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## **CODIFY SUITABLE STRATEGY FOR NEW PRODUCT DEVELOPMENT BASED ON INTEGRATED FRAMEWORK ACCORDING TO EVALUATING AND RANKING RISK**

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### **ABSTRACT**

In a competitive market always demand for goods and services by seasonal, cyclical or as a result of fluctuations in the supply is changing. Accordingly, each of companies to retain in the market, growth and stability in their economic activities, they need to plan strategies for new product offerings. And because development and delivery of any product is not risk free, so identification and assessment of risks in new product development process in order to make the correct development strategy will be high importance. This article is aimed at applied research and industry range of shoes production in the country is examined. First to examine the internal strengths and weaknesses and external opportunities and threats in this industry, SWOT will be analysis and new product development strategies were extracted. Then factors of QFD model based on classified risks in shape of Cooper model of product development from idea to production and product presentation and preliminary assessment of the 3-point FMEA model was evaluated and rated. At the end between the appropriate strategies in order to develop new products, the best strategy with the lowest risk will be chose and proposed for implementation. The results showed that the appropriate strategy includes three important aspects as rigorous economic evaluation; identify the right market and evaluation competitors of new product development.

**Keywords:** *New Product Development (NPD), Cooper Product Development Model, SWOT, QFD, FMEA*

### **INTRODUCTION**

In today business world, all activities of companies and factories are varied around their production and services which they offer. These fluctuations may be seasonal and caused by demand changes or because of competitive market and volatility in supply. Risk based on scope of organization has various types. To stay on the path of recovery and development, it is essential to understand all types of on faced risks and appropriate strategy for strategic management of these risks are considered. One of the strategies that can be useful for any company, delivering a new product would be.

According to a literature review conducted in the area of risk management of new product development process, researchers in this field are dealt with to identify, assess, have models for mitigate the effects of risks, design communicational networks between them, as well as the effects of risk management methods on the overall performance of this process (Jamali *et al.*, 2011; Ramezani *et al.*, 2012; Ohman *et al.*, 2014).

Therefore, none of identified risks, in the process of integrating new product development in the form of practical and proven model in this area, were observed. In the case of solutions in relation to these risks of this process, there are short researches. In this limited scope also considered conditions for specific or small measures (SMEs) (Marcelino *et al.*, 2014; Thailan *et al.*, 2014; Akbar *et al.*, 2011).

To remedy this shortcoming, in the present study we try to check the risks of new product development process and solutions in shoes manufacturing industry deal with any size of business. Also about presentation of a strategic approach to deal effectively with these risks, there is no fusion method. So vacancy of integrated methods related to various fields of management in the managing of the risks, this process is obvious. Fusion methods have been used only for identification and risk assessment up to now. For example, combination of both RFMEA and APN is (Behrouz *et al.*, 2010). To remedy this shortcoming, believe that by taking a combination of three methods FMEA, QFD, SWOT, consider three areas of knowledge management (risk, productivity, strategy) in order to control and manage the risks of

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new product development process with respect to the first period of the product life cycle in form of Cooper model of product development.

Shoes industry in our country today is faced with many problems in the production process and always foreign competitors such as China in Iran market with lower prices and average quality has been prevented from selling local products. In other hand, the country's economic situation and inattention of relevant organizations to this industry were the reasons for bankruptcy and closure of shoes industry in the country.

In Iran, except the number of shoe manufacturers, are often unknown and are not famous brand, therefore, for producers, there are many problems to presence in the market and it seems create a position to maintain is very difficult. So a structure and long-term plan for the shoes industry can provide profitability for this industry and lead to high employment.

### **Background of Research**

In previous studies about selection of strategy and discussion about product development risks can be pointed out (Liu *et al.*, 2014) to improve performance of risk management and provide a model for development and risk reduction in construction projects that with use of an approach based knowledge, and the proposed method to customers and contractors for developing the project risk management based on best practices, function improvement is resulted.

Lehtiranta *et al.*, (2014) reviewed risk management in some related organizations to each other with respect to Articles 2000 and 2012.

Results can be used to inform research programs in the RM concepts of multi-institutional used dynamic and more comprehensive. Also Marcelino *et al.*, (2014) proposed a designed project management method for small businesses that need operations of projects beyond their normal.

These projects are useful for survival of this organization, such as the development of new products to adapt to the market or new law, management of system implementation, and will help manager of professional project. So they need help with time, evidence and a minimum of resources. Risk management procedures outlined in their research on extensive research with a large number of Spanish companies.

