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Review and Evaluation of the Stability of Production and Operations Systems: A Case Study of Mozafariyan Company

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| ARTICLE INFO | ABSTRACT |
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| <p>Article History: Received 2 April 2020 Received in revised form 11 June 2020 Accepted 15 August 2020 Available online 12 September 2020</p> | <p>This research investigates the influential factors on the sustainability of Mozafariyan Company and determines the level of sustainability in the gold, precious stones, and jewelry production and sales industry. Secondary sources, questionnaire results, and the fuzzy Delphi method were utilized for sustainability factors assessment in this industry. Following the fuzzy Delphi method, six factors were selected from the total of 15 primary factors: fair and appropriate pricing, avoidance of competitor and customer annoyance, market exploration and efforts to create jewelry for different customer segments, efforts to improve the livelihood of industry workers, examination and pursuit of ethical principles in production and sales, scrutiny of supplier sourcing methods, and the selection of suppliers attentive to ethical issues such as child labor and human rights. According to experts, the most significant factors influencing the company's sustainability are the investigation and pursuit of ethical principles in production and sales, scrutiny of supplier sourcing methods, and the selection of suppliers attentive to ethical issues. The fuzzy Delphi results indicate a high importance placed by experts on economic business factors, followed by social factors, and lastly, environmental factors. Considering the importance of ethically sound pricing and the establishment of clear rules and regulations to prevent unintended problems from buyers, both individual and legal, and suppliers, it is recommended that companies and unions prioritize this. In this regard, a charter of ethical principles for companies should be defined, established, supervised, and employee training should be conducted to enhance product and service quality.</p> |
| <p>Keywords: Sustainability, Sustainability Assessment, Production and Operations Systems, Fuzzy Delphi, Gold and Jewelry Industry</p> | |

1. INTRODUCTION

The United Nations, in pursuit of the sustainable growth of nations, officially announced the goals agreed upon by various world leaders in a historic assembly on September 15, 2015. These objectives, known as Sustainable Development Goals (SDGs), are the continuation and expansion of the Millennium Development Goals, executed prior to their establishment [1-2]. Their aim is to eradicate all forms of poverty. Sustainable development is defined as meeting the current needs without jeopardizing the ability of future generations to meet their needs. It requires coordinated efforts to build a comprehensive, sustainable, and flexible future for both people and the planet. In the

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face of various global economic challenges, such as the COVID-19 pandemic, the examination of business sustainability, especially in the gold, precious stones, and jewelry production and sales industry, is increasingly emphasized to ensure the businesses' resilience. This industry needs to find a sustainable path to preserve and establish a new position in its survival journey, considering market changes, severe financial problems worldwide, and changes in customer tastes and preferences.

2. LITERATURE REVIEW

While the UN's Sustainable Development Goals are not legally binding, many countries, including Iran, have created national frameworks to achieve the 17 specified goals of the UN [3]. These goals include eradicating poverty, eliminating hunger, ensuring health and well-being, providing quality education, achieving gender equality, ensuring clean water and sanitation, affordable and clean energy, promoting decent work and economic growth, advancing industry, innovation, and infrastructure, reducing inequalities, building sustainable cities and communities, promoting responsible consumption and production, taking climate action, conserving life below water, conserving life on land, promoting strong institutions for peace and justice, and fostering partnerships to achieve the goals. To achieve sustainable development, aligning three essential elements is necessary: economic growth, social growth, and environmental protection. These elements are interconnected, and all these goals are crucial and necessary for creating and maintaining well-being for individuals and societies. Figure 1 illustrates the components contributing to observable sustainable development [4].

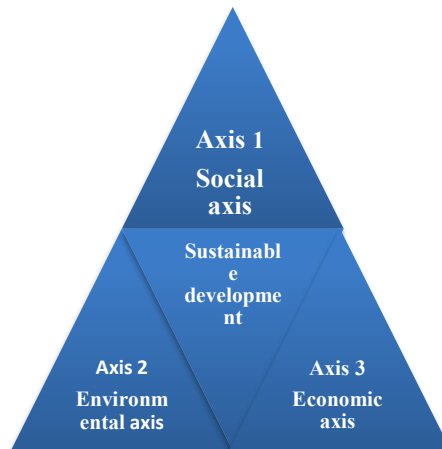


Fig. 1. Sustainable development axes

In the jewelry industry, attention must be paid to the sustainable use of natural resources for jewelry production, the current situation, and the future scarcity of precious metals related to the jewelry trade [5]. Natural resources are limited, and thus, finding innovative designs and production methods to reduce waste, reuse products, and obtain raw materials from alternative sources while leaving a positive ecological footprint is crucial for businesses. To better understand and identify the factors influencing the sustainability of jewelry production and sales businesses, the next section examines secondary resources.

