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Analyzing The Risks of The Production Process in Light of Sustainable Business Using Fuzzy Logic

Menganalisis Risiko Proses Produksi dalam Rangka Bisnis Berkelanjutan Menggunakan Logika Fuzzy

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Abstract

Production operations at the present time reflect a transition towards business sustainability and achieving a balance between human needs and environmental preservation. Accordingly, this study highlights the risks of production operations in light of sustainable business using fuzzy logic. To achieve this goal, previous studies were relied upon to identify risks. The production process, as well as identifying the factors influencing the production process in the organization. After that, 50 experts specialized in the field of production in Iraq were sought to find out their point of view on the risks of the production process and its consequences in Iraq. The results were analyzed using fuzzy logic and special risk matrices. (Easy, standard, difficult). The study revealed that the standard matrix is the best in confronting risks. Moreover, these risks must be faced effectively by adopting comprehensive strategies that combine environmental and economic performance, investing in technology and training, and ensuring the safety and health of workers, in a way that enhances this. Opportunities, reduce risks in production processes and contribute to achieving long-term sustainability.

Highlights:

- Production sustainability requires balancing human needs and environmental preservation.
- Fuzzy logic identifies production risks, analyzed using expert insights and matrices.
- Strategies must enhance opportunities, reduce risks, and ensure long-term sustainability.

Keywords: production risks, sustainable business, fuzzy logic.

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Introduction

Business organizations seek to avoid the risks of the production process to ensure sustainable business, gain customer satisfaction, and achieve competitive superiority in the market. However, these risks cannot be easily avoided and cost the organization a lot of time, effort, and money to overcome them. The production sector is exposed to risks like other sectors, as These risks represent a threat to production processes and sustainability, as the risks of the production process in light of sustainable business include these risks such as safety risks, environmental pollution risks, quality and process control risks, downtime risks, and risks of new technologies and innovations. Understanding and addressing these risks effectively It is crucial to ensuring the sustainability of manufacturing processes and achieving maximum efficiency and quality in production (Smith, 2020, 46), Organizations of all types of production and service seek to achieve sustainable growth goals for all their activities and businesses, by providing products that meet the customer's ambitions from an environmental, social and economic perspective (Al Hadidi & Muhammad, 2023), so this research aims to review and analyze the risks of the production process in light of sustainable business, and provide recommendations and procedures to deal with these risks effectively and sustainably, and to achieve This goal must be to identify the problem of the study, which is to identify the most important risks facing the production process, analyze them, know their causes and consequences, and address them by raising the following question: How does understanding the risks of production science contribute to promoting sustainable business? Answering this question will achieve the goal and importance of the study, and accordingly, the current study includes the following paragraphs: First: previous studies, second: study methodology, third: theoretical aspect, fourth: practical analysis, fifth: conclusions and proposals.

The first section: previous studies

A study of operational risk management practices for manufacturing companies in Ghana presented by (Efua & Ewur, 2021, 88). This study divided operations risks into five types: (process risks, individual risks, system risks, system risks, external and internal risks). (Atan, et.al, 2017) addressed the topic of a review of the decision support tool for operational risk management. This study addressed tools to support operational risk management decisions through risk-based thinking to meet the intended requirements of the ISO 9001:2015 standard, and the scope of operational risk management was divided At the highest level, it is divided into two parts (operational safety, the organization's ability to perform business operations continuously), while the study (Bayer, 2012), which included the introduction of the risk management process in the manufacturing industry, and the main purpose of the study was to identify the most important risks facing The company within the "source" and "manufacturing" operations, creating proactive and reactive mitigation measures, while the study (Diao & Ghorbani, 2018) (Production Risks Caused by Human Factors: A Multiple Case Study of Thermal Power Plants) This study examines the production risks caused by factors Human factors in thermal power plants in China By identifying a set of production risks and human factors that are likely to affect production in negative and positive ways, this study emphasizes work behavior, safety awareness, creativity, and environmental protection awareness as basic human factors that are likely to affect production risks. Study (Brocal, et. al, 2018) (Managing risks of hazardous materials in manufacturing processes: links and transitional spaces between occupational accidents and major accidents). Chemical risk management is of particular importance for preventing occupational accidents and major accidents, in accordance with the directives of the recent ISO 45001: 2018 standard regarding health management systems. And occupational safety, the study (Alam, et. al, 2023) addressed the critical factors for applying green technology to improve the production process, and this research also confirms that combining green implementation and knowledge management leads to reducing manufacturing risks. The results of the study demonstrated that understanding the mutual relationship between green implementation and knowledge management processes contributes to reducing manufacturing risks, while the study (Al-Obaidy, et. al, 2023) (Risk assessment framework for the smart supply chain inspired by business continuity), as this works The study aims to develop a new approach to dealing with smart supply chain risks inspired by business continuity and which can meet appropriate measures in the event of disruptions. As for the study (Santanaa, et. al, 2018), the scope of this study is to obtain an overview of the methods used to evaluate Risks and opportunities for deferred maintenance interventions on old equipment, emphasizing the importance of including monetary risk considerations and schedule considerations, and a study (Tse and Tan, 2011) that addressed talk about quality risks in the global supply chain, and the matter is exacerbated with the decreased "visibility" of quality risks hidden in networks. Global supply is multi-level, and quality risks come from raw materials, manufacturing processes, or logistics operations at any level of the supply network. As for the study (Schwabe, et. al, 2019) (on changing cost risks and uncertainty throughout the life cycle of manufacturing products) the risks Cost and uncertainty are constantly decreasing across the entire product life cycle, and this situation can lead to levels of cost risk and uncertainty higher than those found at technology readiness levels.

