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Evaluation of Sustainable Development of Wooden Furniture Industry Using Multi criteria Decision Making Method

Majid Azizi[a], Nemat Mohebbi[a], Fabio De Felice [b],*

[1]*Wood and paper sciences and technology Department, Faculty of Natural Resources, University of Tehran, Daneshkadeh street, Karaj 31585-4314, Iran*
[2]*Department of Civil and Mechanical Engineering, University of Cassino and Southern Lazio, G. Di Biasio 43 street, Cassino 03043, Italy*

Abstract

Furniture manufacturing industry seems to be significant not only from economical and social standpoints but also from perspective of environmentally compatible industries. Accordingly, moving toward sustainable development in this sector of Iran's industry is regarded as a national necessity. The intent of the current study is to determine and prioritize the indices affecting sustainable development of Iran's wooden furniture industry by benefiting from Analytical Hierarchy Process (AHP) method. After the conducted investigations, 39 indices were identified and categories in seven general groups namely, technical, human, cultural-social, economic, materials and products, rules and regulations, and environmental. Subsequently, Analytical Hierarchy Process was applied in the form of adjusting and distributing questionnaires among professional experts. Results show that the highest priorities for attaining sustainable development in this industry respectively belong to sub-criteria of economic stability increase in the country, development of furniture industrial clusters, adjustment of furniture and wooden products importation tariffs, reduction of volatile organic compounds (VOC), marketing, reinforcement of unions, and creation of competitive environment in this industry.

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* Corresponding author. Tel.:+00 39 07762994350; fax: + 00 39 0776299434.
  E-mail address: defelice@unicas.it

Introduction

Furniture industry currently accounts for considerable portion of global trade; so, development and flourishing of this industry besides providing the grounds for its targeted presence in international markets can serve as developing engine of a large part of the related and dependent industries in a country, which could remarkably influence job-creation and also enhancement of gross domestic production and earning non-petroleum revenues for that country (CSIL, 2009/2010). In addition to economic and social aspects, furniture industry appears to be important from environmental standpoint as well because use of adhesives, dyes and coating materials in furniture production results in emission of large volume of volatile organic compound in the environment annually (Manson, 2005). Therefore, it is vital to identify the criteria affecting sustainable development of this industry taking into account its economic, social and environmental significance. For the time being, Iran only possesses 0.02 percent of furniture global trade (Home and Office Furniture Union, 2009).

This trend is suggestive of fundamental problems in policy-making and planning of country's industrial development. Fatahollahzadeh et al. (2006) mentioned the following items as major problems of production sector of Iran's furniture industry: absence of stable policy for production sector, failure to provide suitable financial credits by banks for manufacturers, time-worn machineries and lack of sufficient specialized human force. Amiri (2008) attributes the reasons for Iranian impaired furniture exports to non-observance of quality control in exported products, negative competition of producers in price reduction in international markets, unawareness and lack of expertise in exportations and dominance of powerful Competitors in target markets. Arian (2007) holds the opinion that presence of strong specialized unions play an essential role in growth and development of country's furniture industry through serving different functions including instruction and propagation, research and development, standardization, and finally, lobbying with governments and social authorities.

By investigating sustainability of Asian wooden furniture industry, Ratnasingam and Lorass (2003) concluded that economic liberating factors, increased research and development activities, expansion of industrial clusters, provision of expert labor force and enhancement of added value of products via marketing and designing are key issues leading to further development of the furniture industry in future. Furthermore, by analyzing reasons of remarkable difference between added value of produced furniture in developed and pioneering countries such as Italy, USA, Germany in comparison with developing countries like China, Malaysia and Brazil, Ratnasingam (2005) shows that "lateral developed and powerful industries", along with factors including design capability, technical skill of labor force, and marketing ability are considered as main causes of higher added value of the furniture produced in developed countries. Gazo (2005) has analyzed competitive strategies of furniture manufacturers in different Asian countries and attributes the major success reasons of Malaysia's furniture industry to low cost of human force, strong marketing, governmental support, furniture industrial clusters, diversity and innovation in design and easy access to raw materials. Ziaei (2011) suggests that competition phenomenon and furniture manufacturers' ability to access design capability are the most important factors affecting growth of Malaysian furniture industry. Also, he mentioned weakness of Malaysian producers in benefitting from strategic marketing techniques as the major reason of declining growth trend of Malaysian furniture industry exportation.