In the quest to find the factors influencing sustainability in organizations, a review of previous research was conducted. Keywords such as "Sustainab*," "Factors affecting sustainab*," and "jewelry" were searched on platforms like Google Scholar, Web of Science, and Emerald. Initially, 58 articles were identified, and after examination by the research team, 13 relevant ones (as listed in Table 1) were selected. Subsequently, by reviewing each of these articles, it was determined in which sustainability domain they were written, the sustainability criterion specified in the article, and the industry under study were also identified.

Table 1. Review of Literature and Preliminary List of Sustainability Factors

| No. | Researcher | Year | Sustainability Domain | Criteria Identified in the Study | Industry Examined |
|-----|----------------|------|---------------------------------|---|------------------------|
| 1 | Tuo & Chan [6] | 2020 | Economic, Environmental | Use of renewable energy, maintenance and repair services, modular product design, recovery mechanisms, virtual online purchasing platforms, 3D printing technologies, and customer bargaining | Jewelry industry |
| 2 | Galli [7] | 2020 | Economic, Environmental, Social | Application of GSI standards for measuring business sustainability | Luxury goods |
| 3 | Pinroy [8] | 2020 | Environmental | Selection of raw materials with minimal waste and optimal efficiency | Jewelry industry |
| 4 | Bora [9] | 2019 | Economic | Improvement of livelihood conditions | Jewelry industry |
| 5 | Khoram [10] | 2019 | Economic | Cost reduction and prevention of unethical competition | Manufacturing industry |
| 6 | Ahmad [11] | 2019 | Economic, Environmental, Social | Raw materials used in products, energy and chemical consumption, cost and profit, employee rights, living conditions, community health | Food industry |
| 7 | Lerma [12] | 2018 | Environmental | Type of raw materials and gemstones used in jewelry | Jewelry industry |
| 8 | Palma [13] | 2018 | Environmental, Economic | Existence and implementation of corporate sustainability strategies | Jewelry industry |
| 9 | Gardini [14] | 2018 | Economic | External governmental factors and internal organizational factors | Public organizations |
| 10 | Amatulli [15] | 2017 | Economic, Environmental | Accuracy in fair pricing, use of sustainable raw materials | Luxury goods |
| 11 | Keller [16] | 2017 | Social | Establishment of new sets of criteria, rules, and certifications for jewelry; sustainability education | Jewelry industry |
| 12 | Musiarira [17] | 2017 | Social | Evaluation of workers' livelihood and occupational safety in gemstone mines | Mining industry |
| 13 | Ferrara [18] | 2016 | All aspects | Child labor, environmental degradation, social inequality | Jewelry industry |

With precision in the targeted industry, consultation with experts, and a review of the repeated factors mentioned in the articles to shape the initial questionnaire, the factors listed below were recognized as primary factors from the literature for investigating the sustainability of companies active in the industry. Given the conducted search and considering the industry's relevance, expert opinions, and literature review, we identified the factors effective in the sustainability of businesses. These items are visible in the "Criteria specified in the article" column in Table 2. In this section, the final criteria were selected based on their repetition in the table and the importance of each criterion, as assessed by the experts.

Table 2. Appropriate Sustainability Criteria for the Jewelry Manufacturing and Sales Business

| Sustainability Domain | Relevant Criteria for the Jewelry Manufacturing and Sales Business |
|-----------------------|---|
| Economic | Energy conservation, adoption of new technologies, life-cycle costing, market segmentation, fair and reasonable pricing, and prevention of bargaining or obstruction by competitors and customers. |
| Environmental | Reduction of environmentally harmful waste, careful selection of suitable gemstones, green production, and measurement of pollutants. |
| Social | Ensuring proper livelihood for employees, monitoring suppliers’ production methods to prevent child labor and forced labor (modern slavery), promoting national branding, entrepreneurship and employment, education, and ethical production practices. |

The initial factors are presented in Table 3.