Methods

First: The problem of the study: The production process in Iraq in light of sustainable business faces great risks represented by the lack of appropriate infrastructure and technology for industry and agriculture. These risks reflect the lack of investment in developing the infrastructure and technology necessary to support sustainable

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business, which exposes production processes to many risks and difficulties. As well as the following risks (UNIDO, 2020):

1. Lack of logistical infrastructure: Many areas in Iraq suffer from a lack of logistical infrastructure, such as roads, bridges, and transportation facilities, and this can lead to delays in the distribution of raw materials and finished products, which increases production costs and reduces the efficiency of operations.

2. Lack of technology and modernization: Many factories in Iraq suffer from a lack of investment in modern technology and modernization, and this makes them rely heavily on unqualified labor and manual operations, which reduces production efficiency and increases its costs.

Second: Objective of the study: The current study aims to:

1. Analyze the factors determining the risks of the production process in Iraq and evaluate their impact on sustainability and efficiency.

2. Provide a comprehensive assessment of the industrial and technological infrastructure in Iraq and identify shortcomings and gaps.

3. Study the impact of safety, environment and maintenance on production operations and provide recommendations to improve operational sustainability.

4. Develop improvement strategies and solutions to increase production efficiency and sustainability, including enhancing technology, improving infrastructure, and enhancing risk management.

5. Estimate and analyze the risks of the production process in Iraq in light of large-scale production and propose strategies to improve sustainability and production efficiency.

6. This research can be an important basis for making political and economic decisions aimed at enhancing production and improving economic conditions in Iraq.

Third: The proposed framework for preparing the fuzzy risk matrix: Figure (1) shows the steps for implementing the scientific aspect of this study, as follows:

1. Identifying the various risks facing the production process. Therefore, the first stage will be to identify those risks (Table 1) with the aim of including them in the proposed framework. Previous research papers have been relied upon to identify these risks. The output will be a list of the main risk factors and sub-risks.

2. Risk Analysis After identifying the risks facing the production process shown in the first stage (Table 1), we analyze them in the second stage. This process requires three steps:

a. Determining the impact of risks: The impact of risks is determined by reviewing the relevant literature (Table 2), and it is worth noting that these factors may vary according to the organization’s policies and capabilities, which are used to estimate the overall impact of risks.

b. Calculating the weights of the risk impact factor: In this step, the impact weights are calculated for each of the risks included in the list (Table 4), and in this regard, the method of Yucel et al. (2012) is applied (see Appendix 1).

c. Calculating the effects of risks and the severity of the consequences: A questionnaire was prepared to collect experts’ opinions on the impact of each risk and the severity of the consequences (Appendix 2). Accordingly, the TFNs are set up in Table 3. Due to the lack of precise quantitative data, this paper uses terminology to deal with uncertainties due to experts' lack of knowledge about providing precise parameters (Can & Toktas, 2018).

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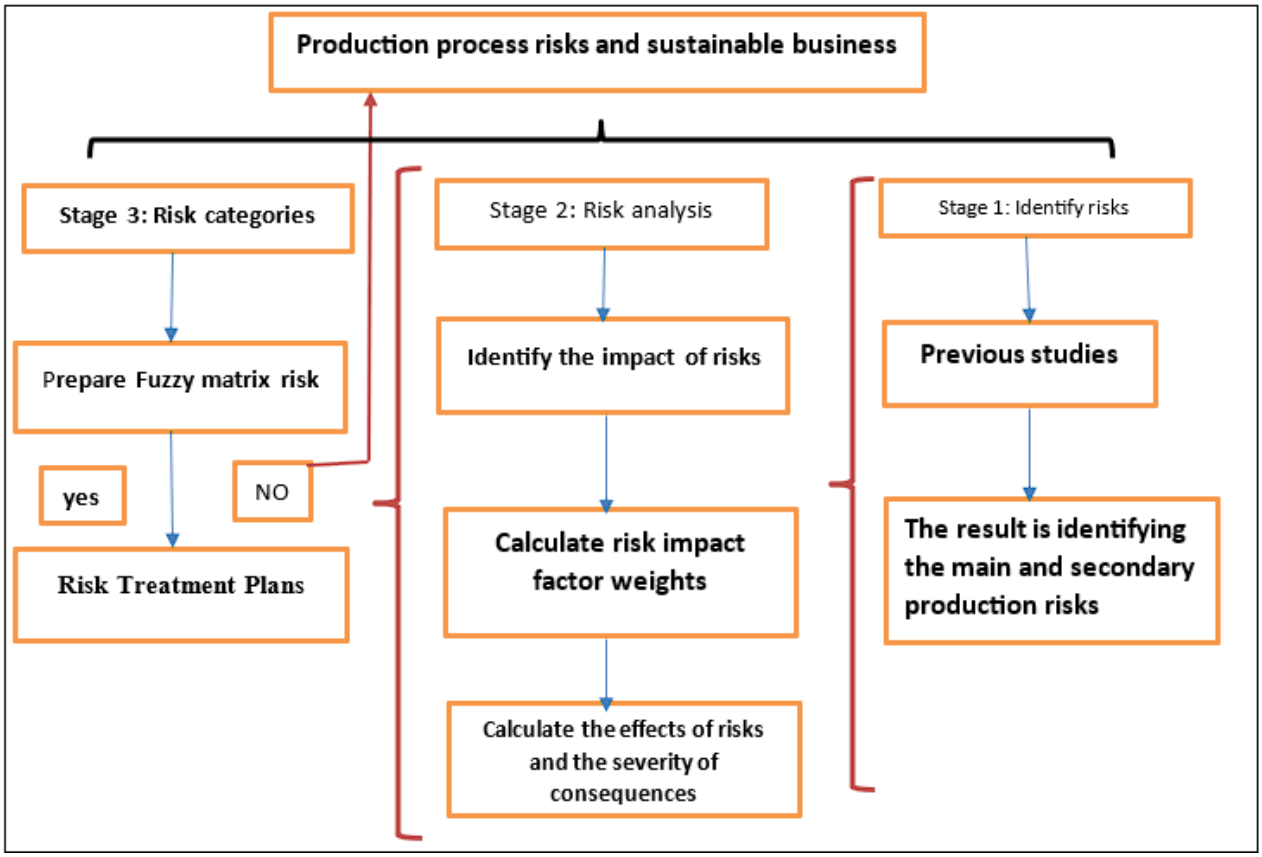

