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Research Paper

Study of Ranking Factors Affecting the Implementation of Timely Management of Goods and Equipment and its Evaluation Criteria in the Power Distribution Company of the Whole Country Using Fuzzy AHP and Fuzzy Dematel

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ABSTRACT

The objective of this study was to investigate the prioritization of factors that affect the implementation of timely management of goods and equipment, along with its evaluation criteria within the nationwide power distribution company, using Analytic Hierarchy Process (AHP). Five dimensions, including production technical factors, managerial level management factors, factors related to IT processes and infrastructure, process-related factors, and factors related to training and manpower, were identified and formed the research hierarchical tree. Based on the expert opinions within this framework, the study explored the interactions between these dimensions regarding the timely management of goods and equipment. To assign weight to these dimensions, a combined approach of fuzzy AHP and fuzzy DEMATEL was employed. The dimensions were found to influence and be influenced by each other, with the factors related to IT processes and infrastructure being part of the influential or expressive dimensions that affect other aspects.

1 Introduction

Today, companies, as an integral part of the supply chain, must compete with each other for greater market share. Although supply chain management is conceptually attractive, it is strategically difficult. Successful supply chain management requires the internal and external integration of business processes across the supply chain. [13] Achieving competitive advantage also depends on the ability of management to coordinate the complex communication network in the supply chain [14]. Because the strength of buyer-seller relationships is critical to the success of supply chain management, it is important to adopt strategies that strengthen these relationships, and the use of JIT can be helpful in this regard. Today, in terms of economic constraints, development and complexity of markets, optimal use of available resources and timely recognition and response to customer demands in different market segments has become inevitable and has led organizations to eliminate structures and Traditional working methods maintain their market share [4]. Timely production system is a comprehensive system for controlling production inventories. In this system, no inventory of raw materials is purchased and no products

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are made except when necessary. This system is primarily focused on reducing costs by eliminating warehouse inventory. In other words, the system of timely production is a new thinking and attitude in the management of industrial organizations that seeks to eliminate waste and increase productivity in all activities with special principles, techniques and methods. Inside and outside the organization [7]. In traditional production systems, inventories of raw materials and parts, semi-finished goods and ready-to-sell goods are stored and maintained to protect against the unavailability of the required items. Be. But in recent years, managers of industrial units have realized that maintaining safety inventories comes at a significant cost. Because maintaining inventory consumes valuable resources and creates hidden costs. Therefore, many production units in industrialized countries have changed the way they produce and manage their inventories and have implemented a new strategy to control the flow and production process, which is called timely inventory management [24].

In this strategy, raw materials and parts are purchased or manufactured when required at different stages of the production process. This way of producing and managing inventories has resulted in significant cost savings due to the reduction of inventory levels. Likewise, the semi-finished goods required in each stage of production are not produced before they are needed in the next stage. Manufactured goods are also produced when it is necessary to meet customer orders) Inventory management in the timely management system of goods and equipment is based on the fact that the amount of inventories, including materials, Work during the construction of manufactured attorneys should be kept as low as possible "even at zero" as much as possible [20]. Materials should be received from material sellers only when needed. The amount of production should be chosen in such a way as to prevent labor from occurring during production "which depends on the speed of production as explained in the next section" Finally, if production is based on customer demand, "production management" never has inventory of manufactured goods We will not have [9]. The successful implementation of timely management of goods and equipment at the time of the significant benefits, including the reduction of inventory of raw materials, goods during the manufacture of manufactured goods; In this way, this reduces the space required as well as indirect costs, such as the cost of warehousing. This system increases the products and timely delivery of the product to the customer, which creates a good relationship between the company and customers. Reducing manufacturing delays and increasing productivity are other important benefits of timely management of goods and equipment.

