovereign defaults etc. In crisis, market has no customer, no product is sold, production rate decreases by zero, factories and industrial units close down and millions of workers lose their jobs (Jaeckel, 2014; Weeks, 2011). Side effects caused by recent natural disasters (e.g. Hurricane Katrina of 2005, Japan Earthquake and Tsunami of 2011, Hurricane Sandy of 2012) and man-made disasters (e.g. Deep water Horizon oil spill of 2010) emphasizes the importance of vulnerability associated with infrastructure, industry and labor force and show that environmental crisis could lead to economic crisis.

Resilience

The term resilience as defined by Christopher and Peck (2004) is the ability of a system to adjust its functions before, during, or after any disruption. It explains a broad concept meaning that a system feels a negligible effect resulting from disasters (Rose, 2004), robustness (McDaniels et al., 2008), vulnerability (Barker et al., 2013) and disaster risk management (DRM) (Field, 2012; MacAskill and Guthrie, 2014). In recent years, it is commonly used in the vast areas of social sciences, becoming a basic term in finance, central banking, corporate strategy, psychology, development, urban planning, public health, education and national security.

Resilience engineering

Resilience engineering (RE) can be considered as the ability of a system to remain stable in risky situations. According to the definition offered by Wreathall (2006), it is the capability of an organization to restore to stable conditions and operate during and after a major mishap

properly. No safety improvement takes place in complex systems and dangerous environments simply because incidents and accidents are reported and errors are analyzed (Huber et al., 2009). Resilience engineering is a new approach which can incidents bring under control and their adverse consequences. (Azadeh et al., 2013).

Organizational Resilience

Organizational Resilience deals with the ability to circumvent disruptions through proactive anticipation, absorb/withstand them through system robustness, adapt and learn through reconfiguration (of organizational design) or reactively recover from them. This describes the different facets of resilience as (i) avoidance - preventive aspects of resilience based on anticipation, (ii) survival - ability to withstand or adapt to disruptive events both passively and actively, and (iii) recovery - ability to survive major disturbances with reduced performance (Madni and Jackson, 2009).

Economic resilience

Economic resilience defined as ‘‘The inherent ability and the adaptive response that enables the organizations to avoid maximum potential losses” (Rose and Liao, 2005). Economic resilience primarily has been studied as seismic resilience of communities (Bruneau et al., 2003; Tierney, 1997), disaster analysis (Rose, 2004) and other fields. According to the importance of economic discussions and the existence of economic recession, enviromental crisis and the scientific nature of resilience, in this study, the performance of some listed companies based on resilience engineering is assessed.

Literatures review

A few studies have been discussed on the contexts of resilience and economy like a research that have been studied the effect of resilience with evolution of new rural economics (Tonts et al., 2014) or another one that have been investigated the determinants of the resilience to the economic crisis across European regions based on the employment changes and revealed that education and economic development level positively affected the resilience of both large and small regional European regions (Giannakis et al., 2017). During economic crisis Sweden textile plants encounter significant threats in their financial performance and consequently their survivorship (Pal et al., 2014), interdependent infrastructure and industry sectors have effects on economic resilience (Pant et al., 2014). Rose (2004) has measuremed and definined the economic resilience to disasters. A part of studies have been proved the impacts of some factors on resilience. Rose and Krausmann, (2013) have affirmed the negative impact of market failure and pollution on the resilience, Mcdonald (2017) has showed the effects of managerial strategy and organization size on the resilience, Brueller et al.(2019) have demonstrated that supply chain and its flexibility has positive effects on the resilience, another research has been verified the impact of psychometric criteria on resilience (Gonçalves et al., 2019). Sawalha (2015) and Heeks and Ospina, (2019) have proved the positive effects of environmental factors and information and communications technologies on the level of organizational resilience. Vaez-Alaei et al. (2018) have demonstrated that resilience engineering factors are more efficient than business process re-engineering factors in organizational resilience. Studying the relations between natural and man-made disasters with resilience (Rose, 2007) or computing the general balance for disruptions of water service (Rose and Liao, 2005) have formed another part of resilience researches. Resilience has special importance in engineering sciences because resilience often covers some studies on safety improvements (Miller and Xiao, 2007), health and safety management systems