Figure 1. *The proposed framework for preparing the fuzzy risk matrix*

Result and Discussion

The third axis: The risks of the production process in light of sustainable business

Failure to confront the risks of the production process before or during their occurrence will make the organization's production position very embarrassing, and this will affect the sustainability of the organization's production work. From this standpoint, the definition of production process risks is all negative deviations that target the production process and whose causes occur with a certain probability, and whose consequences can be seen. Possible by the company's management in the short or long term (Kocha and Braunreuthera, 2017, 361), as production risks include several types, which are:

1. Risks of materials and equipment: The methodology for assessing the risks of materials and machines aims to increase the level of efficiency by implementing preventive measures when using hazardous materials or machines. Among the most important equipment risks are: the undetected risk associated with the sudden stopping of equipment without knowing the reason, in addition to the risks of the workers themselves. Who use dangerous processes or working methods including acting without authorization, against orders, prohibited action, or remaining within a hazard-prone area, as well as the risk of selecting inappropriate processes for the design of the equipment or not observing safety procedures throughout its period of operation (Pacaiova, et. Al, 2021, 3).

2. Cost risks: It is represented by the difficulty of predicting the final cost of the product, with the presence of uncertainty around cost items such as technology, human resources productivity, economic conditions, market conditions, prices, inflation, and other future risks and events, as well as the risk of the actual cost of the project exceeding what was expected. After analyzing the uncertainty in cost, which helps decision makers understand the nature of cost-related risks and potential responses to them (Khodakarami and Abdi, 2014, 1233).

3. Quality risks: In line with the principles of developing and implementing the international standard [ISO 9001:2015] the principle of risk assessment, identifying and evaluating risks and opportunities that may affect the quality management system and the results of the organization's work; Develop a plan to respond to risks and opportunities to make decisions based on the results of the risk assessment in the manufacturing organization, which will increase the efficiency of management processes (TRISHCH, et. al, 2021, 4769).

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4. Design risks: Product design is an important and complex risk, because it integrates technical challenges and the preferences of many stakeholders from inside and outside the organization to derive one comprehensive, ideal set of specifications (Oehmen, et. al, 2010, 2).

5. Technology risks: Technology includes several risks, the most important of which are: the risks of technology variation, as they represent a major problem when it comes to production. Organizations may need to integrate different technology from different sources, and this can be a challenge in terms of compatibility and integration. The second risk is technology renewal. Organizations must be aware of the latest technology to regularly update production equipment. This can be costly and may lead to the organization being exposed to risks if it does not update. The third risk relates to the security of information and data: With the use of technology in production, the risks of information and data being stolen increase. Sensitive. Cybe attacks and information leaks can have a significant impact on production and security, as well as the risk of technology security: advanced production equipment is at risk of theft and damage, and the risk of dependence on a particular technology: organizations may become too dependent on a particular technology, and this increases their risks. If this technology stops working or becomes unavailable (Hsu & Hu, 2008, 589)

6. Supply chain risks: In today's business environment, which is characterized by extreme complexity, supply chain risk management is necessary because it constitutes the difference between a successful business or not. Therefore, supply chain risk management is important for all companies, because studying risks enables companies to be effective in Where the cost is as much as possible and responds in an ideal way to customer and market requirements under any risk (Bayer, 2012, 20).

7. Human Resources Risks: Studying these risks helps focus on safety culture, improve human-machine interaction, discover latent errors, define tasks compatible with human nature, separate tasks to avoid repeated errors, encourage reporting errors, and require workers to follow the correct processes (Diao and Ghorbani, 2018, 3).

8. Safety risks: Safety risk management is the comprehensive and systematic implementation of management functions in managing risks related to the safety of human and material resources. This is done in accordance with the application of the following components and elements of the Safety Management System (SMS): components of safety objectives and policies, components of safety risk management, and components of Safety assurance, and safety enhancing components (Majida, et. al, 2022, 1510).

9. Maintenance risks: The risk analysis process for a maintenance activity depends on three methods: frequency, detectability, and severity of risk. However, the result obtained is a quantitative value that does not take into account uncertainties, and uncertainty analysis can help in identifying risks. Serious maintenance and its causes (Gallaba, et, al, 2018, 227).

