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Research Paper

# Designing the Evaluation Model for Sustainable Technology in the Textile Industry

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**Abstract** **Textiles as a forerunner in the industrialization of many current developed countries to the post-industrial stage has fundamental role. Due to the occurrence of many problems in the Iranian textile industry, this industry has faced many hardships. The objective of this article is to develop an evaluation model for sustainable technology in the textile industry. The present research method is applied, in terms of (quantitative-qualitative) mix method. The qualitative sector is consists of the statistical population of elite in the textile industry, which semi-structured interviews were carried out with 10 experts in the textile industry. Their ideas were refined in two stages using the Fuzzy Delphi method and according to the library studies and expert ideas, the evaluating components of technology were identified and a researcher-made questionnaire was developed in the Likert spectrum. Its validity was measured using confirmatory factor analysis and reliability with combined method. The quantitative sector is consist of the statistical population includes all engineers, managers and university professors of the textile industry, of which 200 people were randomly selected as the sample size. Based on the results of the qualitative and quantitative sectors, the technology evaluating model has been drawn including 10 dimensions of economic, cultural, environmental, marketing, legal, organizational, political, technical, managerial and marketing. Obstacles and influential factors in evaluating technology are stated here with their consequences.**

**Keywords** *Technology Evaluation, Sustainability, Textile Industry*

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## Introduction

The textile industry is one of the largest, most important and oldest industries in the world, which is highly considered by most countries and major economies of the world due to its high employment and extraordinary role in industrial, economic and social fields. It has many diverse advantages, such as high employment power, currency generation, production of national wealth, the need for less investment than other industries as well as high added value and many countries initiate their industrialization solely from the textile and clothing industries to be the pioneers in knowledge-based and high added value sectors (Jaberi, 2014). The main point in sustainable technology evaluation is the related functions with technology in textile industry, which is requires the approaches such as provident and strategic planning in textile industry, evaluating economic justification, sustainable technology and the possibility of creating the essential investment with the of resistance economics approach, evaluating the qualitative and technical performance considerations of technology in the field of textile industry (Radfar, 2011). One of the sustainable technology strategies is in textile machinery, so that the products and machineries are the supporter of textile industry in each country. The market of textile machinery is very dynamic and diverse and its models have expanded from traditional to advanced types due to technological progresses. Countries such as India, China, Turkey, Pakistan and Mexico are the main buyers of textile machinery from developed countries (Sharifi, 2015). Iran must be able to create new technology in its textile machinery in order to capture the domestic and foreign markets and discover new markets. The ability to produce textile machinery in addition to having a significant impact on global levels, play a remarkable role in imports. Also, sustainable technology in machinery and nanotechnology of the textile industry is used to produce new materials, improve the properties of existing materials and promote the quality of products (Pourrahim, 2011). Of course, pursuing the difficulties and economic crises, including inflation,

sanctions, and instability of the dollar, the devaluation of the Iranian currency, reducing exports and increasing imports, high prices of raw materials, lack of timely modernization of machinery and lack of automation in many fields of this industry, as well as lack of models for sustainable technology evaluation and not regarding to the nanotechnology and reducing demand for domestic goods and importing clothing and textiles from countries such as China, Pakistan and Turkey are among the causes of stagnation in Iran's textile industry and many cities such as Esfahan, Kashan and so on (Pourrahim, 2011). Despite of having abundant comparative advantages in the textile industry that can be considered as a positive point in meeting the domestic need for textiles and clothing and access to export markets and currency generating, unfortunately a very large percentage of the country's need for textile products is meets through smuggling and import, which is estimated that this will damage the national economy billions of dollars every year. Experts and members of parliament have criticized the excessive import of goods into the country and considered it a principal obstacle to the growth of national production. Iran for achieving sustainable technology in textile industry should increase its knowledge about the countries such as Italia and Belgium that are the pioneers in producing sustainable technology to surpass its Chinese and Turkish competitors. Iran's' textile industry, with the dynamism of products and processes, can strengthen its weak position and prevent the loss of opportunities with sustainable technology, and helps to eliminate or reduce obstacles of growth in textile technology sectors to three dimensions of sustainability (economy, environment and social) to be restored (Dehghani, 2010). Evaluating the technology model in addition to the correct use of engineering science in the way of identify, selection, acquire, uptake and improving technology appropriated to business goals, create an innovative environment in which the firm to have research and developmental activities or the ability to negotiate and conclude technology transfer contracts. Technology model evaluation is a