Gupta and Subramanian (2008) believe that by development of furniture industrial clusters, its members can benefit from advantages such as synergy of customer attraction ability, reduction of per capita advertising costs, use of supports and services available in the nearest possible region along with lower per capita expenditure, and providing grounds for establishment of guild unions for organizing and promoting cooperation level in future; they also claim that these clusters play a significant role in furniture industry development.

By investigating sustainable development of UK furniture industry, Mason (2005) introduced the following factors as the main indices affecting sustainable development of the respective industry: stable design, reduction of pre-built furniture imports, waste management, transportation management, controlling pollution of coatings and plastering, and continual education of labor force. In another conducted research concerning sustainable development of Canadian organizational furniture industry control criteria of volatile organic compounds (VOC), materials recycling management, energy management, and facilitation of difficult and complex customs process besides financial facilities and competition with cheap-price foreign producers were proposed as the principal factors impacting sustainable development (Regis, 2007).

According to what was discussed before, this question arises: "which criteria are the most important factors that influence Iran's furniture production?"

The research hypothesis is: improvement of economic stability in the country, creation of industrial clusters, modifying importation tariff, and creation of competitive environment in industry are among the most important indices affecting sustainable development of Iran's furniture industry. Using analytical hierarchy process method, this research is intended to determine and prioritize indices that influence sustainable development of Iran's wooden furniture industry.

1. Materials and Methods

The first stage of this research was carried out as a field study. In addition to reviewing the available literature, large number of experts and specialists, mass producers and members of furniture unions were orally interviewed for determining the indices affecting sustainable development of Iran's wooden furniture industry. Then, according to the collected data, 39 influencing sub-criteria were identified and categorized in seven general groups including technical, human, cultural-social, economic, materials and products, rules and regulations, and environmental ones; the hierarchy of indices was plotted as shown in figure 1. Subsequently, in order to prioritize and determine significance degree (weighting value) of each index using AHP (Analytical Hierarchy Process), a questionnaire was designed for paired comparison of these criteria and sub-criteria when distributed among 20 individuals of professional experts and specialists in this industry; the opinions collected through questionnaire were processed by Expert Choice 2000 software ©.

2. Analysis of Hierarchical Process (AHP) Method

AHP method is a collaborative decision-making technique initially devised by Thomas L-Saaty in 1970 (Memariani and Azar,1995) this method is used in decision-makings that have qualitative and quantitative indices. General structure of this process consists of three main parts: target, criteria & sub-criteria and choices (options). In AHP method, a hierarchy is designed for scales and sub-criteria and then paired comparison matrices are formed, and following comparison of major indices in decision-making, weighting value of each one is specified (De Felice and Petrillo, 2014). The numbers used for paired comparison are in the interval between 1/9 and 1 and constitute a standard scale (Saaty,2001). The mechanism of using this method in the current research comes as follows: after designing hierarchy for the indices influencing sustainable development of furniture industry, the questionnaire is prepared for paired comparison of the criteria and sub-criteria; opinions of some of related experts are asked regarding significance level of these indices and sub-indices compared to one another. Weighting values of each criteria and sub-criteria are obtained according to the following matrix (Ghodsipour, 2000).

$$\begin{bmatrix} w_1/w_1 & w_1/w_2 & \cdots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \cdots & w_2/w_n \\ \vdots & \vdots & \cdots & \vdots \\ w_n/w_1 & w_n/w_1 & \cdots & w_n/w_n \end{bmatrix} \Rightarrow \begin{bmatrix} w_1\left(\sum_{i=1}^{n} 1/w_i\right) \\ w_2\left(\sum_{i=1}^{n} 1/w_i\right) \\ \vdots \\ w_3\left(\sum_{i=1}^{n} 1/w_i\right) \end{bmatrix}$$