Their new method count factors which are usually ignored by the SMEs.

Joseph *et al.*, (2014) based on new product development, evaluated the relationship between risk management practices with five programs of product development performance: A. the quality of decision-making, B. High stability of program, C. Solve open problem of organization, D. The overall success of product development projects and E. The overall success of product. The results of this study showed that the most effective risk management techniques can be divided into six categories: 1. skills, resources and risk management development 2. Taylor risk management and integration with new product development. 3. Determine the risk effects in its main objectives 4. Support critical decisions with risk management results. 5. Monitor and evaluate its risks, risk mitigation measures, and the risk management process and 6. Transparent risks of new product development. As well as risk management practices directly result in the first three categories is connected (improved decision making, stability of program and problem solving).

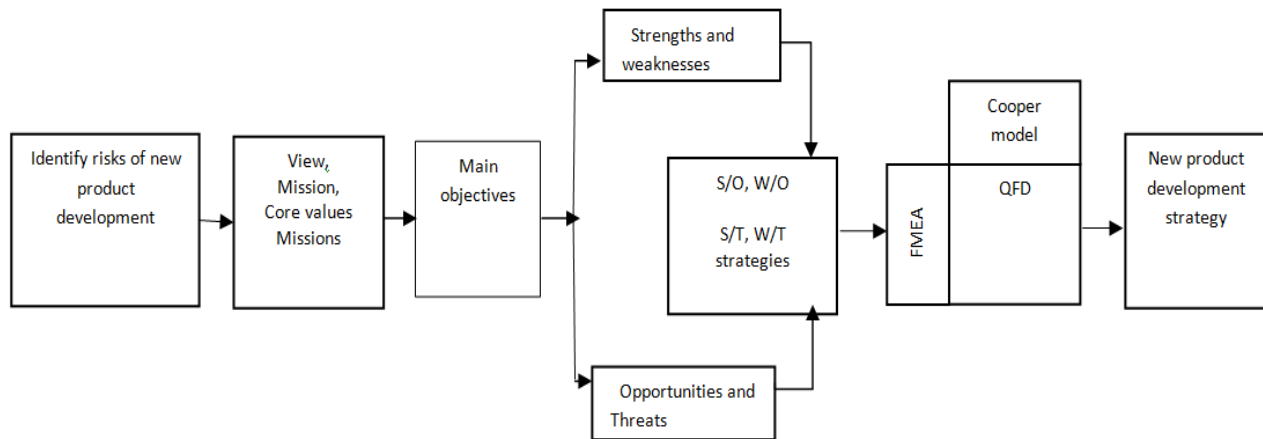
Ramezani *et al.*, (2012) provided a model for risk analysis of new product development with using Biz networks. In this article, risks in new product development in an electric company identified and categories into three: high, medium and low categories and results of output showed that production of relatively product has high risk.

Jamali *et al.*, (2011) and Alam and colleagues (2011) have articles about the project risk analysis with RFMEA techniques. Firstly, identify risks of project and classify by using RFMEA technique and finally, response strategies for critical risks are appointed.