committed decision about the technologies required by the firm in the framework of the firm's business strategy. Since the resources of firms are restricted and selection of one technology option means not being able to pursue other options, so the right selection and decision making is an essential issue.

## Background

Technology management will be successful when an appropriate connection establishes between business strategy and technology strategy. Technology strategy is the application, development and maintenance of total knowledge and ability of the company. Although technology is regarded as a very essential factor, but it alone is not adequate to guarantee the success of the business. Successful business is the integration of technology innovation with production, marketing, finance and human resources in regard with attaining the determined goals. The increasing importance of technology and its related issues has occupied policymakers in various countries over the years. To study technological issues and make decisions about their diverse aspects, policymakers need tools that provide them with the essential information and help them in policy-making and decision-making in this field. Modern organizations face the dual challenges of technological understanding and synergy with rapid challenges. To achieve a competitive advantage, it is not adequate to look at it only from the perspective of being used as a specialty (Baker, 2016). Technology evaluation is in fact a mental tool or template that the firm can rely on to examines the technology deeply in its full context and given all the new opportunities, facilities and paths that are created for the firm. Identifying outdated technologies requires knowledge and judgment. Judging the advent of new-emerging technologies also requires knowledge and insight. In addition, how to select the best technology from which firm is also requires resolution. Selecting a non-technical technology is very difficult because determining these criteria is influenced by policy

judgments, such as what is best for the firm in the long period of time, and analysis of social and environmental consequences of technological selections is difficult too, because technological development takes small steps and each step has consequences that the integrated prediction of steps is very difficult. The science of predicting the consequences of technological change forms the core of technological evaluation. Most importantly, some people are trying to get an extensive, far-seeing picture of the consequences of a technology. Technology evaluation not only requires foresight thinking, but also desires seeing beyond the obvious, which means that should expand spatial and temporal horizons (Dey, 2019). Radfar (2011) in a study using dynamical system models modeled the transportation statue of Mashhad. 20 scenarios in five policy groups were considered to evaluate the sustainable development of urban transportation for the 20 years horizon and based on its results; intended policies in three projects are prioritized. In this evaluation, it was determined that the policies of convergence, reducing outdriven cars and increasing the quality of public transport, have had the greatest influence on sustainability indexes and have been able to minimize the dilemmas caused by transportation for the next 20 years. Jaberi (2014) in an article entitled "Evaluation Framework of Knowledge-Based Companies for Admission to the Aviation Industry Technology Park" with the aim of providing a framework for evaluating knowledge-based companies for admission to the technology park attained 27 indexes in 8 categories including: outputs, finance, research and development, human resource, capabilities, corporations, planning and marketing as admission factors for knowledge-based companies in the aviation technology park as an admission framework. Sharifi (2015) conducted a study entitled "Performance Evaluation of the Knowledge-Based Organizations with a Combined Approach of BSC, AHP and TOPSIS in the Field of Commercialization of Nanotechnology in Iran" with the aim of evaluating the performance of knowledge-based organizations in Tehran using a combined method BSC, AHP and TOPSIS in the field of