If "n" is the number of decision-makers and aij represents element of i-th row and j-th column of one of the comparison matrices, the following formula will yield the collaborative judgment concerning aij:

$$a_{ij} = (a_{ij1} * a_{ij2} * \ldots * a_{ijn}) / 1/n \qquad (1)$$

The results will be normalized after computing geometric mean of all paired comparison matrix cells, and, weighting values of criteria and sub-criteria are evaluated through merging weights of low-ranking elements with weight rate of high-ranking elements of the hierarchy. The important point about paired comparison matrices is their inconsistency ratio; according to Professor Saaty, for having consistent judgments, inconsistency ratio of matrices need to be equal or less than 0.1 (Saaty,1980).
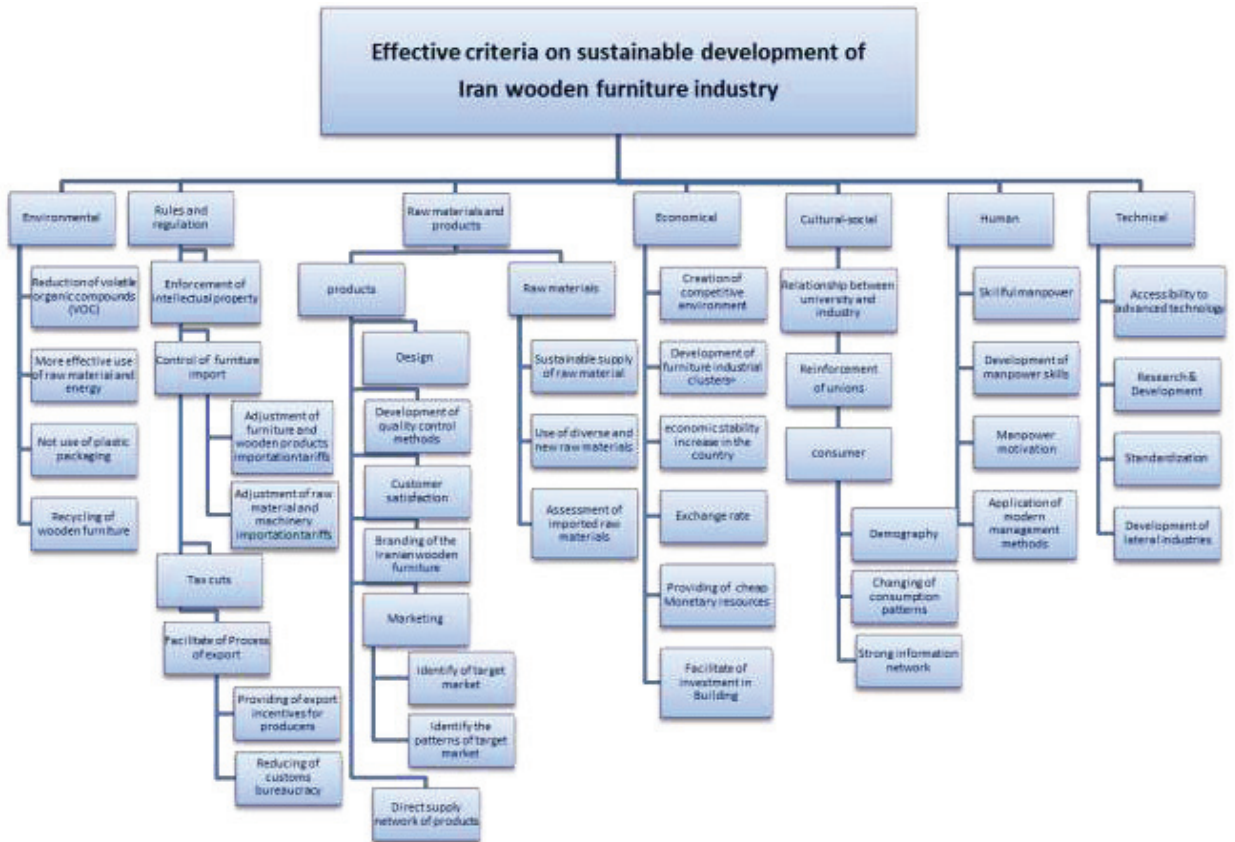
Fig. 1: A hierarchy model of criteria and sub criteria.