10. Scheduling or time risks: Identifying product schedule risks enables managers to take measures to facilitate effective control of schedule risks with low effort. The most prominent scheduling risks are fluctuations in activity periods, which affect fluctuations in the duration of the entire project, and the schedule can be measured on As follows: (1) probability of delay, (2) negative outcomes, (3) combination of probability and impact of schedule outcomes, (4) variance in project duration (5) relative standard deviation (Tao, et. Al, 2017, 3).

11. Environmental and sustainability risks: Sustainable green accreditation must lead to building an environmentally friendly environment that does not endanger the lives of employees and the quality of manufacturing, and to solve the environmental obstacles affected by rapid economic growth, the government and society must build sustainable industries with environmental technologies (Zeng et al. 2021) .

As for sustainable businesses: they are tools to achieve social and environmental sustainability of systems by integrating the principles and goals of sustainability into the value proposition, value creation, and value-capturing activities of companies, and sustainable business aims to achieve the following (Nosratabadi, et. al. 2019, 2):

a. Employing proactive multi-stakeholder management to support innovation activity.

b. A long-term perspective of the company's various businesses to achieve sustainability goals.

c. Contribute effectively to reducing the harmful effects of commercial activities on the environment and society by providing solutions to help companies achieve their economic and sustainability goals simultaneously.

The relationship between the risks of the production process and sustainable business:

The necessary transformation towards a sustainable society depends on product development and manufacturing companies assuming leadership in developing products and developing business models and technologies that affect environmental and social systems (Gaziulusoy et al., 2013), as product development companies need to Developing capabilities to link societal change at the macro level with social and environmental sustainability while achieving tangible impacts on the economic sustainability of its business to ensure suitability and competitiveness in changing markets (Schulte, et. al, 2020), as identifying production risks in light of sustainability is subject to several restrictions, Broman and Robèrt, 2017; (Villamil et al., 2021):

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a. It requires detailed information that is not usually available in the early stages.

b. Focus on environmental sustainability rather than the perspective of complete social and ecological sustainability.

c. Focus on the relationship between sustainability aspects and product cost rather than focusing on a broader perspective of stakeholder value.

d. Lack of a long-term strategic perspective, the importance of which has been emphasized by an increasing number of studies

These limitations make decision-making processes more complex for companies that have a sustainable business model compared to a more traditional business model. The concept of sustainability represents an evolution of a continuous process of exemplary achievements. This development leads to a change in the focus of business management from a one-dimensional point of view to a perspective It also takes into account social and environmental aspects in decision-making processes (Da Silva & Filho, 2020). If we want to help the transition towards a more sustainable society, we must commit to making more environmentally friendly decisions about the goods and services we buy and the means of transportation we use. It is important that companies in the public and private sectors also take environmental and social measures. Companies and governments must strive to better manage natural resources in order to protect the environment for future generations (Santander, 2021), and accordingly there are three different successful strategies for a sustainable business model or production model (Atasu, Dumas, & Van Wassenhove 2021):

1. Retaining ownership of the product: In this business approach, the producer rents his product to the customer rather than selling it, so the producer is responsible for the products when the consumer is finished with them. The rental transaction model creates repeat business that is often useful for more complex products or services.

2. Extending the life of the product: Companies applying this strategy focus on designing products to last longer, which creates market potential in used products and a longer life cycle for the product. Durability is considered a key competitive differentiator and provides a strong rationale for premium pricing.

3. Design for recycling: Through this strategy, companies redesign their products and manufacturing processes to maximize the recovery potential of used materials for use in new products. This strategy often includes partnering with technology-focused companies that may enable the use of recovered materials.

Integrating the risks of the production process with the sustainable business model determines for management the way of thinking behind the business model that is more and less risky to both the production process and sustainability, because the sustainable business model is about reconnecting and working completely differently to confront risks to make our societies more sustainable (De Vries, De Vries, & Kikkert, 2019).

Fourth axis: the practical aspect

First: Identifying the risks of the production process: Table (1) shows the main and subsidiary risks facing the various production processes, as the process of identifying these risks was done based on previous studies, as the table expresses the questionnaire form with a response scale according to the seven-point Likert scale, and these were distributed The questionnaires were submitted to (50) Iraqi experts specializing in the field of various types of production, and this will help us determine whether or not there are critical risks.

Very high - high - moderate - low - very low - unlikely - Remote	References	code	Subrisk	Main risk
	Oduoza, 2020	SR1	Equipment obsolescence	
	Equipment and materials			
	Oduoza, 2020	SR2	Working with hazardous equipment	
	Oduoza, 2020	SR3	Maintain equipment on time	
	Punyamurthulaa & Badurdeen, 2018	SR4	Operational risks on the production line	
	Shah, et. al, 2013	SR5	Failure of the	quality