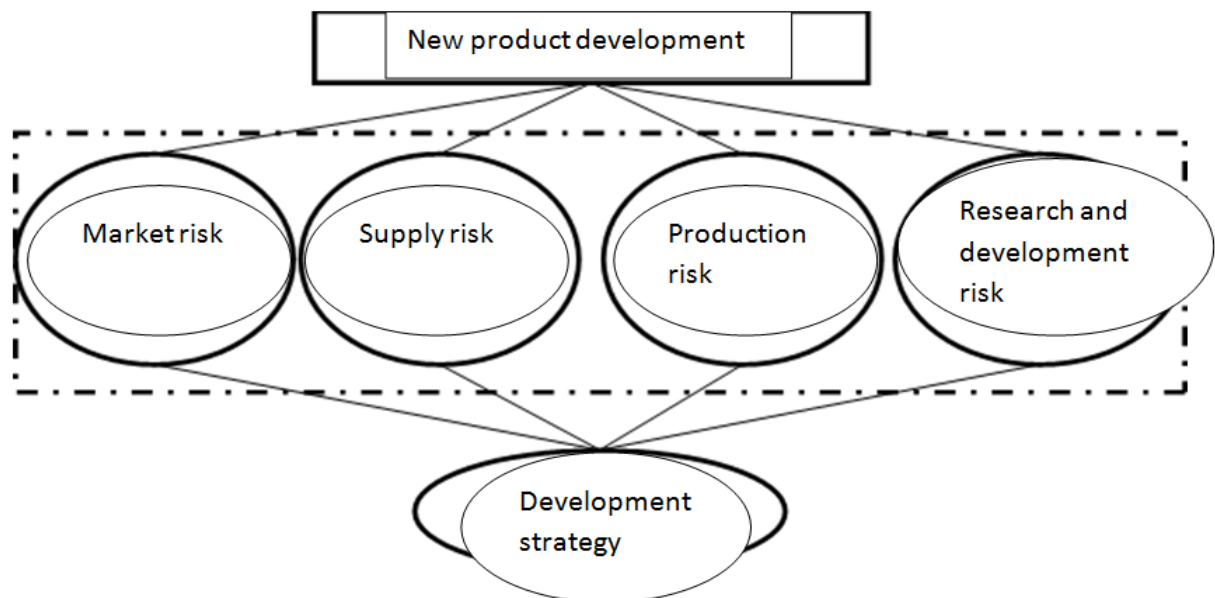
Behrouz *et al.*, (2010) with the aim of modifying and improving used FMEA, ANP-FMEA methods in order to provide systematic structure, is achieved flexible system in the realm of risk management. Using this method provides more accurate risk analysis that the pursuit of it, more effective and efficient measures to acquire and maintain the confidence will be better.

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Farajpour and Nur-alnesa (2011) in a research to develop and implement the strategy of IRI Post, with help of an integrated framework of matrix SWOT, parallel card score, QFD, EFQM and map strategies solved the problems of implementation of strategy in the organization.



**Figure 1: Framework of Methodology**



**Figure 2: Conceptual model of proposed research**

Farajpour and Hadianpour (2015) also have made a research on the issue of Iran's strategy of entering producer to international markets and the integration method based on SWOT, BSC, QFD, EFQM was used to determine the appropriate strategy for entering to international markets.

Ohman *et al.*, (2014) in their research named the product development risks with titles such as risk: identification, analysis, evaluation, and implementation and reviewed the relation of the risk management practices with the five categories of program performance of product development. Also Ramezani *et al.*, (2011) enumerated three risk of research and development, production and procurement as NPD risks and analyzed these risks also under affect eight sub factors (product design complexity, similarity with existing products, the ability to research and development, procurement similarity and existing supplying, suppliers performance, complexity of production process, similarity of production process, productivity).

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### Research Model

Faced research models and factors based on a combination of Ramezani *et al.*, (2011) research and research of Ohman *et al.*, (2014) is derived. In addition to considering the literature review, we will evaluate other risks of new product development process to identify and evaluate the model.

## MATERIALS AND METHODS

### Research Methodology

In this paper, we tried, according to the development stage of the product life cycle and considering it in terms of product development Cooper model, identify risk of this process and rank in this framework, then extract strategies may be in this process by SWOT analysis method and then with using the methodology of quality home, QFD Cooper model combine with the FMEA technique. Thus with use of FMEA techniques can analyze and prioritize the risks classified in Cooper model, and finally with respect to this priority, we choose the right strategy from obtained strategies of the SWOT analysis.

#### SWOT in New Product Development

Matrix SWOT analysis is a tool to analyze strengths and weaknesses of internal factors, opportunities and threats in external environment and ultimately determine organizational strategies. The Strengths and weaknesses are identified based on identification and evaluation of internal factors.

The strengths and weaknesses are some featuring of controllable factors of the organization that can organize them with a plan.

The Strengths are characteristics of some factors that organizations are enable about them and help to competitive advantages and lead effectively to organizational success. Where the weaknesses are factors that open up the organization of what they need to do, and lead to the failure of organization. Loyal customers, distribution efficient channels, good financial condition, reputation of the organization, are including the strengths and unskilled labor, weak leadership, old technology are including weaknesses in an organization.

Organizations have to constantly monitor domestic and foreign events and trends so that they can adapt at the right time, in terms of necessity and in a successful way to under changing conditions of the environment. Opportunities and threats are largely outside control of the organization. Developments in computer, information technology, population growth and mobility, government regulations, are examples of opportunities and threats.

Organizations utilizing external opportunities and eliminating or reducing the negative impacts of environmental threats, as well as emphasizing the weaknesses would set their strategies to achieve their goals (Kaplan, 2004).