3. Results

Weighting values of each criteria and sub-criteria which are products of collaborative decision-making of all experts involved will be presented in this section.
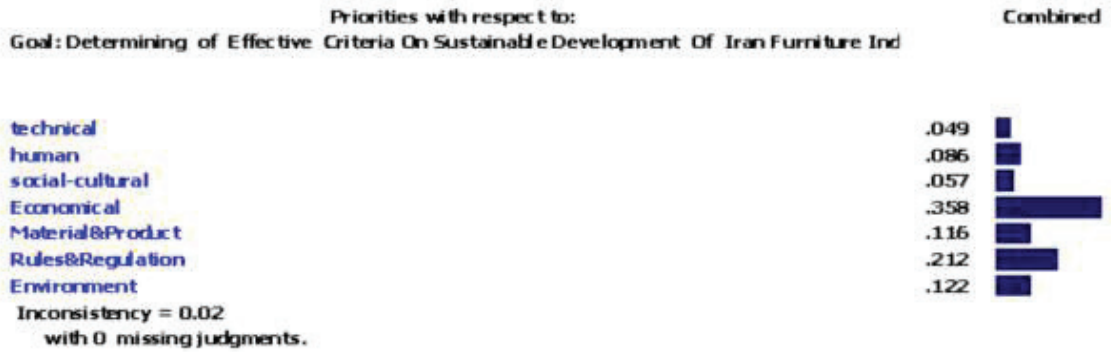
Priorities with respect to: **Combined**

Goal: Determining of Effective Criteria On Sustainable Development Of Iran Furniture Ind

Criterion	Value
technical	.049
human	.086
social-cultural	.057
Economical	.358
Material&Product	.116
Rules&Regulation	.212
Environment	.122

Inconsistency = 0.02
with 0 missing judgments.

Fig. 2: Final weighting values of criteria.