improvements (HSMS) (Costella et al., 2009), evaluating safety and health management systems in a power distribution (Saurin and Carim J̊nior, 2011) and planning for resources distribution based on sustainability indices (Ahmadi et al., 2017). Some studies in resilience context emphasis on designing a questionnaire or tool to measure the resilience like designing a questionnaire to collecte data with principal component analysis (PCA) procedure to evaluate the resilience engineering (Shirali et al., 2013) or establishing a mechanism for measuring safety culture (Shirali et al., 2018). A lot of researches in resilience have been studied the resilience of a company or a section of company with resilience engineering factors (Azadeh et al., 2014; Azadeh et al., 2015; Azadeh et al.,2017; Huber et al., 2009). Some researchers have emphasized on attention to survive ability or resilience in planning like management planning or crisis management (Siahmansori and Mahmoudzadeh., 2018; Mousavi et al., 2018; Olya, 2018; Shapouri and Hassanzadeh Moghimi., 2018). According to the literature review, organization resilience has not been investigated in crisis period by factors of engineering-based added to competitiveness, creativity and innovation factors and knowledge management. Due to the importance of environmental and economic crisis and requirement of listed organizations to robustness against crisis like sanctions, authors decided to investigate the resilience performance of a sample listed companies in Tehran Exchange during crisis.

Material and Methods

Methodology

This paper proposes an integrated approach based on resilience engineering and knowledge management, competitiveness, creativity and innovation in some listed companies by DEA. The methodology of research is developed in 8 following steps.

Step 1: Consider resilience engineering with knowledge management, competitiveness and Creativity and innovation factors to design a suitable questionnaire in order to measure performance of cases study.

Step 2: Perform content validity test. If the results are acceptable, go to step 2. Otherwise, go Back to step 1.

Step 3: Collect essential data. Employees should fulfill standard questionnaire.

Step 4: Identify inputs and outputs. Awareness, learning culture, management commitment, flexibility, reporting culture, preparedness, redundancy, teamwork, self-organization, fault-tolerant, knowledge management, competitiveness and creativity and innovation factors are outputs, also consider a dummy input to run model. Employees and managers of the listed companies in Tehran Exchange define as decision-making units (DMUs) in this model.

Step 5: Apply data envelopment analysis (DEA) and identify efficient DMU according to efficiency and results of DEA model.

Step 6: Perform sensitivity analysis. To select the important resilient shaping factor by sensitivity analysis and compute weight of each factor by calculation of percentage changes in efficiency that each factor creates.

Resilience factors in crisis

In this study, management commitment, reporting culture, learning, awareness, preparedness, flexibility (suggested by Hollnagel et al.,2008), self-organization, teamwork, fault-tolerance, redundancy (suggested by Azadeh et al.,2014), knowledge management, competitiveness, creativity and innovation factors (suggested by this study) are identified as effective factors for being resilient in crisis.

Now, definition of these indices in the field of crisis has been proceeding:

1. Management commitment: Top management recognizes the possible problems and worry caused by the occurrence of economic crisis and try to predict them before the occurrence of crisis and resolves them in case of the occurrence of economic crisis.
2. Reporting culture: Without reporting, the willingness of the staff to mention the problems and issues would decrease. By creating a reporting culture in the organization, not only the staff and operators, but also the managers would oblige themselves to find solutions and resolve the problems in order to keep the organization in a robust state.
3. Learning: Economic issues and the problems occurred by these issues can be repeated frequently and grip the organization. The organization must learn from the issues caused by environmental and economic crisis in the past and use these lessons for coping with upcoming crisis.
4. Awareness: A successful organization is frequently interacting with other organizations and corporations and shares problems with other organizations and acquires the necessary information from them. Thus, it can find solution in conditions of crisis.
5. Preparedness: If an organization is constantly investigating and searching, it can predict the problems and prepare itself to deal with them.
6. Flexibility: The ability of the organization in adjusting with important and immediate changes in environment is called flexibility. While the uncertainty of the environment is a serious threat for many organizations and it can lead to an environmental and economic crisis, those organizations with high flexibility can change this threat into an opportunity.
7. Self-organization: A process in which longer and general patterns of a system emerge through numerous interactions among minor and shorter components of the system. Self-organized systems usually overcome wide ranges of changes/errors.
8. Teamwork: When the system's workload is high or the system is coping with a crisis such as environment problem, sanction or recession, team work can reduce the personal and organizational pressure with mutual support.
9. Fault-tolerance: If due to environment or economic factors, the organization encountered a problem, it could be able to continue its production in an acceptable level.
10. Redundancy: Existence of alternative routes from supplies to demand or the extra capacity in normal conditions to be used when the components are not available.
11. Knowledge management: Process of creating, sharing, using and managing the Knowledge of an organization. Knowledge management efforts typically focus on organizational objectives such as Commitment to safety and reliability, improved performance, competitive advantage, innovation (Gupta et al. 2004).
12. Competitiveness: The ability to adapt to a changing competitive environment is a characteristic which is increasingly incorporated into discussions of crisis management and resilience (Mitroff, 2000; Woods and Wreathall, 2008).
13. Creativity and innovation: Defined as Staff are encouraged and rewarded for using their knowledge in novel ways to solve new and existing problems, and for utilizing innovative and creative approaches to developing solutions (Stephenson, 2010). Having these 13 factors in hand, the organization performance or systems can be identified.