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			technical performance of the product	
	Oduoza, 2020	SR6	Deviation from the specified standard	
	Tse and Tan, 2011	SR7	The threat of hidden quality and customer satisfaction	
	Tse and Tan, 2011	SR8	Defects in raw materials	
	Shah, et. al, 2013	SR9	The cost of the product is higher than expected	Cost
	Oehmen, et. al, 2010	SR10	The cost of product development is normal	
	Schwabe, et. al, 2019	SR11	Unpredictability of cost risks and uncertainty	
	Schwabe, et. al, 2019	SR12	The accuracy of cost estimation during the product life cycle	
	Zhou, et. al, 2023	SR13	Lack of knowledge and experience in the field of design	design
	Zhou, et. al, 2023	SR14	Risk of violating customer requirements when designing	
	Zhou, et. al, 2023	SR15	Risks of design parameter selection or tolerance	
	Oehmen, et. al, 2010	SR16	Difficulty in designing easy to use and repair	
	Oduoza, 2020	SR17	Technology obsolescence	Technology
	Oduoza, 2020	SR18	Internet of things	
	Oduoza, 2020	SR19	Efficient performance and use of resources	
	Oduoza, 2020	SR20	Cybersecurity and individual ownership	
	Abdi et. al, 2018	SR21	Supply and demand risks	Supply Chain
	Abdi et. al, 2018	SR22	Infrastructure risks	
	Abdi et. al, 2018	SR23	Supplier risks	
	Al-Obaidy, et. al, 2023	SR24	Reliability and integration (cooperation and control) to achieve customer satisfaction	
	Diao & Ghorbani, 2018	SR25	Knowledge and experience	Human Resources
	Diao & Ghorbani, 2018	SR26	Human-machine interaction	
	Diao & Ghorbani,	SR27	Mental pressure,	

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	2018		time pressure and discomfort	
	Diao & Ghorbani, 2018	SR28	Concentration fluctuations due to poor training	
	Santanaa, et. al, 2018	SR29	Postponing maintenance work due to poor funding	Maintenance
	Santanaa, et. al, 2018	SR30	There is regular maintenance that can be stopped	
	Santanaa, et. al, 2018	SR31	There are suggested methods for determining maintenance options	
	Santanaa, et. al, 2018	SR32	Monitor equipment condition to determine system reliability	
	Brocal, et. al, 2018	SR33	Personal protective equipment	Occupational safety
	Menchenkova, et. al, 2022	SR34	Equipment hazard in the workplace	
	Brocal, et. al, 2018	SR35	Tools for handling, storing and transporting hazardous materials	
	Brocal, et. al, 2018	SR36	Noise at work	
	Shah, et. al, 2013	SR37	Delay processing time	Time and scheduling
	Shah, et. al, 2013	SR38	Production disruption times	
	Lu, et. al, 2022	SR39	Avoid the risks of a multi-target schedule to meet customer demands	
	Lu, et. al, 2022	SR40	Difficulty distributing work orders to stations	
	Alam, et. al, 2023	SR41	Prevent and control pollution at the source	Environment
	Alam, et. al, 2023	SR42	Environmentally friendly prevention within the organization	
	Alam, et. al, 2023	SR43	Recycling waste in safe ways	
	Alam, et. al, 2023	SR44	Providing environmentally friendly products(	

Table 1. *The main and secondary risks of the production process*

Second: The impact of risks on production: Table (2) shows that the risks of the production process will be affected in the short and long term by a number of factors starting from (slowdown in production up to work bottlenecks as a result of poor scheduling), and the influencing factors were identified based on previous studies.

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Impact Risks	code	References
Slow production	RI1	(Diao & Ghorbani, 2018)
Employee stress	RI2	(Diao & Ghorbani, 2018)
Exposure to serious accidents or death	RI3	(Brocal, et. al, 2018)
Exposes the natural environment and human health to deterioration	RI4	(Abdu, 2016)
Difficulty maintaining the flow of materials and products	RI5	(Al-Obaidy, et. al, 2023)
Failure of the technical performance of the product	RI6	(Shah, et. al, 2013)
High price of the product	RI7	(Shah, et. al, 2013)
Delayed delivery of the product to the customer	RI8	(Shah, et. al, 2013)
The production process stops due to equipment downtime	RI9	(Oduoza, 2020)
Poor production flexibility as a result of technology obsolescence	RI10	(Oduoza, 2020)
Customer dissatisfaction as a result of the design deviating from the plan	RI11	(Zhou, et. al, 2023)
Work bottleneck due to poor scheduling	RI12	(Lu, et. al, 2022)

Table 2. *Impact of risks on production*

After identifying the main and secondary risks of the production process, as well as after determining the impact of those risks on the production process, Table (2) was distributed to the committee of experts in various specializations to determine the weights for each factor affecting the production process, as shown in Table (3).

□□□□□□□ □□□□□□□	RI1	RI2	RI3	RI4	RI5	RI6	RI7	RI8	RI9	RI10	RI11	RI12
□□□□□□	0.0843	0.0731	0.0901	0.1012	0.0634	0.0778	0.0843	0.0596	0.0977	0.1122	0.0846	0.0712

Table 3. *Weights determined by experts for the impact of risks on production*

Third: Classification of risks: The application of the ambiguous risk matrix must take place after the process of defining the linguistic terms of the risks, their impact, and the consequences resulting from those risks, as well as after their category has been determined in terms of the impact and consequences resulting from this impact. In this step, reliance is placed on the risks of the matrix. Ambiguous risk classification: Acceptable (1), somewhat acceptable (2), acceptable, unacceptable (3), and unacceptable (4). This classification was adopted as rules for determining the category of each of these risks and the consequences resulting from them, and Table (2) shows) A description of all four categories and the characteristics of each category.