A prerequisite for success in the timely management of goods and equipment while having sufficient human capital, as well as the implementation of Theory Z to manage work. Theory z explained by William Ochi; It includes a series of principles that include collective decision-making based on the worker, absolute trust between workers as well as between workers and management, informal control of the worker, clearly define responsibilities and insure workers in the long run. These terms and conditions place restrictions on the use of timely management of goods and equipment. Effective implementation of timely management of goods and equipment when needed requires that workers are well trained and have the necessary skills and competencies to perform the responsibilities assigned to them. Timely system not only requires broader skills, but also teamwork and coordination of individuals, because there are not enough resources to deal with the problems that arise. Therefore, the whole production system must be more closely coordinated by the workers. Deployment of equipment and devices in the system at the time, should be appropriate deployment because inventory is maintained at the workshop level, not in warehouses and between the implementation process of a system that can manage goods and equipment and materials in the case Provide the company with the need to be able

to fulfill its obligations. All of this requires a system that can provide goods and equipment to the company. Implementing production on time requires tools and techniques that are our weapons in the fight against waste. Due to the breadth and dispersion of these techniques, it is not easy to classify them into separate groups. A division method is as follows:

1- Timely techniques within the organization: change the activities of the organization to timely processes

2- Inter-organizational timing techniques: Expansion of timely systems to customer-supplier relationships.

3- Complementary mechanisms: systems, methods and policies that support timely production.

Another method of division is as follows.

Timely production: deals with an organization's readiness to compete. The goal is to provide a flexible, low-cost, short-term service system.

On-time production: Deals with services based on the ideal goal of on-time production / TQ, ie services at the moment completely and without waste.

The main question that the researcher seeks to answer in this study is to first identify the effective factors and then to study the ranking of effective factors on how to implement timely management of goods and equipment in a timely manner (Just in time) and Analyze its evaluation criteria in the National Power Distribution Company using AHP. This research is also innovative from several perspectives:

1) Identify models and theories related to the research topic in order to better understand the concepts related to the timely management of goods and equipment in a timely manner

2) The results of this research can lead to the development of accounting literature in the field of the role of management accounting theories.

Logistics is defined as a set of tasks such as packaging, warehousing and distribution of goods during the process of transporting goods from seller to buyer [11]. From the past to the present, the issue of optimal allocation of goods to warehouses and warehouses to customers, it has been one of the most fundamental issues in the supply chain. In general, the concept of supply chain management is formed around the company's customer-centric perspective, which creates changes across a company's internal and external links [3]. In today's market, customer satisfaction with products and services is critical to the business. Among the factors of service quality, we can mention the delivery time. Delays in the delivery of services or goods may lead to a loss of market share. Due to rapidly changing customer priorities, customer orders are increasingly characterized by higher product diversity, smaller order sizes, and shorter response times. [19] From a global market perspective, it does not matter where the product is produced, but how much time and money is spent on transportation and logistics operations. It costs. Shipping costs often account for a large portion of the total cost of a product, especially for relatively small value products. The allocation of goods is related. One of the methods that companies use to increase the speed of delivery of goods to customers on a large geographical scale is the use of decentralized warehouses. Each of these warehouses can provide services on their own, and in many cases there is no need to provide goods or services from the central warehouse. In general, network design decisions include determining the location of facilities, their role and capacity, and allocating them to different resources and markets. All of these issues have a significant impact on flexibility, efficiency, and consequently supply chain performance [25]. In today's competitive markets, customer satisfaction is critical to business. New challenges in customer satisfaction include the delivery of goods or services on time and without delay, routing. Transportation means in delivering customer orders, selecting and allocating orders in connected warehouses, modeling and solving allocation models at the

right time for multiple and multi-product warehouses, and clustering orders and products in multiple warehouses. In transportation system, one warehouse is often Is a bottleneck that increases total delivery costs; As a result, if product allocation planning is done randomly, it may increase the distance of selecting products with higher demand, leading to a loss of time, an increase in the number of employees required, and an increase in the use of means of transportation [28]. And warehousing is one of the key challenges in developing a successful supply chain system. While some effective strategies for selecting warehouse location have been identified by experts based on their experience, the emergence of new supply chain data collection methods has created a new pattern for warehouse location selection [12].