Questionnaire design

Collecting data by questionnaire is a proper way in countries that does not have reliable datasets. It this paper, thirteen resilience factors has been considered to design an appropriate questionnaire. In this paper each DMU is staff that responded the questionnaire, like other standard questionnaire first section starts with common information of responder such as employee's position, age, level of working background of the DMU in the organization and

etc. The second part contains 47 questions which evaluate all resilience factors. Appendix C shows questionnaire for this case study.

Data collection

Case selection was via random sampling. From 330 companies were listed in Tehran exchange in March 2019, 178 companies selected as the sample. 74 expert individuals from 59 organizations as DMUs completed this questionnaire from March to July 2019. The number of DMUs in different organizational posts, and other information about DMU are given in Appendix A. For investigating and analyzing these factors, DEA method is used. DEA is a vigorous linear programming-based tool which is nowadays employed considerably by most researchers for assessing the performance of the systems with multiple inputs and outputs. DEA is applicable for ranking and analyzing the efficiency and productivity of units called decision-making units (DMUs) (Ji and Lee, 2010). DMUs can be the units like industries (Azadeh and Ebrahimipour, 2004; Azadeh and Ebrahimipour, 2002), universities (Abbott and Doucouliagos, 2003), the efficiency of insurance companies (Hwang and Tong-Liang, 2006), etc. The reason of the high popularity of DEA in comparison to other methods is the possibility of investigating complex and often unclear relationships between numerous inputs and outputs and is valuable decision support tool for measuring efficiency and has better performance than other evaluation mode (Azadeh et al., 2014). Efficient and inefficient units are identifiable in this model and decision makers can use his information for continuous performance assessment and improvement of their systems (Charnes et al., 1978; Azadeh et al., 2014a). The DEA model considers linear addition of the resilience factors in order to obtain the overall resilience performance, being also further on used as a DEA efficiency score for the purpose of this paper. In this study, there are thirteen outputs and one dummy input. So, output- oriented DEA models are applied to evaluate performance and to identify the important resilient shaping factor in sample companies. Performance of each company is assumed as linear combination of these factors for this particular case study based on Azadeh et al. (2014). Objective function (1) of CCR output-oriented model shows efficiency score for each DMU (Charnes et al., 1978). This DEA model evaluate the relative efficiencies of 74 DMUs (j = 1, …, 74), with one dummy input and 13 outputs denoted by x and y, respectively.

CCR Model: $Max\theta$

Subject to:

$$\sum_{j=1}^{n} x_{ij}\lambda_j \le x_{io}\ ,\ i = 1;\ \theta y_{ro} \le \sum_{j=1}^{n} y_{rj}\lambda_j\ ,\ r = 1,\ ...,\ m;\ \lambda_j \ge 0$$

This CCR output-oriented maximizes outputs so that the inputs of model to be constant. In this model, x ij shows value of i^{th} input for j^{th} DMU and yj^{th} DMU. In addition, x_{io} and y_{ro} shows value of r^{th} output for shows value of i^{th} input and r^{th} output for target DMU respectively. As seen in CCR model, Constraint set shows that the weighted sum of inputs cannot be higher than value of i^{th} input for target DMU, $x_{io,}$ and the weighted sum of outputs must be greater than θ y_{ro} that θ demonstrate efficiency score of each DMU.

Reliability and validity of questionnaire

Content Validity

Content validity assures that all features and constraints about resilience factors are evaluated by questionnaire. In addition, representative and comprehensive of questionnaire is check by this method. For evaluating of content validity, it is modified by experts after designing questionnaire.