Table 3. Title and Code of Initial Factors

| Factor Code | Factor Description |
|-------------|---|
| C1 | Fair and reasonable pricing, and prevention of bargaining or obstruction by competitors and customers. |
| C2 | Energy conservation for the sustainability of businesses in this industry. |
| C3 | Precision in production methods and selection of gemstones that do not harm nature. |
| C4 | Senior management’s attention to green production practices and prevention of environmental pollution. |
| C5 | Measurement and reduction of pollutants generated by production and services. |
| C6 | Use of modern technologies such as artificial intelligence and 3D printing to reduce gold and jewelry waste. |
| C7 | Utilization of domestic resources in Iran and production of jewelry under a national (Iranian) brand. |
| C8 | Prohibition of importing pre-manufactured jewelry. |
| C9 | Product life-cycle assessment and costing. |
| C10 | Market research and creation of jewelry collections for various customer segments. |
| C11 | Establishment of factories for manufacturing and producing high-value gold and jewelry items. |
| C12 | Expansion of training and education programs in luxury jewelry manufacturing. |
| C13 | Efforts to improve the livelihood of employees in this industry. |
| C14 | Adherence to ethical principles in jewelry production and sales. |
| C15 | Evaluation of suppliers’ production practices and selection of suppliers committed to ethical issues such as avoiding child labor and ensuring employees’ human rights. |

3. RESEARCH METHOD

To familiarize ourselves with the fuzzy Delphi method, which we employ in this article, explanations are provided in this section. The Delphi method is a multi-stage iterative process designed for group consensus building. In the first round of this method, after receiving responses from experts, the data is summarized. In the second round, a new questionnaire is designed based solely on the results obtained from the first round. The second questionnaire is returned to each of the experts, and they are asked to reconsider their initial opinions (based on the results of the first round) and provide their responses once again to the researcher. Iterative rounds of this process are repeated until reaching a consensus or a point of diminishing returns [19].

To select experts for collaboration in filling out the created questionnaire, criteria were defined based on the factors in Table 3. Conditions for demonstrating expertise were defined so that the questionnaire could be sent to experts who have the competence to answer the questionnaire's questions (Table 4).

Table 4. Expert Qualification Criteria

| No. | Criterion | Threshold |
|-----|--------------------|---|
| 1 | Academic Education | Diploma and above for factory managers; bachelor’s degree and above for technical experts |
| 2 | Age | 35 years |
| 3 | Work Experience | 15 years |
| 4 | Position and Role | Experts, senior managers, and owners of manufacturing companies |

Based on the above qualification criteria, as well as the accessibility of potential participants (using quasi-judgmental and snowball sampling), and after excluding individuals unwilling to participate, the following participants were selected as experts for completing the research questionnaire.

Their demographic and professional details are presented in Table 5.

Table 5. Selected Experts

| No. | Expert Code | Criterion 1 (Education) | Criterion 2 (Age) | Criterion 3 (Work Experience) | Criterion 4 (Position) |
|-----|-------------|--|-------------------|-------------------------------|----------------------------------|
| 1 | E1 | M.Sc. – Certified Judicial Expert in Watches and Jewelry | 40 | 18 | Manager |
| 2 | E2 | M.Sc. in Auditing | 35 | 15 | Gold and Jewelry Factory Manager |
| 3 | E3 | High School Diploma (Old System) | 68 | 22 | Workshop Owner |
| 4 | E4 | High School Diploma | 56 | 26 | Complex Manager |
| 5 | E5 | B.A. in Accounting | 45 | 22 | Business Manager |
| 6 | E6 | Ph.D. in Economics | 50 | 25 | Gallery Owner |
| 7 | E7 | Humanities | 68 | 35 | Business Owner |
| 8 | E8 | M.Sc. in Accounting | 42 | 15 | Business Manager |
| 9 | E9 | B.A. in Political Science | 45 | 16 | Business Manager |
| 10 | E10 | B.A. in Humanities | 63 | 29 | Business Manager |

At this stage, three experts from the jewelry manufacturing and sales sector—those with the highest levels of formal education and professional expertise—evaluated the designed questionnaire to confirm its face validity.

To assess its reliability, the test–retest method was employed. Specifically, the questionnaire items were duplicated in an online survey system and redistributed to seven experts who were accessible for follow-up. However, due to time constraints, only three experts completed the questionnaire again.

Using SPSS software, the correlation coefficient between the first and second responses was calculated. The obtained correlation coefficient was $r = 0.84$ ($p = 0.000$), which indicates high reliability, as values above 0.7 are considered acceptable.

The results of the reliability assessment are presented in Table 6.