Risk impact		Severity consequences SC		Risk category RC	
Very high VH	(1, 1, 2)	Negligible (N)	(0, 0, 1)	Acceptable 1	(0, 0, 0.5)
High H	(1, 2, 3)	Low L	(0, 1, 2)	Tolerable–acceptable 2	(0, 0.5, 0.7)
Moderate M	(2, 3, 4)	Moderate (M)	(1, 2, 3)	Tolerable–unacceptable 3	(0.5, 0.7, 0.9)
Low L	(3, 4, 5)	High (H)	(2, 3, 4)	Unacceptable 4	(0.7, 0.9, 1)
Very low VL	(4, 5, 6)	Catastrophic (C)	(3, 4, 5)		
Unlikely U	(5, 6, 7)				
Remote R	(6, 7, 7)				

Table 4. *Trigonometric Fuzzy Numbers (TFN) and Linguistic Terms for RI, SC, and RC*

Table (4) will help us in preparing the organic functions for assessing fuzzy risks by embodying this in a graphical chart shown in Figure (2), as the figure indicates the classification of risks into categories (1, 2, 3, 4), where 1 indicates acceptance of the risk and its response. The percentage is (0, 0, 0.5), while 2 indicates acceptance of the risk to some extent and constitutes a percentage (0, 0.5, 0.7), while the classification 3 indicates that the place of the risk is between acceptance and rejection and the percentage is (0.5, 0.7, 0.9). As for the category 4 The risk is

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unacceptable if the ratio is (0.7, 0.9, 1).

As for the serious consequences, when the percentage of consequences is limited to between 1 and 1.5, the result is negligible. When the value of the consequences is limited to between (1.5 - 2), the consequences are low. As for the values (2, 2.5), the consequences are moderate. If the values are between (2.5). 4) The consequences are high, and when the risk score is 5, the impact will be catastrophic. With regard to the impact of risks, the closer the score is to 1, the higher the risk, and the farther it is from zero, the more low the risk is.