#### FMEA in New Product Development

FMEA is a tool and powerful approach to analyzing potential failure modes within a system that ranking and deal with it will be done by measuring and considering situations and intensity of hazards. This approach seeks to identify risk scenarios based on past experience in products and services and similar processes, with the help of teams of specialists and experts, with a minimum of effort and resources and thereby reducing the time and cost of development as extensive in the industry and the various stages of the project life cycle, is used. In fact, the FMEA analysis of design features of the production process is planned to ensure that the product or the services, meet customer needs and expectations. After investigation, risk methods will identify and register and the necessary corrective actions to eliminate or gradually reducing potential hazards are done. Thus FMEA approach is stepping on improving of quality, safety and reliability and can also be used in evaluating and improving of maintenance programs (Nikpay, 2014).

It is important to note that causes of failure also can be used as the root causes and the mechanisms that are likely to fail due to be considered. In fact, failure modes, is not failure but it is a way to defeat driven. So FMEA method, attributed data value to each of the existing risks that are set based on criteria such as likelihood, severity and diagnosis. Based on increasing the risks, rank and the ratio of value would increase. And then these ratios are defined as a measure to assess risk in form of risk priority number

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(RPN). Due to targeting RPN with high value is called high risks and also due to different use of FMEA in industries such as Electro technical , military, nuclear and aviation industries, is considered certain standards in relation to its application that the most their extensive can be noted to standards that are used in America's defense industry.

About FMEA, elements like severity, occurrence and detection are ranking individually with using a numerical scale ranging from 0 to 10 as usual, and when a standard is defined then it should be used throughout the project (Hatami, 2007).

Since FMEA approach concentrates on identifying possibility of failure modes and their effects on the equipment. So discrepancies of known design and viewed reforms will be achieved, and thus identifying potential mode of failure, will lead plan to effective and reliable plans. Herewith it is necessary to be mentioned priorities of failure modes under risk priority number (RPN) and done concentrated and continuous efforts on risks with high RPN. And daily development of project life cycle process can be detailed FMEA analysis and more frequently.

#### ***QFD in New Product Development***

Since the mid-1950s, development of performance of quality was taken into account and in all sections of organizations, to be known as a management tool. Modification of QFD was created in the concepts and methods of new product development (NPD) and in the light of total quality management (TQM) (Jiang, 2007).

Toyota co. in 1977, developed it and used for expanding its products. This approach for developing of products, from the beginning of 1980s, in American industry was used. Automotive industry, were the first group of industries in the United States resorted to the use of QFD. But soon other industries, particularly the service industries would also use it (Zare, 2010).

Once that QFD is used for product development, customer expectations concerning the main characteristics of product design is used in the original matrix of quality house (HOQ). HOQ is a matrix includes numerical entries which shows the most important customer requirements (CRs), technical product requirements (DRs), the relationship between CRs and DRs (the relationship between customer requirements and technical product requirements) as well as communication between the technical requirements of product show DRs (Ramanathan, 2009).

QFD and use it, originated according to two related object. These two targets started with consumer (client) of a product and will terminate with its manufacturer. These objectives include:

1. Convert demands of consumer (voice of customer) from product to qualitative characteristics in the design phase:

2. Deployment of identified quality characteristics (quality improvement) at the design phase to the other manufacturing processes and product development with determination and establishment of control points and inspection prior to actual production (Zare, 2010)

Existence risks in new product development can distinct to four parts based on conceptual model. Risk of research and development expresses this possibility that product characteristics can not be met in expected schedule.

The risk is focused on the relationship between R & D Company in new product development and related to R & D capability, product reviews and feasibility and product concept. Production risk suggests this possibility that production requirements would be consistent with the expected schedule. In production process, the internal and external factors of organization should have affecting role in order to be fulfilled organization's objectives with efficiently.

This risk with similar production processes, lack of confidence in quality, structure and product innovation as well as used technology is considered. Risk of supplying expresses the likelihood that provider is unable to deliver high quality raw materials in time of expected schedule. Suppliers of raw materials and services play an important role in the competitiveness of the organization. Market risk refers to the risks associated with sales market or demand for raw materials. Accordingly, we can consider market and competitors understanding, acceptance and recall of produced product are including involved risks in the different stages of product development.