Table 6. Reliability Assessment

| Average of the second series | Average of the first series | Final Evaluation | | |
|------------------------------|-----------------------------|-------------------------|------------------------------|----------------|
| 0.841 | 1.000 | Correlation coefficient | Average of the first series | Spearman index |
| 0.000 | . | Sigma (bidirectional) | | |
| 15 | 15 | Number | | |
| 1.000 | 0.841 | Correlation coefficient | Average of the second series | |
| . | 0.000 | Sigma (bidirectional) | | |
| 15 | 15 | Number | | |

For comparing the factors, seven linguistic expressions were used: Very Important, Important, Fairly Important, Moderate, Fairly Unimportant, Unimportant, and Not Important.

Numerical values from 1 to 7 were assigned to these linguistic terms (1 = Not Important, 7 = Very Important). For the Fuzzy Delphi analysis, corresponding triangular fuzzy numbers were assigned to each linguistic term. For

example, Very Important was represented by the fuzzy number (1, 1, 0.9), while the others were defined accordingly, as shown in Table 7.

Table 7. Linguistic Variables and Corresponding Crisp and Fuzzy Numbers

| Fuzzy numbers | | | Definite numbers | Linguistic propositions |
|---------------|------|------|------------------|---------------------------|
| b | m | a | | |
| 1 | 1 | 0.9 | 7 | Very Important |
| 1 | 0.9 | 0.75 | 6 | Important |
| 0.9 | 0.75 | 0.5 | 5 | Approximately Important |
| 0.75 | 0.5 | 0.3 | 4 | Ordinary |
| 0.5 | 0.3 | 0.1 | 3 | Approximately Unimportant |
| 0.3 | 0.1 | 0 | 2 | Unimportant |
| 0.1 | 0 | 0 | 1 | Unimportant |

4. RESULTS

After completing the survey stages, the experts’ responses reached a final consensus. The scores assigned by the experts to each factor ranged from 1 to 7. At this stage, the collected data were entered into the Fuzzy Delphi table according to the corresponding triangular fuzzy numbers.

Using the triangular fuzzy numbers to record expert opinions, the defuzzified final values are presented in Tables 8 and 9. If the final defuzzified value of a factor is less than 0.7, it is considered insignificant from the experts’ perspective. Conversely, if the value is above 0.7, the factor is regarded as important. The results of the fuzzy Delphi calculations are shown below.

Due to the large volume of data, the responses of the first to fifth experts are presented in Table 8, followed by those of the sixth to tenth experts in Table 9.

Table 8. Opinions of Experts 1–5 Based on Triangular Fuzzy Numbers

| Expert 5 | | | Expert 4 | | | Expert 3 | | | Expert 2 | | | Expert 1 | | | Operator code |
|----------|------|-----|----------|------|-----|----------|------|-----|----------|------|-----|----------|------|-----|-----------------|
| b | m | a | b | m | a | b | m | a | b | m | a | b | m | a | |
| 1 | 1 | 0.9 | 0.75 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | C ₁ |
| 0.1 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | C ₂ |
| 0.1 | 1 | 1 | 0.9 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | C ₃ |
| 0.1 | 0.5 | 0.3 | 0.1 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | C ₄ |
| 0.5 | 0.75 | 0.5 | 0.3 | 0.75 | 0.5 | 0.3 | 0.75 | 0.5 | 0.3 | 0.75 | 0.5 | 0.3 | 0.75 | 0.5 | C ₅ |
| 0.1 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | C ₆ |
| 0.1 | 1 | 1 | 0.9 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | C ₇ |
| 1 | 0.3 | 0.1 | 0 | 0.5 | 0.3 | 0.1 | 0.5 | 0.3 | 0.1 | 1 | 1 | 0.9 | 1 | 1 | C ₈ |
| 1 | 0.5 | 0.3 | 0.1 | 0.5 | 0.3 | 0.1 | 0.5 | 0.3 | 0.1 | 0.5 | 0.3 | 0.1 | 1 | 1 | C ₉ |
| 1 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | C ₁₀ |
| 0.1 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | C ₁₁ |
| 1 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | C ₁₂ |
| 1 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | C ₁₃ |
| 1 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | C ₁₄ |
| 1 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | C ₁₅ |