commercialization of nanotechnology in Iran. The results of this study, in addition to being used in a practical way to plan and improve the performance of similar organizations, it can provide the development for BSC model in the field of nanotechnology with an appropriate combination of two techniques for summarizing the results of evaluating different BSC aspects. Mehrabi (2017) conducted a study entitled "Technology Evaluation in Kharazmi Information Technology Company" with the aim of studying technology capability using the technology Atlas method and TAM method. The scores obtained for the capability of the 4 dimensions of technology in the Atlas method are 58.0 (technology-ware), 45.0 (information-ware), 66.0 (organization-ware) and 0.53 (human-ware) on a scale of zero to one. Naghizadeh (2019) in an article has reviewed the evaluation and transfer of technology in the textile industry. In this article, stated that complete and successful technology transfer is achieved when all stages of the technology transfer process are completed accurately, and with comprehensive evaluations, the implemented models and stages of phasing implementation can be examined. The Khamseh model, designed in 2013, has been implemented in the textile industry and its technology transfer process has been studied. There is the smallest gap in the technology deployment variable in the textile industry and the rest have significant gaps. Minoo (2017) has written an article on the development of a sustainable technology evaluation model in the field of urban transportation in Tehran. Strategies stated under the influence of society's values and culture, level of awareness and public understanding of the society from the dangers of unsustainable technologies in the field of transportation, urban culture and compliance with laws and regulations in the field of transportation by the people and features of Tehran in terms of climate, population, geography, politic, facilities, infrastructure and engineering and so on. Morovati (2011) in a study entitled "The Approach of Technology Level Evaluation Models in the Field of Information and Communication Technology" in a descriptive-analytical method concluded that

evaluation of technology level as one of the important steps in the technology management process has a fundamental role in technology awareness. Therefore, technology, like other competitive resources, must be managed with a strategic perspective. Mahdavi (2017) in an article entitled "Evaluating the Technology Sustainability Indexes of Conservation Agricultural: A Case Study of Wheat in Marvdasht" for data analysis used financial analysis and hierarchical analysis (AHP) process. The AHP results demonstrate that among the main criteria for the sustainability of conservation agriculture, the following: environmental, economic and social indexes have priority, respectively. Also, among the economic sub-criteria, improving productivity and efficiency, among the social sub-criteria, production and food security, and finally, among the environmental sub-criteria, the protection of water resources are a priority. Chen (2009) divides evaluation criteria into two general categories of objective and subjective criteria in order to evaluate and select advanced technologies. Objective criteria include required space, capacity, latency, investment cost, and subjective criteria include process flexibility, product quality, learning, and creating unrest for the workforce. Jorje et al. (2015) in an article identified six main criteria of costs, quality, time, service, resource consumption and environmental impact as the major criteria for evaluating reproduction technology portfolios. Buer (2011) introduced the sustainable technology balance sheet and the technology evaluation framework with sustainable and systematic approach. They concluded that technology is invisible and is often crystallized in the knowledge of individuals or physical assets; from this point it is very difficult to determine its scope and content. They categorize technology evaluation methods and tools, including: economic analysis, decision-making methods, engineering, systems analysis, technology prediction, information monitoring, and technical performance evaluation, risk assessment, market analysis, and consider them under the influence of external factor analysis. Wang (2017) in an article entitled "Quantitative Evaluation of Appropriate Technology",

while pointing to the definition of technology evaluation and the need to use multi-criteria decision making, stated the following factors as indexes of technology evaluation, which are: efficient use of resources, job creation, the availability of raw materials, simplicity, ease of use, threatening resources, appropriate adaptability and their independence for each index, defined five levels from very low to very high and evaluated the technologies based on the principles of multi-criteria decision making.

## Method

The method of the present study is applied-developmental. The research method consists of two stages:

**Qualitative sector:**

A) The researcher by collecting the well-known books considered the study field and then among the books, articles and materials that were closer to the subject under study, selects examples of analysis. At the time of using research documents, its exact connection with the concepts under study were considered; based on this, the relevant themes and factors are extracted and finally the model is regulated.

B) Based on library studies, compiling semi-structured interview questions and collecting information obtained from the interview by Delphi method. The result of this section is the preliminary extraction of topics from research literature and theories and models related to industry analysis and technology evaluation. The results obtained from interview have led to the extraction of factors and obstacles to evaluate the technology and sustainability of the textile industry.

From the results of the two sectors, a model has been designed which, in addition to identifying the parameters of technology evaluation, has also identified the obstacles and influential factors and expressed the consequences of each.