2 Research Background

[22] proposed an innovative clustering algorithm to optimize product batch allocation across multiple warehouses based on the distribution of multi-item orders. In an online supermarket, people may buy several items for convenience or to earn free delivery points. Multi-item customer orders often have to be divided into several shipments; Because custom items may be stored in different warehouses. Splitting the order leads to higher shipping costs. [15] Research The problem of product allocation in the warehouse has been solved using artificial neural networks and clustering. Customer order selection list was prepared and analyzed to be used as input data in artificial neural network and clustering. [21] research presents the application of a storage allocation model in a food company by considering several products in a defined time horizon. This algorithm identifies the area of operation and the corresponding spaces required for product allocation in order to reduce material storage and handling costs; As a result, planning produces the allocation of products in each period, which reduces planning, storage and relocation costs in the warehouse. An important decision in the planning of facilities and operations is the design and dynamic allocation of storage spaces, which can be done using mathematical techniques and creates the allocation of various items in specific spaces to warehouses.

The quadratic allocation method is used to model product allocation and involves assigning a set of elements to a set of spaces when the distances between all locations and the flow of products are known. [26] presents a special solution to the problem of warehouse locations based on the application of genetic algorithms. The main purpose is to show the location of the warehouses from those that already exist. [1] in a study investigated a combined data mining algorithm and data-driven supply chain modeling to allocate goods to warehouses and provide warehouse services to customers. In this study, a combined solution based on data mining and model Mathematical instrumentation is used to manage the variety of goods and the number of customers. It has been suggested that mathematical models solve allocation with high accuracy in less time. This method is implemented by "Digi Kala" data. [30] in a study examined the impact of company strategy, political costs and management power on the timeliness of financial reporting. The findings showed that in relation to the impact of corporate strategy, only competitive strategies and corporate strategy with respect to future information will increase the timeliness of financial reporting. The findings also show that systematic risk and firm size reduce and increase the timeliness of financial reporting, respectively. According to the research results, it can be claimed that management ability, one of the indicators of management power, has a significant effect on the timeliness of financial reporting and a higher ability increases the timeliness of financial reporting. [31] in a study examined the ranking of levers of JIT production system by DEMATEL method (Case study: Complex of steel industry factories in Bonab city). This research is applied in terms of purpose and descriptive survey in terms of method. The statistical population of this research is the

complex of steel industry factories in Bonab city. A questionnaire and library and field studies were used to collect data. In order to analyze the data and rank the criteria, the DEMATEL multi-criteria sampling technique was used. According to the results of this study, the levers of production control and planning, process technology, control and organizational structure, human resources, suppliers and facilities are important, respectively.

[32]in a study examined the process model of improving the company's financial performance based on timely production, agility and total quality management. The results of this study and analysis showed that timely production system has a greater impact on financial performance and total quality management; But it has no effect on operational performance. In addition, the findings indicated that TQM affects organizational agility and operational performance, as well as operational performance and organizational agility affect logistics performance, and finally, logistics performance has a greater impact on financial performance.

3 Research Target

The purpose of the research is to find out what the nature of the problem is, why it arose and how it can be addressed.

Thus, this study, which was formed in the mind of the researcher with the concern of implementing timely management of goods and equipment in time, calculating the importance and ability to monitor timely management of goods and equipment in time, dimensions, components and indicators, in the form of a question. The following can be proposed:

- What are the necessary factors related to the implementation of timely management of goods and equipment?