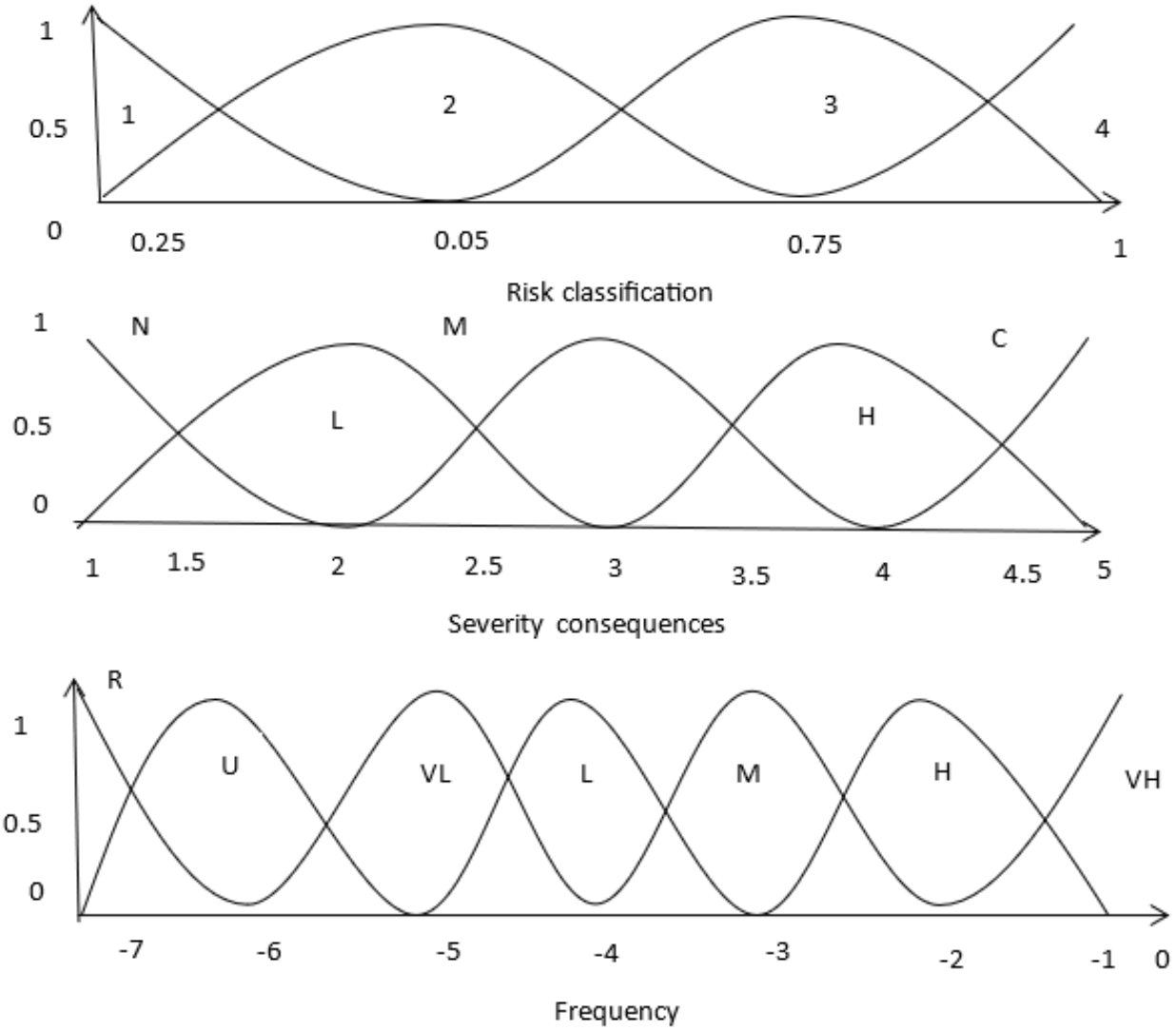

Figure 2. *Membership functions for fuzzy risk assessment*

The fuzzy risk matrix is a risk assessment tool that uses fuzzy logic to evaluate the impact of risks and their consequences, as this stage is considered one of the basic steps of the sustainable business model. Figure (3) shows the risk matrices that will be adopted in determining the relationship between the impact of risks and their consequences and the category of each of these risks. The easy matrix is the one that has a low cost but has fewer layers of protection to provide safety against risks. There is the hard matrix that has a high cost but is safer. As for the standard matrix, it is in the middle between them and is the most widely used. In addition, by combining the different levels of influence and consequences of influence (5*7*4) A total of 140 bases are extracted. However, only 35 out of 140 rules were accepted by experts and adopted (Motevali Haghighi & Torabi, 2020).

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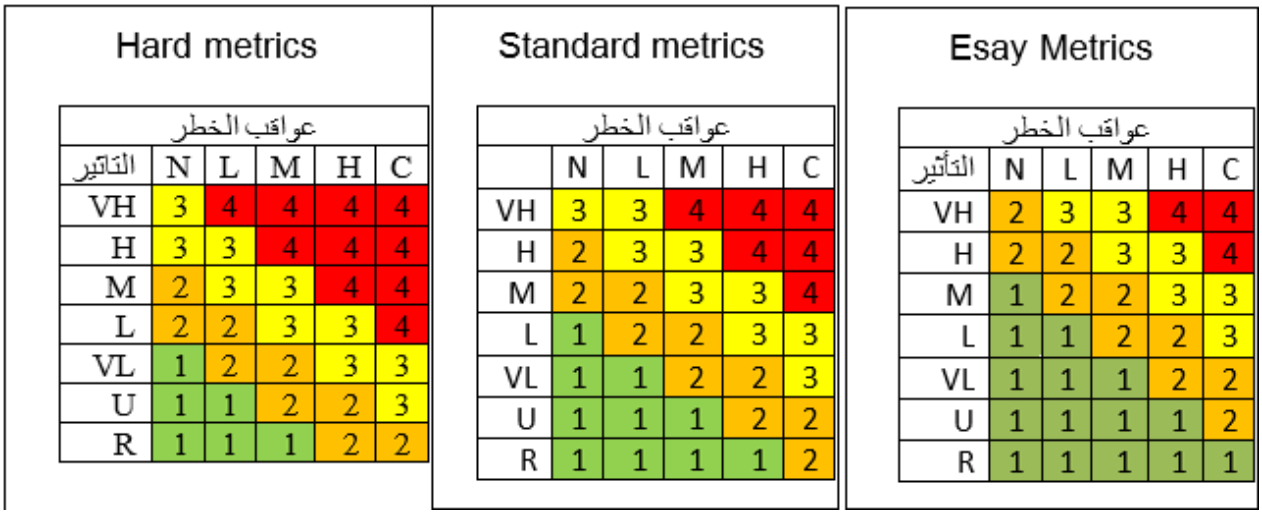

Figure 3. *Identifying risks according to the matrices (easy - standard - difficult)*

Table (5) shows the calculation of the values of the total risks of the production process and its consequences and its impact on sustainable business in production and service business organizations, where the total risks amounted to 74.9%, and the highest total risk was due to (SR 39) with a rate of 66.8%, which is related to scheduling and its consequences on the business, estimated at a rate of 22.9. %, while the total consequences are 26.1%, and to address this matter, matrices must be used (easy, standard, and difficult). It turns out that the easy matrix is able to confront risks by 80.4%, while the standard matrix can address risks by 75.9%, while the difficult matrix has the ability to confront risks. The risks are at a rate of (66.1%), and these results are according to the opinion of experts specialized in the field of production. Thus, we can say that the standard matrix is the best for confronting the risks because its rate is 75%, which is closer to the total risk rate of 74.9%.