**Quantitative sector:**

According to the categories and components obtained from the qualitative stage, a researcher-made questionnaire has been compiled. Using Fuzzy Delphi results and refining the ideas of experts in two stages, structural equations have been regulated. The result of this section was:

A) Refining the ideas of experts from the Delphi method, B) Examining the validity based on Cronbach's Alpha method, C) Examining the reliability using exploratory and confirmatory factor analysis.

The population in the qualitative sector includes textile industry experts who, due to the novelty and wide range of subjects for designing sustainable technology model, need collective wisdom to obtain the desired data through effective communication with textile industry experts and reaching their consensus in the qualitative sector. In order to extract and identify technology evaluation, information is collected by theoretical sampling method, and by considering the theoretical saturation index, 10 semi-structured interviews were conducted with textile experts, 6 of whom were interviewed electronically and online. Based on the library studies related to technology evaluation and the results collected from the articles, the text of the interview was prepared and in the first stage, the experts were interviewed with open and semi-structured questions. In the second stage, the experts answered the questions with open questions and all their statements were refined by Fuzzy technique and the components that had the most consensuses with the experts were extracted. In quantitative sector of the statistical population, including experts, engineers and textile industry managers of Kashan is in the field of machine-made carpets, according to the statistics, the number of Kashan machine-made carpet factories is 460 in the statistical population. Using Morgan and Krejcie table, sampling of the quantitative sector including 200 people was calculated which was sampled randomly.

## Findings

Table 1 shows the identified components of qualitative sector results, which is the obtained from content analysis and interviews with experts and refinement of their ideas by the Fuzzy Delphi method, which it shows obstacle and influential factors of technology evaluation in two columns. Table (1) shows influential factors and obstacle of sustainable technology evaluation in textile industry based on the findings of the qualitative sector and finally the model (Figure 1) is presented as a model of these factors and the consequences of each.

Table 1
*Extracted Factors*

| **Influential factors** | **Obstacles** |
|---|---|
| **Knowledge of sustainability strategy** | Raw material deficit |
| **Discrete investment** | Lack of funds to buy machinery |
| **Encourage to foreign investment** | Environmental pollutants of factories |
| **Customer satisfaction** | Using old machines |
| **Organizational commitment** | Behavior change of the customer |
| **Identifying market potential** | Not having the competitive power |
| **The technical potential** | Tax problems |
| **Managers' decision-making methods** | Lack of government support |
| **Analysis of the sales market** | Sanctions |
| **Technology prediction** | Economic considerations |
| **Research and knowledge development** | Budget deficit |
| **Variety of products** | Technology deficit |
| **Identifying the goals** | Complex rules and regulations |
| **Using the experiences of leading countries** | High costs of energy resources |
| **Specialization and training in technology** | Smuggling |

In the table, the number of factors identified by experts is prioritized after refinement. According to Table 2, economic, political and technical engineering factors are prioritized.

Table 2
*Prioritization of Expert Ideas*

| Factor | Ranking |
|---|---|
| **Economical** | 1 |
| **Political** | 2 |
| **Technical engineering** | 3 |
| **Legal** | 4 |
| **Marketing** | 5 |
| **Organizational** | 6 |
| **Cultural** | 7 |
| **Managerial** | 8 |
| **Research** | 9 |
| **Environmental** | 10 |

Table 3 shows the model fitness that the value of the indexes indicates the goodness of the model fitness. Obvious and hidden items and variables have been analyzed by confirmatory factor analysis of LISREL software and combined reliability has also been calculated. The main model of confirmatory factor analysis is presented as follows in which the relationships between variables and coefficients of each, has been stated.