Reliability of questionnaire

For investigating the reliability of the questionnaire's data, we use Cronbach's alpha test. Cronbach's alpha values were calculated for each factor separately, and since these numbers are larger than 0.6, it shows the significance of the data's reliability (Sharma, 1996), that are presented in Table 1.

Table 1. The values of Cronbach's alpha for all factors

Cronbach's alpha values	Factors	Cronbach's alpha values	Factors
Management Commitment	0.692	Teamwork	0.848
Reporting Culture	0.639	Fault-Tolerant	0.739
Learning Culture	0.783	Redundancy	0.781
Awareness	0.806	creativity and innovation	0.850
Preparedness	0.809	knowledge management	0.880
Flexibility	0.722	competitiveness	0.822
Self-Organization	0.794		

Case study

As mentioned previously, if an industrial unit or a large organization facing an issue during environmental and economic crisis, staff may lose their job. For listed companies that produce many products, deliver lots of services in addition to direct labor force and many investors, causes unemployment of labors or investors loss related to the these companies. Thus listed companies need to have suitable turnover to deal with the these crisis.. The Tehran Stock Exchange is Iran's largest stock exchange which first opened in 1967. As of May 2012, 339 companies with a combined market capitalization of US$104.21 billion were listed on that(wikipedia.org). Some listed companies in Tehran Exchange selected as the case study of this research beacause of sanctions, they are facing crisis.

Computational results and discussion

Results of DEA and Select the Best Model

Data envelopment analysis (DEA) was introduced as a method to examine and evaluate the efficiency of decision-making units (DMU) (Charnes et al., 1978). This method has been utilized in different plants for ranking and analyzing technical efficiency and performance of each DMUs (Shirali, 2018). CCR model was introduced as a basic model of the DEA and all other models are based on this model. Output oriented model calculates the efficiency of each DMU by considering fixed input. Our tendency is to maximize awareness, learning culture, management commitment, flexibility, reporting culture, preparedness, redundancy, teamwork, self-organization and fault-tolerant as integrated resilience engineering factors; where knowledge management, competitiveness and creativity factors were considered as the outputs, then selecting a dummy input, the CCR model was run. Employees of the listed companies were defined as the decision-making units (DMUs) in this model. Table 2 shows results of this CCR model.

Table 2 shows efficiency and rank of each company. Value of efficiency score shows really company performance. Base on efficiency score of CCR model, 7 companies have the

best performance among the other. The managers of inefficient companies with efficiency score lees than 1 can use policy of managers in efficient companies to improve performance and resilience in their department.

Table 2. Results of full ranking output-oriented DEA model

Company	DEA result	Rank	Company	DEA result	Rank
1	0.6	58	31	0.85	38
2	1	1	32	0.74553	53
3	0.8	42	33	0.94	14
4	0.8	42	34	0.89732	26
5	0.7	55	35	0.76471	51
6	0.8	42	36	1	1
7	0.9	23	37	1	1
8	0.85	36	38	0.945877	13
9	0.89386	28	39	0.91964	20
10	0.55	59	40	0.95	11
11	0.8	42	41	0.929655	18
12	0.786957	49	42	0.80435	41
13	0.9	23	43	0.96015	8
14	0.82608	39	44	0.85941	35
15	0.76	52	45	0.96	9
16	0.7	55	46	0.94736	12
17	0.66522	57	47	0.91964	20
18	0.74091	54	48	0.87273	30
19	0.87053	31	49	0.8	42
20	1	1	50	0.9	23
21	0.86522	33	51	0.86957	32
22	0.8	42	52	0.77392	50
23	0.93333	16	53	0.89473	27
24	0.92174	19	54	1	1
25	0.86076	34	55	0.91964	20
26	0.87332	29	56	0.93151	17
27	0.8	42	57	1	1
28	0.93478	15	58	0.95957	10
29	0.81987	40	59	0.85	36
30	1	1			

Sensitivity Analysis

To identify the important resilient shaping factors for this particular case study, sensitivity analysis is performed. DEA model has been run thirteen times. In each run, one factor must be removed. As seen in Appendix B, Management commitment column shows efficiency score for each DMU when Management commitment is removed form factors list. Other columns have been obtained similarly. To select the important factors, average efficiency is calculated for each column. Table 3 shows the average efficiency for each eliminated factor.