Table 9. Opinions of Experts 6–10 Based on Triangular Fuzzy Numbers

| Expert 10 | | | Expert 9 | | | Expert 8 | | | Expert 7 | | | Expert 6 | | | Operator code |
|-----------|-----|------|----------|------|------|----------|-----|------|----------|------|------|----------|-----|------|-----------------------|
| b | m | a | b | m | a | b | m | a | b | m | a | b | m | a | |
| 0.75 | 0.5 | 0.3 | 0.8 | 0.5 | 0.3 | 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | C₁ |
| 0.75 | 0.5 | 0.3 | 0.8 | 0.5 | 0.3 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | C₂ |
| 0.75 | 0.5 | 0.3 | 0.8 | 0.5 | 0.3 | 0.8 | 0.5 | 0.3 | 0.5 | 0.3 | 0.1 | 0.5 | 0.3 | 0.1 | C₃ |
| 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | 0.75 | 0.5 | 0.3 | 0.8 | 0.5 | 0.3 | C₄ |
| 0.5 | 0.3 | 0.1 | 0.5 | 0.3 | 0.1 | 1 | 0.5 | 0.5 | 0.3 | 0.1 | 0.1 | 0.1 | 0.3 | 0.1 | C₅ |
| 0.5 | 0.3 | 0.1 | 0.1 | 0.5 | 0.3 | 0.1 | 0.5 | 0.3 | 0.1 | 0.75 | 0.5 | 0.3 | 0.8 | 0.5 | C₆ |
| 0.75 | 0.5 | 0.3 | 0.5 | 0.75 | 0.5 | 0.3 | 0.3 | 0.1 | 0.5 | 0.3 | 0.1 | 0.5 | 0.3 | 0.1 | C₇ |
| 1 | 0.9 | 0.75 | 0.8 | 0.5 | 0.3 | 0.8 | 0.5 | 0.3 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | C₈ |
| 0.5 | 0.3 | 0.1 | 0.5 | 0.3 | 0.1 | 0.5 | 0.3 | 0.1 | 0.5 | 0.3 | 0.1 | 0.5 | 0.3 | 0.1 | C₉ |
| 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | C₁₀ |
| 1 | 0.9 | 0.75 | 0.8 | 0.5 | 0.3 | 0.8 | 0.5 | 0.3 | 0.3 | 0.1 | 0 | 0.3 | 0.1 | 0 | C₁₁ |
| 0.75 | 0.5 | 0.3 | 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | C₁₂ |
| 0.75 | 0.5 | 0.3 | 0.8 | 0.5 | 0.3 | 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | C₁₃ |
| 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | 1 | 1 | 0.9 | C₁₄ |
| 1 | 0.9 | 0.75 | 1 | 0.9 | 0.75 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | 1 | 1 | 0.9 | C₁₅ |

In Table 10, the columns for averages and defuzzified numbers are provided. As mentioned, if the defuzzified numbers for each row corresponding to one of the factors are less than 0.7, that particular factor will not be selected for the next stage.

Table 10. Results of Defuzzified Values for the Factors

| Decision | Defuzzified numbers | Average | | | Operator code |
|-----------------|---------------------|---------|-----------|------|-----------------------|
| Agent selection | 1.009624261 | 1 | 0.8346243 | 0.3 | C₁ |
| Agent rejection | 0.52529226 | 1 | 0.2752923 | 0 | C₂ |
| Agent rejection | 0.504164711 | 1 | 0.2541647 | 0 | C₃ |
| Agent rejection | 0.547700031 | 1 | 0.2977 | 0 | C₄ |
| Agent rejection | 0.590189581 | 1 | 0.3651896 | 0.1 | C₅ |
| worker reply | 0.355419049 | 0.5 | 0.230419 | 0 | C₆ |
| worker reply | 0.501500877 | 1 | 0.2515009 | 0 | C₇ |
| worker reply | 0.589345819 | 1 | 0.3393458 | 0 | C₈ |
| worker reply | 0.563383462 | 1 | 0.3383835 | 0.1 | C₉ |
| Agent selection | 1.011183298 | 1 | 0.9486833 | 0.75 | C₁₀ |
| Agent rejection | 0.522406993 | 1 | 0.272407 | 0 | C₁₁ |
| Agent selection | 1.088577726 | 1 | 0.9135777 | 0.3 | C₁₂ |
| Agent selection | 1.018464393 | 1 | 0.8434644 | 0.3 | C₁₃ |
| Agent selection | 1.021231516 | 1 | 0.9587315 | 0.75 | C₁₄ |
| Agent selection | 1.041648362 | 1 | 0.9791484 | 0.75 | C₁₅ |

As presented in Table 10, factors with a defuzzified value below 0.7 were excluded from the next stage, indicating insufficient importance according to experts. Conversely, factors with defuzzified values above 0.7 were retained, demonstrating their perceived significance for sustainability in the jewelry manufacturing and sales business. Consequently, factors C1, C10, C12, C13, C14, and C15 were selected for further analysis based on expert consensus.