Table 3
*Reviewing the Model's Goodness Indexes*

| Index's name | Standard value | Model index value | Conclusion |
|---|---|---|---|
| **The ratio of kai 2 to d.f** | More than 3 | 0.89486 | Goodness of the model fitness |
| **P- value** | More than 0.05 | 0.7842 | Goodness of the model fitness |
| **G.F.I** | More than 0.9 | 0.95 | Goodness of the model fitness |
| **A.G.F.I** | 0.9 | 0.94 | Goodness of the model fitness |
| **N.F.I** | 0.9 | 0.94 | Goodness of the model fitness |
| **C.F.I** | 0.9 | 1 | Goodness of the model fitness |

In general, there are several fitness characteristics to evaluate the model of confirmatory factor analysis. One of these indexes is the combined reliability or CR value. As the fitness indexes of the model show, the data of this research have a good fit with the factor structure and theoretical basis of the research, and this indicates that the questions are in line with theoretical structures. According to Table 4, since the CR indexes are less than 0.7, it can be said that the relevant indexes and questions are at an acceptable level of significance.

Table 4
*Combined Reliability*

| **Indexes** | **Standard error S.E.** | **C.R** | **Significance level** | **Factor load** |
|---|---|---|---|---|
| **Economic factors** | 0.121 | 4.93 | 0.000 | 0.491 |
| **Political factors** | 0.111 | 4.42 | 0.000 | 0.493 |
| **Cultural factors** | 0.224 | 6.67 | 0.000 | 0.403 |
| **Engineering factors** | 0.171 | 5.88 | 0.000 | 0.447 |
| **Environmental factors** | 0.213 | 6.37 | 0.000 | 0.175 |
| **Managerial factors** | 0.191 | 3.03 | 0.000 | 0.772 |
| **Organizational factors** | 0.143 | 4.25 | 0.000 | 0.324 |
| **Legal factors** | 0.265 | 3.27 | 0.000 | 0.264 |
| **Marketing factors** | 0.156 | 4.19 | 0.000 | 0.537 |
| **Research factors** | 0.432 | 5.57 | 0.000 | 0.436 |