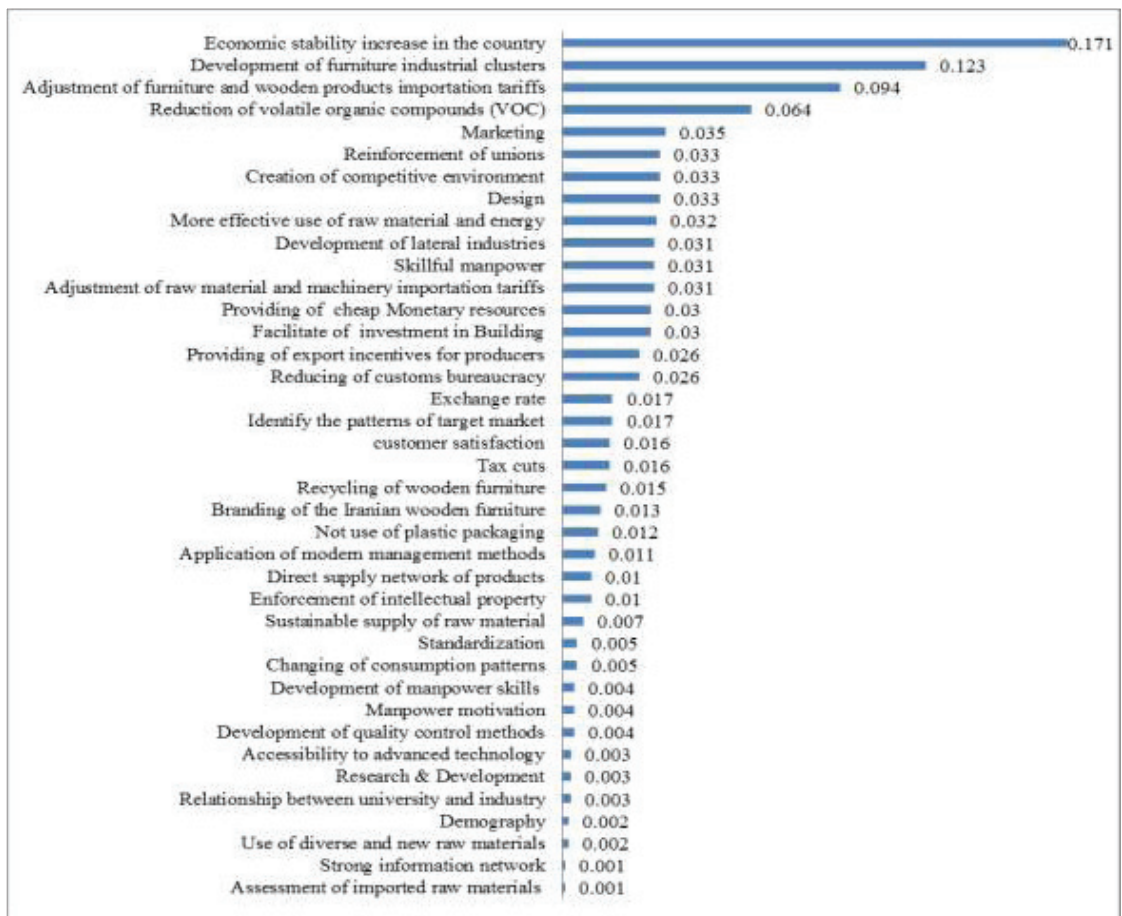| Criterion	Value
Economic stability increase in the country	0.171
Development of furniture industrial clusters	0.123
Adjustment of furniture and wooden products importation tariffs	0.094
Reduction of volatile organic compounds (VOC)	0.064
Marketing	0.035
Reinforcement of unions	0.033
Creation of competitive environment	0.033
Design	0.033
More effective use of raw material and energy	0.032
Development of lateral industries	0.031
Skillful manpower	0.031
Adjustment of raw material and machinery importation tariffs	0.031
Providing of cheap Monetary resources	0.03
Facilitate of investment in Building	0.03
Providing of export incentives for producers	0.026
Reducing of customs bureaucracy	0.026
Exchange rate	0.017
Identify the patterns of target market	0.017
customer satisfaction	0.016
Tax cuts	0.016
Recycling of wooden furniture	0.015
Branding of the Iranian wooden furniture	0.013
Not use of plastic packaging	0.012
Application of modern management methods	0.011
Direct supply network of products	0.01
Enforcement of intellectual property	0.01
Sustainable supply of raw material	0.007
Standardization	0.005
Changing of consumption patterns	0.005
Development of manpower skills	0.004
Manpower motivation	0.004
Development of quality control methods	0.004
Accessibility to advanced technology	0.003
Research & Development	0.003
Relationship between university and industry	0.003
Demography	0.002
Use of diverse and new raw materials	0.002
Strong information network	0.001
Assessment of imported raw materials	0.001

Fig. 3: Final weighting values of sub-criteria.