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**Table 1: Involved risks in product development Cooper model**

Risks	The Cooper model process
Innovation	Idea
Concept	
Understanding the market	Preliminary assessment
Industry Recognition	
Feasibility	Business Review
Identify competitors	
Technology	Develop
Structure	
Quality	Testing and validation
Performance	
Acceptability	Production and product presentation
Collectivity	

**Table 2: Threats Matrix, opportunities, weaknesses, strengths (SWOT)**

Weaknesses -W •	Strengths -S •	
• Lack of proper economic assessment	• Experience and record high	
• Burnout current machines	• quality manufactured goods	
• high-quality raw materials	• Innovation in design and production	
• Production capacity than is possible	• Activity Related Industries	
WO strategies	SO strategies	Opportunities -O •
1. The mobilization of new technology	1. Diversification of export production	• The domestic market is very wide
2. The economic feasibility study on new production	2. The benefit of skilled labor in the production of new products	• appropriate export market to exchange technology
3. Reduce the final price with the benefit of professional capacity	3. Innovation tailored customer	• high employment capacity
4. Marketing for export in order to cover the cost of production	4. jobs in related industries	• diversify production according to customer
WT strategies	ST strategies	Threats - T
1. Economic plan to increase exports of new products	1. New production quality better than competitors	• There is no limit imports
2. Government support in the construction of a new production line	2. Promotional support for new product against foreign competition	• Low price Chinese goods
3. Use knowledge to reduce the price	3. Benefit from the experience of specialists to reduce the price	• Lack of liquidity for development workshops
4. The use of loans to provide employment workshops	4. The review of the manufacturing process and reducing cost	• Lack of government support of the industry
5. supply of raw materials from domestic suppliers through participation in profits		• reluctance of consumers to buy domestic products

In the process of Cooper product development model is intended 6 stages that each of these stages is associated with risks. Table 1 is showed existence risks as a case. Presented indexes in each of above

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steps in Cooper model can be used as a benchmark for analyzing and assessing of risk strategy that will be considered in rest.

Threats Matrix, opportunities, strengths and weaknesses ((SWOT) is one of the important tools that managers can compare data and show four types of strategy: SO strategies, WO strategies, ST strategies, and WT strategies.

Compare internal and external factors is the hardest part of preparing threats matrix, opportunities, weaknesses and strengths and needed good judgment and also there is no such thing as a best set of comparable factors. According to the above, the strengths, weaknesses and the opportunities and threats of shoes industry in the table below, which can be considered in choosing the right strategy.

In Table 2 it can be seen that according to new product development and the four mentioned factors what strategies can be considered adopted, each one should be assessed according to the conditions and time circumstances of organization.

Then we will complete the house of quality with considering the average of expert opinions and regard to the proposed measures in past and ultimately analysis will be carried out with considering risk priority number. The risk priority number is sum of three number of severity(S), the probability of occurrence (O) and probability of detection (D) and accordingly for numbers of high risk, must take corrective action to bring down this number.

**Table 3 : House of quality**

		Process of Cooper Model											
How's		Innovation	Concept	Market understanding	Industry recognition	feasibility	Identify competitors	technology	structure	quality	efficiency	acceptance	integrity
What's													
FMEA criteria	Probability	3	3	7	4	6	7	7	4	6	4	5	4
	Detection	4	2	6	4	10	7	3	4	3	2	7	5
	probability												
	Incidence	6	4	8	4	9	6	10	5	5	3	6	6
Risk priority number (RPN)		72	24	336	64	540	294	210	80	90	24	210	120

Based on the results presented in above table are derived from distributed questionnaires, Cooper model risk and the risk priority number calculated and is listed in the last row. These numbers represent the amount of risk in each of the stages of Cooper product development model that has been collected by views of experts. The greater of risk priority number, means that this stage of product development has been less reliable and more will be at risk. So it is needs to review, revise or modify its process.

According to the results of the scoring table, it can be concluded that the new product development process, the most important parts of the process are rigorous economic evaluation; identify the right market and evaluation competitors, special attention should be to this section. The priority of risk follow-up and care for each stage will be as follow and is categorized based on Cooper product development model.

If we consider Pareto's Law as a principle, will see that more than 80% of the risks associated with 20% risk and on this basis we can say that three first factors have been identified as the most important risk of new product development.

According to the above table it can be said that the feasibility in stage of business study is most important and dangerous risk that possibility of errors and possible wrong diagnosis can impose the most severe damage in the path of new product development.