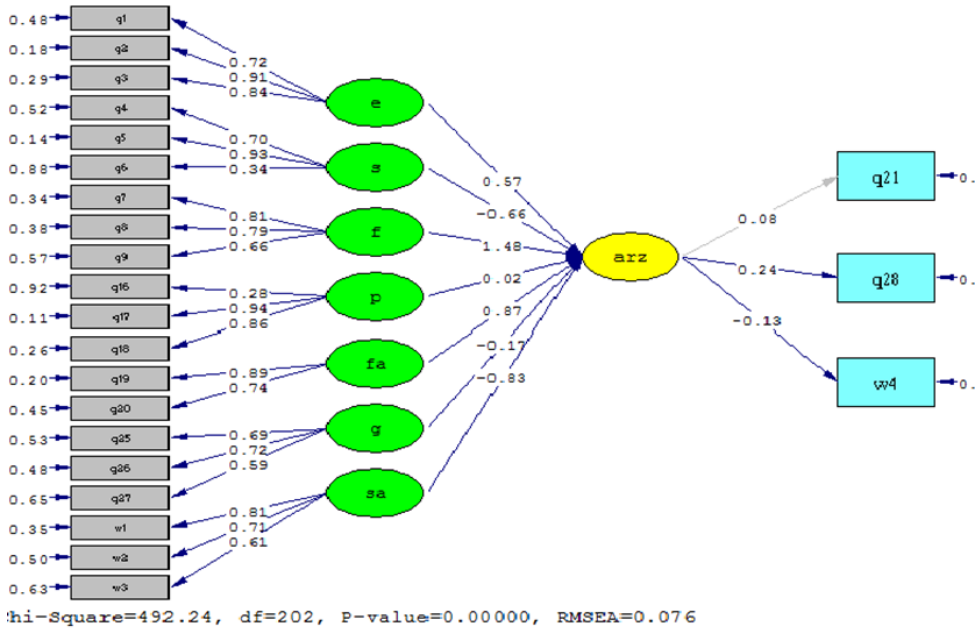


Figure 1

*Relation of Latent Variables*

Table 5

*Direct Coefficients and T-value*

| Variables | Direct influential coefficient | t-value | Confirm/reject | Influential rank |
|---|---|---|---|---|
| **Economic Factors** | 0.83 | 16.72 | Confirm | 1 |
| **Cultural factors** | 0.45 | 10.12 | Confirm | 6 |
| **Political factors** | 0.73 | 15.43 | Confirm | 2 |
| **Managerial factors** | 0.21 | 9.43 | Confirm | 7 |
| **Research factors** | 0.11 | 8.75 | Confirm | 8 |
| **Technical engineering factors** | 0.64 | 10.12 | Confirm | 3 |
| **Legal factors** | 0.61 | 9.43 | Confirm | 4 |
| **Organizational Factors** | 0.19 | 6.54 | Confirm | 9 |

| Variables | Direct influential coefficient | t-value | Confirm/reject | Influential rank |
|---|---|---|---|---|
| **Environmental factors** | 0.13 | 5.19 | Confirm | 10 |
| **Marketing factors** | 0.58 | 10.21 | Confirm | 5 |

According to Table 5, the direct influence of independent variables on the dependent through factor loads and the t-value in the structural equations is demonstrated. Given to the output of the table, the t-value of the variables is greater than 1.96. So, the relation of the variables according to their significance coefficients is significant. Also, the influential ranking of the variables shows that economic, political and technical engineering factors are in priority. Also, the results of Table 6 show that the model is in good position of fitness. Goodness indexes of model indicate that the model is good for measurement.

Table 6
*Model Fitness Indexes*

| Index | Estimation | Acceptable fitness of the model |
|---|---|---|
| $\frac{X^2}{df}$ | 2.697 | $1 \leq \frac{X^2}{df} \leq 5$ |
| **GFI** | 0.880 | GFI $\geq$ 0.9 |
| **RMSEA** | 0.021 | RMSEA $\leq$ 0.08 |
| **TLI** | 0.880 | TLI $\geq$ 0.9 |
| **NFI** | 0.816 | NFI $\geq$ 0.9 |
| **CFI** | 0.920 | CFI $\geq$ 0.9 |
| **IFI** | 0.929 | IFI $\geq$ 0.9 |
| **PRATIO** | 0.905 | PRATIO $\geq$ 0.5 |
| **AGFI** | 0.780 | AGFI $\geq$ 0.9 |