Table 3. Average efficiency for each eliminated factor based on sensitivity analysis

Management Commitment	Reporting culture	Learning culture	Awareness	Preparedness	Flexibility	Self-organization	Teamwork	Fault-tolerant	Redundancy	Creativity and innovation	Knowledge management	Competitiveness
0.83	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86

Difference between total average efficiency, which is computed by thirteen factors and average efficiency of each eliminated factor, is calculated and Table 4 shows these differences.

Table 4. Difference between average efficiency before and after factor elimination

Eliminated factor												
Management commitment	Reporting culture	Learning culture	Awareness	Preparedness	Flexibility	Self-organization	Teamwork	Fault-tolerant	Redundancy	Creativity and innovation	Knowledge management	Competitiveness
0.0369	0.0015	0.0003	0.0058	0.0017	0.0001	0.0048	0.0015	0.0044	0.0000	0.0009	0.0016	0.0045

As seen in Table 4, elimination of self-organization, management commitment, and awareness have greatest effect on average efficiency respectively. Therefore, these factors are introduced as important factors in this particular case study through sensitivity analysis. Planning for improvement these influential shaping factors can enhance performance of each company.

Calculation of Weight Factors

In this section, weight of each resilience factor is computed based on results of sensitivity analysis. These weights are calculated by percentage of change in efficiency score, which is created by each factor. Fig. 1 shows weight of each factor for this case study.

Figure 1 shows that self-organization, management commitment, awareness, and competitiveness compose about 81 percent of total weights. Weight of, management commitment is 58 percent, which shows the importance this factor from the perspective of DMUs in forming performance efficiency in listed companies in Tehran Exchange.

Table 5. The weight of each resilience factor

Management commitment	Reporting culture	Learning culture	Awareness	Preparedness	Flexibility	Self-organization	Teamwork	Fault-tolerant	Redundancy	Creativity and innovation	Knowledge management	Competitiveness
0.576	0.023	0.005	0.090	0.027	0.001	0.075	0.024	0.069	0.000	0.014	0.025	0.070

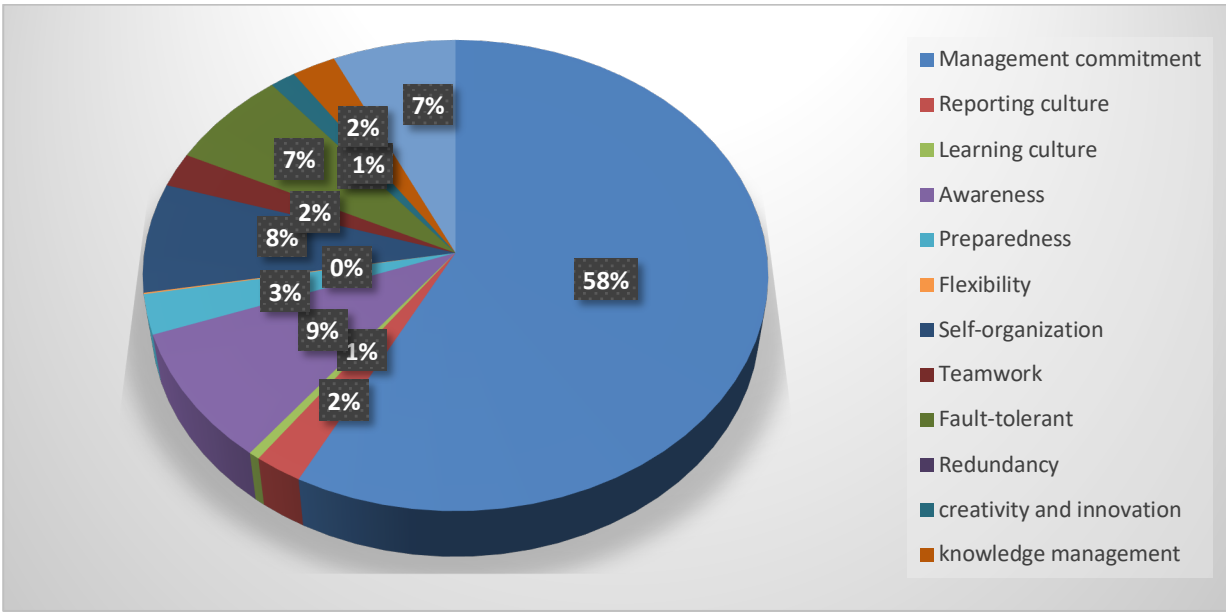

Figure 1. Weight of each resilience factor in forming performance efficiency

Calculation of correlation coefficient

In this section, Pearson correlation coefficient between each ten factors proposed in previous studies for evaluating resilience and knowledge management, competitiveness and creativity and innovation factors are computed. Table 6 shows this correlation coefficient for this case study.