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Feasibility is the most important starting activities or its developing that has been emphasized on its importance in several studies. Always managers and experts to start a business or offering new product first will search for economic assessment and feasibility study and its implementation based on a pattern just step up and are able to achieve its predicted results.

This aspect of risk that covers economic aspect and the proposed plan for new product development can be considered a good lever to choose the right strategy for the company. So that the new product development should have clear business plan and took place under detailed economic assessment of costs and revenues.

Market recognition as vision of experts is the significant risk of in shoe manufacturing industry. This recognition in the preliminary evaluation phase and then after presenting the idea should be considered. Thus, some questions will arise such as whether the market is currently enough capacity for production? Would Market accept such good with this cost? And are presented ideas in line with market demand and can sell enough?

**Table 3: Categorized risks based on Cooper product development model**

<b>New product development process</b>	<b>Risks</b>	<b>Importance of risk</b>
Business Review	Feasibility	1
Preliminary assessment	Understanding the market	2
Business Review	Identify competitors	3
Development	Technology	4
Production and product presentation	Acceptability	5
Production and product presentation	Collectivity	6
Testing and validation	Quality	7
Development	Structure	8
Idea	Innovation	9
Preliminary assessment	Industry Recognition	10
Testing and validation	Performance	11
Idea	Concept	12

These questions all are effective for market studies and enough knowledge about supplying goods to market. If didn't pay attention enough in this phase of new product development, in the process of product life cycle we will see that supply and growth period would face with failure and decline and decay much earlier than usual.

As well as recognition of competitors has been identified as one of three major factors in risk of product development, should have special attention. Identify of competitors in competitive market is used, in addition to choosing the right strategy, as a strong lever to outshine in the market. On the other hand, lack of attention to the activities of competitors in the market can fail your strategy product development and manufacturing new products and cause heavy losses to you.

Among actions that can be taken at this stage would be named pay attention to products and manufactured goods by rival companies, corporate strategy and supply of raw materials and final products of the mentioned market. However, a manufacturing company for product development is depended on innovative and creative ideas, but regarding evaluating business should pay attention to production experiences of competitors companies and also keep in mind this point that competitors don't have the same ideas that have failed! It can also be said that referring experiences of competitors in field of new



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product and the success of their competitors on the market can guide companies to choose the right strategy.

Other risks ranked in the table has less importance and referring aspects of creation, production and product development effort is done to reduce relevant risk. Technology, acceptance and integrity are next risks which will be considered in future and approaches to reduce risks in the organizations should be on the agenda.

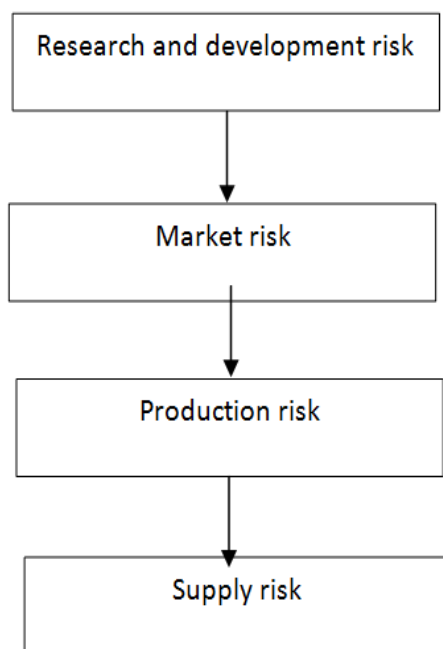
### **Conclusion**

Presented strategies in results of SWOT matrix analysis points various discussions about interaction of shoe manufacturing company and have considered different circumstances to make each one. Accordingly, each of selected strategy will create more favorable conditions than the current situation, which is described below.