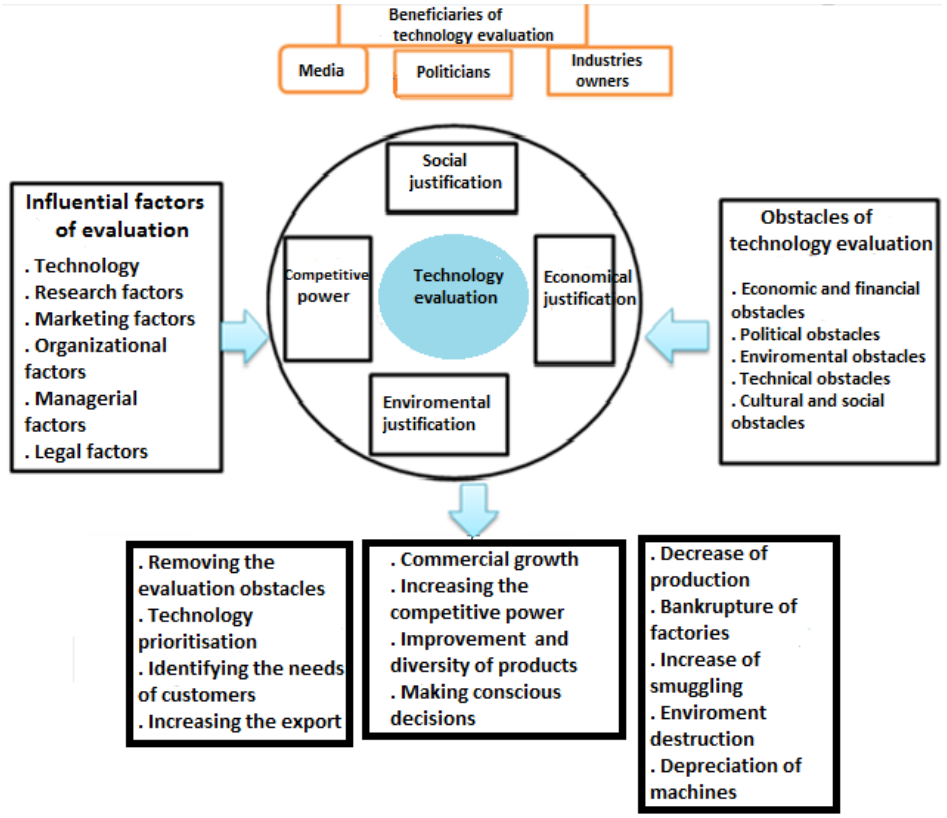


Figure 2
*Technology Evaluation Model*

Source: Based on the findings of the qualitative section (content analysis and interviews with experts)

## Conclusion

Based on the results of content analysis and analysis of experts idea in the qualitative sector, review and study the current situation and evaluation of products, determining the priorities in relation to products and increase of exports, development of general goals based on priorities, determining annual goals, monitor and reviewing the implementation by supplying raw materials from agriculture to operation, the development

of short-term and long-term purposeful plans were among the points that were collected from the studies and placed in the category of organizational factors. According to the qualitative results of the research, creating a national credit line for textiles, budgeting and financing for the purchase of expensive machinery and raw materials, developing a national strategy for supplying textile equipment, supporting physical and human resources, accurate monitoring of machines as well as their testing and observing way in allocating resources and machines is among the economic factors. Lack of using Iranian products, dependence on ready to use clothes and textiles as well as increasing population and different tastes and fashion in the urban sector are cultural problems in the way of sustainable technology of the textile industry. According to findings in political factors, economic considerations, sanctions and smuggling from other countries are the most important obstacles in the way of sustainable technology in the textile industry. This dimension is one of the main obstacles in sustainable technology, because in addition to sanctions that prevent the import and export of raw materials and other necessities of the textile industry, smuggling has also added to the problems of this industry. The findings showed that in the research sector, creating applied educational plans in each province, reviewing and studying the experiences of leading countries in the textile industry, managers' visits to advanced factories in the textile industry and identifying researchers and experts in the textile industry are research factors in the sustainability of the textile industry. According to the findings of qualitative sector, customization encouragement, creating competitive challenges, providing the proper distribution chain and increasing the marketing networks are important in terms of marketing factors in technology sustainability Also, reforming policies and laws, reforming tax and customs laws, and reforming production policies in the private sector are important aspects of legal factors in the technology sustainability of textile industry. In interpreting this finding, it is concluded that given the state of sanctions and

economic problems, the government should revise customs and tax laws as much as possible. In the field of environmental factors in sustainable technology, the adoption of the law to prevent soil and air resources, etc., research in the field of sustainable technology and the environment and attention to pollutants is of particular importance. Therefore, in addition to technological sustainability, environmental sustainability is a remarkable matter. Findings showed that in effective management factors of technology sustainability, identifying the beneficiaries of textile industry development and supporting them, using experienced managers as well as using the experiences of entrepreneurial managers is effective in technology sustainability. In interpreting this finding, it is concluded that using entrepreneurial and innovative managers given to the problems occurred in this industry have significant important in sustainability of textile technology. According to the findings of qualitative sector, adaption of technology with markets' demand, monthly repair and maintain of machinery, not using outdated machinery and using up-to-date and advanced machinery. Requiring manufacturing companies to provide after-sales service and selecting advanced technology are the influential technical engineering factors in the technology sustainability of textile industry. Interpretation of this finding shows that the factories' easy access to up-to-date machinery is very important in technological stability, but due to the political and economic problems that make the machinery update difficult, repair and maintain of machinery is as important as supplying them.