Accordingly, factors C1, C10, C12, C13, C14, and C15 were identified as the most influential variables contributing to sustainability from the experts’ perspective.

The final list of these selected factors, ranked by their defuzzified values, is shown in Table 11.

Table 11. Final Selected Factors and Their Rankings Based on Expert Opinions

| Factor Code | Sustainability Domain | Factor Description | Defuzzified Value | Rank |
|--------------------|------------------------------|---|--------------------------|-------------|
| C1 | Economic | Fair and appropriate pricing; absence of bargaining obstacles and unfair competition from rivals or customers | 1.0096 | 1 |
| C10 | Economic–Social | Market research and efforts to design jewelry suitable for different customer segments in society | 1.0112 | 2 |
| C13 | Social | Efforts to improve the livelihood of workers in this industry | 1.0185 | 3 |
| C14 | Social–Environmental | Adherence to and promotion of ethical principles in production and sales | 1.0212 | 4 |
| C15 | Social–Environmental | Evaluation of suppliers and selection of those who respect ethical issues such as avoiding child labor and ensuring human rights in the workplace | 1.0416 | 5 |
| C12 | Social | Expansion of training in the production and manufacture of fine jewelry | 1.0886 | 6 |

4. DISCUSSION AND CONCLUSION

The results of the fuzzy Delphi method demonstrate that, considering the defuzzified numbers and factor rankings, fair and appropriate pricing, avoidance of manipulation and collusion with competitors and customers, market analysis, and efforts to create jewelry for different customer segments are the top factors influencing the sustainability of businesses in the jewelry industry. Additionally, efforts to improve the livelihood of industry workers, adherence to ethical principles in production and sales, scrutiny of supplier production methods, and selection of suppliers attentive to ethical issues like child labor and human rights are recognized as crucial factors by experts.

The results highlight the high importance placed by experts on economic factors in business. Subsequently, social factors and, finally, environmental factors are considered of secondary importance. The categorization of these factors and their defuzzified numbers are provided in Table 11. In terms of attention to significant factors, the results of this research are similar to studies by Fernandez [18], Musyariara [17], and Gali et al. [7], as indicated in Table 1 in the factors' analysis section.

These findings underscore the paramount importance of fair and appropriate pricing, and the avoidance of manipulation and collusion with competitors and customers. In many instances, both sellers and buyers face challenges arising from the lack of fairness in pricing, leading to issues. Awareness among sellers about ethical pricing methods and buyers' knowledge about the laws and customs in this industry for buying, selling, and repurchasing goods can help address these challenges. Market analysis and efforts to create jewelry for various customer segments have been identified as the second most crucial factor, indicating the importance and necessity for businesses in the industry to pay attention to different market segments and the changing preferences of modern buyers. In this regard, innovative branding and alignment of products with the tastes of different segments of society are required.

Efforts to improve the livelihood of industry workers contribute to the industry's survival, continuous job stability, and having loyal employees in an industry where trust is crucial. Examining and following ethical principles in production and sales, shaping an ethical charter, and pursuing it at the organizational level are essential. Investigating supplier production methods and selecting suppliers attentive to ethical issues such as child labor and human rights are highly important. Producers, considering buyer preferences, need to align themselves with ethical standards to have satisfactory sales. The expansion of education in the production and manufacture of high-value gold and jewelry is considered one of the most critical factors by experts. Businesses in this industry must apply principles of education and promote learning among employees for the production of high-quality products, superior service delivery, and the establishment of suitable internal and external relationships.

In conclusion, it should be emphasized that the importance of ethical pricing and the establishment of clear principles and regulations to prevent unintended problems from buyers and suppliers should be prioritized in the agenda of companies and associations. In this regard, a charter of ethical principles for companies should be defined and implemented, with ongoing monitoring and training of employees and managers for quality improvement of goods and services.

Transparency Statement

The data supporting this study are available upon reasonable request to the corresponding author, subject to ethical and confidentiality considerations.

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Declaration of Interest

The authors declare that they have no competing interests.

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