Table 6. Correlation coefficient between pervious mentioned resilience factors and three new factors in this study

Three new factors	Management commitment	Reporting culture	Learning culture	Awareness	Preparedness	Flexibility	Self-organization	Teamwork	Fault-tolerant	Redundancy
Creativity and innovation	0.56	0.63	0.67	0.62	0.70	0.70	0.54	0.46	0.37	0.52
knowledge management	0.51	0.60	0.65	0.46	0.61	0.65	0.48	0.51	0.54	0.55
Competitiveness	0.54	0.47	0.47	0.51	0.60	0.64	0.52	0.57	0.43	0.59

The result of Table 6 show that the relation of knowledge management, competitiveness and creativity and innovation factors with flexibility, preparedness and learning culture are significant at the 0.01 level. This results confirm that existence of knowledge management system in companies motivate all staff to learn more about processes of companies (Penin, 2007). This result show that managers of companies in Tehran Exchange with attention to creativity and innovation, knowledge management and competitiveness can be more flexible and more prepared in crisis period.

Conclusion

Evaluating the performance during the occurrence of environmental and economic crisis was the main goal of this study which integrated resilience engineering (IRE), knowledge management, competitiveness and creativity and innovation factors were utilized as a new approach for the evaluation and optimization of organizations performance. Resilience is a new concept for safety improvement of complex systems such as petrochemical, cement, mining, machinery industries. Literature review in this field shows that among resilience factors, redundancy in petrochemical has the greatest impact on the system resilience in certain circumstance and teamwork factor has the greatest impact on the system resilience in uncertain circumstance and IR factors in particular, teamwork and learning culture are more efficient than business process reengineering factors in resilience of an oil company and among IRE factors, reporting culture, management commitment and preparedness are the most important resilience factors in petrochemical industry and self-organization, reporting culture, fexibility and learning have the greatest impact on the performance of the organization to cope with economic crisis. In addition, earlier researches studied the organization resilience in one organization or one industry or a section of the organization and also, studied the relation of some factors or criteria with resilience or have measured and assessed the reliability of resilience measurement methods. To the our best knowledge, this is the first research to evaluate the performance of some public organizations in different industries like petrochemical, iron, steel, medicine, cement and mining by DEA with respect of IRE added to the knowledge management, competitiveness and creativity and innovation factors. In the first step, a standard questionnaire was design based on those factors. After checking the validity of questionnaire content by some experts and resilience researchers, necessary data were collected. In this study, the value of efficiency that is evaluated with DEA shows the performance of each company and their managers. Likely, managers of companies that have higher efficiency score are more aware and committed in their works and reporting culture and preparedness and team working spirit are more visible in their companies. Finally, by applying sensitivity analysis, influential factors were identified. Based on this study and among the studied factors, management commitment, self-organization awareness and competitiveness are the most important resilient factors for these investigated companies. In addition, the percentage of each resilience factor in forming efficiency was computed based on the sensitivity analysis. These weights are calculated based on the change in efficiency score, related to each factor. Weight of management commitment is 0.58, which shows the importance of this factor in forming performance efficiency. Planning for improvement of self-organization culture, awareness, competiveness and management commitment can significantly improve the performance of organization and help them for cope with any crisis that originates from environmental or economic changes. Therefore, considering resilience engineering factors and knowledge management, competitiveness, creativity and innovation in an organization can affect total efficiency of the workplace in positive way and is a proper method for performance assessment. Furthermore, these results can help top-managers to have a comprehensive understanding of their companies with

respect to the resilience and develop their potential resilience in face of environmental and economic crisis, help policymakers in Tehran exchange to introduce new structure for improving resilience in the listed companies and help decision-makers to have a better evaluation of organizations. It should be noted that the framework of this study may be used for all types of industrial companies to identify the most important resilient factors in case of environmental and economic crisis.

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