## References

Bauer, M., & Brown, A. (2014), Quantitative Assessment of Appropriate Technology Procedia Engineering, 78, 345-358.Czarniawska, B. (2007). Shadowing: And Other Techniques for Doing Fieldwork in Modern Societies. Copenhagen: Copenhagen Business School Press.

Bhaskar B. Gardas, (2018) Modeling the Challenges to Sustainability in the Textile and Apparel (T&A) sector: A Delphi-DEMATEL. Production and Consumption (2018), https://doi.org/10.1016/j.spc.2018.05.001.

Bijker, Wiebe E. "Why and How Technology Matters." Oxford Handbook of Contextual Political Analysis (2016): 681-706.

Chen, L., Wang, L., Wu, X., and Ding, X. (2009), A process-Level Water Conservation and Pollution Control Performance Evaluation Tool of Cleaner Production Technology in Textile Industry. Journal of Cleaner Production, 143:1137{1143}.

Dehghani, J. (2010), Study of Influential Factors on the Export Development of Textile Industry, Journal of Knowledge and Development, No. 31.

Dey, B. K., Sarkar, B., Sarkar, M., and Pareek, S. (2019), An Integrated Inventory Model Involving Discrete Setup Cost Reduction, Variable Safety Factor, Selling Price Dependent Demand, and Investment. RAIRO-Operations Research, 53(1):39{57}.

Hensel, P. (2018), Organizational Responses to Proto-Institutions. Journal of Management Inquiry, 27(2).

Jaberi, F. (2014), Study of Obstacles, Challenges and Strategies of Iranian Textile Industry, Journal of Textile Science and Technology, Year 4, No. 2, Pp. 29-33.

Jorge, M. L., (2015), Jesús Herrera Madueño, Maria Yolanda Calzado Cejas, Francisco Javier Andrades Peña,. An Approach to the Implementation of Sustainability Practices in Spanish Universities. Journal of Cleaner Production, 106, 34-44.

Mahdavi Chabok, S., Fakhr Shamloo, N., Rajabi, M. (2017). Evaluation and Modeling of Steel Production Performance. International Conference on Energy Technology and Management, p.7. Tehran: Iranian Scientific Association of Energy, Shahid Beheshti University.

Mehrabi, A. (2017), Identification and Ranking of Factors Affecting Technology Transfer in the Textile Industry, Industry Article, 3 (19): 45-54.

Minoo, A. (2017), Presenting a Model for Evaluating Sustainable Technology in the Field of Urban Transportation, Tehran, Institute of Humanities and Social Studies, Jihad University, Tehran, Iran, Urban Economics and Management Quarterly, No. 3.

Morvati, A. (2011), Technology Verification and Providing a Suitable Solution to Solve the Technology Gap. Iranian Journal of Management Sciences. No. 2, p. 34.

Naghizadeh, M. (2019), Combined Index of Capability Monitoring, Scientific Research Quarterly, Technology and science Policy, Year 2, No. 4.

Pourrahim, R. (2011), Educational Booklet of Enzymatic Biotechnology Application in Industries, Organization of Iran's Industrial Development and Renovation, Developmental Research Center, Biotechnology Unit.

Radfar, R. (2011), Mathematical Model of Technology Capability in Sapco Company, SID site.

Sharifi, M. (2015), Development of a Identifying Model and Evaluating New, Needed and Key Technologies of Iran's Electricity Industry, International Energy Conference.

Sunder, L. S., & Myers, S. C. (1999). Testing Static Tradeoff Against Pecking Order Models of Capital Structure. *Journal of Financial Economics*, *51*, 219-244. https://doi.org/10.1016/S0304-405X(98)00051-8

Teymouriyan, M. (2015), Studying Strategic Technology Management Models and Presenting the Appropriate Model for Water and Sewage Companies, Journal of Water and Sustainable Development, No. 1: 1-8.

Wang, L., Lu, Z., and Han, X. (2019), Joint Optimization of Production, Maintenance and Quality for Batch Production System Subject to Varying Operational Conditions. International Journal of Production Research, P 1-15.Sterman, J. D. (2000). *Business Dynamics*. McGraw-Hill, Boston.