4. Discussion and Conclusion

According to the results, total inconsistency ratio of matrices equals 0.01 which is indicative of the fact that results are consistent and compatible. Results also show that the sub-indices of improvement of economic stability in country, development of furniture industrial clusters, regulation of furniture and wooden products import tariff, reduction of volatile organic compounds, marketing, reinforcement of technical unions, creation of competitive environment, and designing in industry assume the highest weighting values for achieving sustainable development of Iran's wooden furniture industry. Reasons for high significance of these indices can be explained and discussed as follows:

Improvement of economic stability (weighting value: 0.171): Flourishment of investment in industrial sector depends on existence of financial security for the investor. Also, according to investigation of World Bank, economic instability has been known as one of the important factors impacting non-development of different industries (Meydari, 2006). Based on the views of furniture producers and experts, the investors presently prefer to invest on other countries or on brokering activities which require lower risk due to reasons such as inconsistency of raw materials price and customs tolls, unclear and unstable condition of imports and exports, and as a result, absence of financial security and return on equity. In a developing country like Iran where development plans are greatly influenced by sudden changes in governments' approaches toward large and small-scale political and economic strategies, establishment of permanent or long-term economic stability is not possible, at least in mid-term. Consequently, it is potentially risky to make investment on industries such as furniture, in which the final product is not among the basic needs of the people. Under such circumstances, governments can provide the possibility for attraction of foreign and domestic investors to invest on this industry through executing solutions like production support via granting loans or effective long-term insurances to the investors, observing taxation equality or allocating tax exemptions, precise control over furniture exports and imports, and lastly, controlling price of raw materials from one hand and establishing consistent political and economic relations with regional countries from the other hand.

Regulating furniture and wooden products importation tariff (weighting value: 0.123): Currently, excessive increase in importation of cheap, and in some cases, low-quality furniture –especially from China- has led domestic furniture producers' market into recession; it is predictable that domestic manufacturers are not mainly able to compete with very cheap Chinese furniture whose low price results from low human force costs and availability of inexpensive raw materials, and as this trend goes on, we will see bankruptcy of more producing units of this industry in near future. The tariffs received by Iran's customs for furniture imports is not by no means compatible with domestic production structure since the customs entry toll allocated for furniture is based on commodity weight and disregards the qualitative and artistic aspects which determine real value of the furniture. This tariff must be regulated so that, in addition to constructing sense of further competition for producers, it is not led to their loss of market.

Development of furniture industrial clusters (weighting value: 0.094): Industrial cluster structure could be very effective in development of Iran's furniture industry because most of domestic furniture manufacturing units are in the form of small workshops that cannot be successful in export markets by themselves; thus, if certain industrial areas are allotted to accommodate small furniture manufacturing units, efficient steps can be taken for quality promotion and development of furniture exports through further specialization of issues. Undoubtedly, by organizing the available traditional clusters based on pretested models and experiences of styled countries such as Italy in creation and expansion of furniture clusters, and also, designing and generating modern furniture clusters in potentially suitable regions in Iran, it will be possible for the small manufacturing units to guarantee continuity of their presence, progressive growth and development through achieving economy of scale advantage in sectors like purchasing raw material, production volume, ability to participate in large markets (national and international) as

well as reducing expenditures of utilizing costly technologies and infrastructures, marketing, and investment risk. Ratnasingam and Lorass (2004) believe that Taiwan's furniture industry is capable of maintaining its position as one of the world's great exporters despite the increase in production costs; the reason is explained by different structure of furniture production in Taiwan, or in other words, dominance of furniture industrial clusters. Gupta & Sabramanian (2005) also mentioned furniture industrial clusters as one of the major reasons for success of Malaysian furniture industry.

Reduction of volatile organic compounds (weighting value: 0.064): At present, one of the most important environmental concerns is to increase greenhouse gas emission in atmosphere and the issues related to air pollution, thinning of ozone layer, global warming, and also, human health. Furniture industry annually causes emission of large volume of volatile organic compounds which originate from consumption of variety of adhesives, dyes and coating substances; these pollutants are detrimental for human health besides having negative impact on the environment. Since several years ago, furniture producers in advanced countries were pressurized to control emission of production process contaminants and to move toward sustainable manufacturing paradigms. In England for instance, under pressure of governmental laws and regulations, furniture manufacturers changed the ratio of solvent to solid materials in chemicals from 1/5 to 1/3.03 within the time interval between years 1995 and 2000. Effective steps can be taken in this regard by using new VOC-free adhesives and resins, advanced treatment technologies with capability of recycling volatile vapors (like spray gun and spray bath technologies equipped with recycling system), water-based coating materials (dyes, sealer & killer, etc) or those with lower level of VOC, powdery coating and treatment materials, applying ultraviolet ray treatment technology and so on. Moson (2005), Regis (2007) and Canada Furniture Industry (2003) proposed control and mitigation of the volatile organic compounds existing in raw materials used in furniture industry as one of the most important indices that affects achieving the sustainable development in this industry.