1. Diversification of production for exporting goods: this strategy with regard to the aspect of export, consider opportunities that lie ahead, discussion would make ideas and innovation as a strength measure in the shoe manufacturing industry. By choosing this strategy can have discussion about acceptance' risk from customer view and their diversity; also as the criteria for economic and income can be considered in exporting.
2. The benefit of skilled labor in the production of new products: a skill workforce can be very effective in production process and can cause quality and performance. This strategy due to the risk of production process and product offerings could cause acceptability, quality and efficiency and reduce the risk of dissatisfaction of new product.
3. Innovation fit to customer's taste: customer tastes criteria is with the importance of new product development. The fact that ideas and innovations associated with product development can attract the customer's taste or not, can success or failure manufacturing companies. So this strategy can reduce the risk of acceptability and innovation.
4. Employment in dependent industries: industries depend on shoe industry such as leather bags and so can be on the agenda as a production expansion project. This is due to market expansion, reduces risk of industry identification and structure and can be accepted as a workshop development project.
5. Equipping workshops with new technology: new technology is an important element in the development and updating of domestic production and can pave the way for competition in the market. New Technology and equipment can reduce risk of human error and recall great products.
6. Economic feasibility study of new production: Always any new business needs preliminary assessment and estimates in order to study and evaluate the results and have economic outlook for the integrity of the project. In the process of new product development, feasibility is also very important and economic plans are key factors in achieving acceptable profit. This strategy is fitted to the risk of feasibility and evaluation of business risk and can reduce relevant risks on uneconomically plan of new product development as much as possible.
7. Decreasing final price with profited by jobs potentiality: final price of manufactured is factor of bankruptcy of many companies and non-use of full capacity production. So most of producing workshop with this strategy and skilled workforce, try to reduce the final price and make benefit from the capacity job opportunities.
8. Marketing for export in order to cover production costs: This strategy can support costs of production and increase export would be followed. In this regard, companies can increase marketing in other countries to export non-sold products in domestic markets and supply costs of new product. This strategy reduces the risk of market identification and make good place for products via marketing.
9. New product with better quality than competitors: quality of product is one of the most demanding of customers from domestic manufacturers and one of the main reasons for buying foreign products. In a competitive market, products with a similar price and better quality would be sold more and that are produced more sales and a good place in market. Herewith production strategy of new quality product by taking risks support competitors recognition, quality risk and comprehensiveness of risk and customers accept it more.

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10. Promotions of new product against foreign competitors: new products are entering a market must be protected between similar foreign product diversity so that they can have a place in the shopping basket of customers. Promotion of locally-produced goods as supporting the production and Iran could have a positive impact on customer view and selection of these products. Of course, this choice is subject to other conditions such as price, quality and ... This strategy can reduce risk of acceptability and integrity in the development phase and product offering, meanwhile predict better sales market.
11. Benefit from experience of specialists to reduce prices: experience of educated and professionals in this field can decrease production cost, waste and final price. So a suitable strategy to reduce price, use of experienced workforce to improve productivity and reduction of production costs.
12. Review of manufacturing process and reducing final price: a review of manufacturing process can reduce the risk of structure and recheck new product development process by taking into account new science and technology and finally reduce production costs. So this strategy is a good way to reduce the risk of structure, technology, development and creation.
13. Economic plan, increase exporting of new product: plan of increasing export can bring economic benefits associated with professional studies. This strategy is with feasibility and market recognition and also considering foreign markets for developing new product, the export economic plan is proposed. Also under Cooper model, then will relate to business and reduce market risk.
14. Government support in construction of new production lines: financial and economic support of government is related to new product development and associated risks. These support can cover both financially, supply of raw materials. Construction of a new line of production and development activities focus more on development and new product development will reduce supply risk.
15. The use of modern technology to reduce the price: Technology and mass production could serve to develop a new product and review the structure of production, costs and prices down and marketed product with high production. So this strategy can reduce the risk associated with the production and cost of equipping and use of knowledge receive suitable feedback.
16. Use of loans for job creation and equipping workshops: many manufacturing workshop due to lack of sufficient funds were already semi-closed or bankrupt. Business loans to boost job creation and suppliers will be required to enable their production continued low interest and good terms that they have.
17. Supply of raw materials from domestic suppliers through profit-sharing: Manufacturers have problem for importing raw materials. And this approach to supply of domestic production workshops put forward.



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As a strategy for the development of new products, company should have the most investment in research and development and focus on economic feasibility and also based on the ideas and innovations of remove more risks.

Among other strategies that can help in this regard, the economic plan for increasing export and competitor recognition for effective presence in a competitive market. This approach can be the same way of diversify and attention to market are the most effective measure of success in future.

Shoes manufacturing companies by choosing this superior strategy can provide a proper development plan based on knowledge of the market and economic conditions can have banking benefits and facilities and in line with new product development and supply of finance is expected reasonable profit. In the framework of this study suggests that researchers of other industries to be reviewed and more indicators may be considered for product development. As well as other researchers can use a combination of methods for analysis associated with new product development strategies and evaluate by complementary structures.

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