Easy	Standard	Hard	consequences	Overall Risk	Sub risk	Easy	Standard	Hard	consequences	Overall Risk	Sub risk
0.581	0.594	0.603	0.201	0.593	SR23	0.123	0.212	0.275	0.091	0.207	SR1
0.534	0.561	0.57	0.19	0.558	SR24	0.099	0.158	0.181	0.060	0.152	SR2
0.472	0.495	0.497	0.165	0.491	SR25	0.099	0.1587	0.203	0.067	0.156	SR3
0.568	0.5861	0.589	0.196	0.583	SR26	0.122	0.215	0.25	0.083	0.205	SR4
0.377	0.399	0.402	0.134	0.395	SR27	0.099	0.185	0.31	0.103	0.191	SR5
0.643	0.665	0.673	0.224	0.662	SR28	0.198	0.284	0.301	0.100	0.272	SR6
0.565	0.587	0.597	0.199	0.585	SR29	0.117	0.207	0.255	0.085	0.200	SR7
0.364	0.376	0.381	0.127	0.374	SR30	0.096	0.158	0.181	0.060	0.151	SR8
0.557	0.575	0.591	0.197	0.574	SR31	0.195	0.257	0.27	0.09	0.248	SR9
0.472	0.554	0.584	0.194	0.545	SR32	0.11	0.195	0.26	0.086	0.191	SR10
0.261	0.293	0.303	0.101	0.289	SR33	0.093	0.1578	0.195	0.065	0.153	SR11
0.251	0.264	0.274	0.091	0.263	SR34	0.182	0.277	0.294	0.098	0.264	SR12
0.6	0.655	0.681	0.227	0.650	SR35	0.102	0.119	0.127	0.0423	0.117	SR13
0.621	0.649	0.659	0.219	0.646	SR36	0.09	0.147	0.222	0.074	0.15	SR14
0.415	0.433	0.443	0.147	0.431	SR37	0.089	0.114	0.128	0.042	0.112	SR15
0.356	0.357	0.36	0.12	0.357	SR38	0.185	0.201	0.215	0.071	0.200	SR16
0.65	0.669	0.687	0.229	0.668	SR39	0.187	0.252	0.289	0.096	0.247	SR17
0.35	0.358	0.365	0.121	0.357	SR40	0.186	0.257	0.261	0.087	0.245	SR18
0.63	0.644	0.656	0.218	0.643	SR41	0.1875	0.272	0.302	0.100	0.262	SR19
0.562	0.573	0.587	0.195	0.5735	SR42	0.384	0.568	0.581	0.193	0.539	SR20
0.275	0.31	0.319	0.106	0.305	SR43	0.483	0.567	0.615	0.205	0.561	SR21
0.601	0.621	0.64	0.213	0.620	SR4 4	0.432	0.505	0.531	0.177	0.497	SR22

Table 5. *Results of the matrices (easy, standard, and difficult) and the overall risks and their consequences according to experts' opinion*

Fourth: Administrative effects and treatment mechanism: The production process is considered the backbone of

any company, so the risks that affect it negatively and on this basis, this study provides a framework to mitigate their effects by providing programs that mitigate the risks inspired by sustainable business that the production process faces, as There are many managerial implications related to the proposed framework, the application of which can improve the performance of the production process. The proposed framework helps executives visualize risks that have devastating effects on the production process and thus proactively develop appropriate procedures.

The proposed framework helps companies anticipate the impacts (Table 2) that could affect them if expected risks occur (Table 1). The proposed framework offers many advantages, most notably the classification of risks in terms of impact and consequences and thus the ability to understand the application of the ISO 22301:2019 standard. On the other hand, companies can benefit from measuring risks in a quantitative way and through three different points of view (soft, standard, and hard), which makes the risk assessment and analysis process more comprehensive and accurate.

The proposed framework is based on three basic stages. In the first stage, risks and the effects of risks on the production process were identified. In the second stage, the risks identified in the first stage were analyzed using several appropriate techniques. In the third stage, the risks were classified according to minimum values. Determine appropriate mitigation plans for each risk category. In addition, the proposed framework provides practical guidance or treatments for companies, as some risks related to information technology can be avoided by organizing training courses and improving the infrastructure, while others require the presence of skilled human resources. Some risks require adopting flexibility in all production activities and diversifying suppliers.

Conclusion

First: Conclusions: The study reached several conclusions:

1. Determine the type of main and secondary risk by classifying risks based on their type, such as technological risks, environmental risks, financial risks, and others.

2. Detect the extent of the impact of risks on the production process using expert opinion according to a low to high scale or symbols to determine the level of impact.

3. Determine the possibility or likelihood of risks occurring. These levels must be low to high, and can usually be calculated by multiplying the effect of risks by the probability of their occurrence. This level is used to rank risks and determine risk management priorities.

4. The tripartite fuzzy risk matrices (easy, standard, and difficult) concluded that the standard matrix is the best for confronting risks, analyzing priorities, allocating resources, and taking the necessary measures to deal with risks effectively.

5. The study revealed the impact of administrative risks on the production process and developed a general framework for how to mitigate their effects by providing programs that mitigate risks inspired by sustainable businesses faced by the production process.

6. The total total risk reached 74.9%, and the highest total risk was due to (SR 39) at 66.8%, which was related to scheduling and its consequences on the business, estimated at 22.9%, while the total consequences were 26.1%.

Second: Recommendations: Based on the conclusions, we present the following recommendations:

a. The need for companies to periodically evaluate potential risks in production operations and develop a plan to analyze and classify risks and determine the extent of their impact and the probability of their occurrence.

b. Working to provide an effective risk prevention system that includes monitoring the quality of the product and raw materials, regular maintenance of equipment, and training employees on safety.

c. Diversify the supply chain by diversifying sources of raw materials and suppliers to reduce the impact of supply chain disruptions. This will help improve the stability of production operations.

d. Work to develop strategies to comply with environmental laws and reduce the environmental impact of operations. This must include improving the efficiency of resource consumption and effective waste management.

e. Searching for sustainable materials and green technology that can be used in production processes, which contributes to reducing the impact of operations on the environment.

f. Developing crisis response strategies that include dealing with various emergency scenarios such as production accidents and environmental disasters.

g. Building collaborative relationships with local and global stakeholders, including non-governmental

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organizations and government agencies, to cooperate in the areas of sustainability and risk management.

h. It encourages a sustainable business culture within the organization as all employees must be committed to contributing to improving the environmental and social performance of the organization.

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