Marketing (weighting value: 0.035): Researches have shown that one of the failure reasons of companies originates from their inability to benefit from marketing techniques. These companies neglect target markets, market developments, and changes in customers' consumption pattern. Absence of total information system about target markets and their features is among the failure causes of Iranian furniture exporters as they tend to achieve experience through trial and error; notification responsibility is mainly undertaken by Iran's embassies in the respective markets and also by export affairs authorities (Amiri, 2007). By identification and appropriate selection of target markets, not only are the possibility of satisfying demands and expectations of customers extended, but also, provision of proper goods commensurate with requirements and interests of foreign consumers would have a viable and convenient manner. Ratnasingam and Lorass (2003) suggest the increase in added value of products through marketing and designing among the crucial factors to reaching sustainability in Asia's wooden furniture industry. Gazo (2005) mentions strong marketing activities among the major success factors of China's furniture industry. Ziaie (2011) stated that weakness of Malaysian producers in benefitting from strategic marketing techniques is one of the principal causes of declining growth trend of country's furniture industry and also a decrease in added value of their products during the last decade.

Creation of competitive environment in furniture industry (weighting value: 0.033): Creation of competitive environment among manufacturers is a sort of economic mechanism which brings about more productivity for manufacturing units in the long term. If competition exists in the market, real producers will attempt to heighten quality, increase production to reduce costs, and ultimately, to reduce price for their survival. Examples of policies for creating competitive environment in furniture industry include: codification and enforcement of exclusive spiritual ownership law (copy-right) in furniture design, encouragement and attraction of foreign investment in this industry, development of industrial clusters, importing high-quality furniture and imposing appropriate tariffs, supporting branding, and applying regulations to support the consumer. Ratnasingam and Lorass (2003) mentioned creation of competitive environment as one of the sustainability reasons of Asia's wooden furniture industry in future. Ziaei(2011) asserted that competition phenomenon and ability of Malaysian furniture producers in analysis of their competition environment and applying relevant and highly efficient competitive strategies to contend with intensely competitive global furniture market are the main factors contributing to profitability and flourishment of

Malaysia's furniture industry at present and in near future.

Design (weighting value: 0.033): Lack of innovation and creativity in design, and, copying the domestic and foreign works are among the upcoming problems of Iran's furniture industry. Nowadays, with exceeding number of wood industry manufacturing units and an increase in supply amount, the competition among sellers and manufacturers of these products is pursued more seriously than before. In this arena, the winner is the one who takes advantage of more distinctive design having the same raw material and machineries as others. Presenting diverse and new designs for different tastes along with observing qualitative and ergonomic standards plays an effective role in development of Iran's furniture industry and gaining shares in international furniture markets. Ratnasingam and Lorass (2003) propose criteria of designing as one of the factors influencing sustainability of Asia's wooden furniture industry future. Gazo(2005) regards furniture manufacturers' capability of achieving designing ability and execution of this valuable tactic as the prerequisite for success of Malaysia's furniture industry in implementing distinction strategy and attaining growth and higher added value in the global markets.

In the end, it can be stated that according to result obtained by AHP method in this research, the abovementioned indices having the highest weighting values compared to other criteria- have greater influence on sustainable development of Iran's wooden furniture industry that shall be taken into account by the authorities and all officials involved in this industry. Furthermore, the assumption of this research- proposed at the beginning- is confirmed in this way.

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