Therefore, it can be said that the purpose of conducting research is to find appropriate answers to the above questions. How to place the dimensions, components and key indicators of timely management of timely goods and equipment monitoring at each level of the model can indicate the map and path of timely management of goods and equipment timely monitoring. Therefore, the objectives of this research can be stated as follows:

- Compilation of a set of concepts and dimensions of timely management of goods and equipment in time: In order to compile the components and indicators of timely management of goods and equipment based on a review of research literature for the country's electricity industry, in the first place should be comprehensive and complete knowledge about it Industry to exist. Therefore, the first goal of research is to identify and separate the concepts and dimensions of timely management of goods and equipment in a timely manner.
- Development of components of timely management model of goods and equipment in a timely manner: After determining the dimensions of monitoring of timely management of goods and equipment in a timely manner, the components of timely management of goods and equipment are identified. This step paves the way for determining the indicators of timely management of goods and equipment at the time of each component.
- Determining barriers to timely management of goods and equipment at the level of each component: To monitor the timely management of goods and equipment at the level of each component, barriers such as high costs, lack of benefits over management monitoring costs to When

goods and equipment are in that component, there is the impossibility of making human judgments by computer, or the lack of data needed to perform the evaluation, the identification of which is one of the goals of this research.

. Develop an evaluation tool or guidance model for the management and other effective elements in the timely management of goods and equipment during the organization of companies that intend to establish or improve the timely management of goods and equipment in a timely manner. Once established, the timely monitoring model of goods and equipment will be provided to the relevant units and other stakeholders of the management process as a self-assessment tool so that they can always benchmark themselves with an optimal and predetermined model. Determine themselves and determine future actions for continuous improvement. Obviously, this tool can be provided to companies that intend to create a system for timely management of goods and equipment in accordance with the level of their various factors, or measure its level to determine and implement corrective measures. Therefore, this research is applied research in terms of purpose.

4 Research Method

In the Delphi method, members of the community must have extensive expertise, experience and knowledge in the relevant field and the desire to participate in research. For this purpose, questions prepared with experts with more than 5 years of experience in the electricity industry in this study of the statistical community, all managers and experts working in the departments of national deputy and support, head of warehouses, management of program and project control, deputy Before starting, by explaining that the Delphi process may take several rounds, the consent of individuals to participate in the research process was obtained. These people through homogeneous qualitative sampling method as members of the panel group. were chosen. In this sampling method, the researcher selects his / her samples with the aim of gaining deep, focused and detailed knowledge from among those who have experienced this phenomenon and can provide a lot of information to the researcher. Some argue that the fuzzy Delphi method saves research time and money because traditional Delphi requires multiple cycles to reach consensus; However, the fuzzy Delphi process makes it possible to reach a consensus in one round. Some say 15 experts are enough for Delphi; This number is adjusted according to the percentage of experts expected to fall during the research process, and if necessary, the number of experts is determined so that if experts fall during the Delphi period, the number of remaining experts is sufficient to obtain a valid result and, for example, less than 15 people.

The steps of conducting research to achieve the set goals are as follows:

Literature study: Based on the study of theoretical foundations and experimental research, 18 indicators were extracted and classified according to Kozo in 5 dimensions of production technical factors, process related factors, training and manpower factors, infrastructure and equipment factors, and managerial level management factors. Designing interview questions: After removing and merging repetitive factors and interviewing a number of experts and obtaining their opinions, a list of 18 indicators of effective factors was obtained. Awareness and effort in the relevant field and motivation to participate in research. Through interviews (face to face or by phone) with experts with more than 5 years of experience in the electricity industry, including 22 CEOs, board members, middle managers and senior experts of active and effective generating companies in the electricity industry, as well as current and former senior officials The electricity industry was completed.

Delphi is a method of obtaining structural data based on the consensus of experts on a subject. Delphi requires multiple cycles to reach consensus, but Delphi phase has the possibility of consensus in one cycle and leads to reduced costs and research time.

5 Basics

Identifying and prioritizing the critical factors of timely implementation of goods and equipment management system facilitates the improvement of processes and if they are considered based on importance, they have a great impact on success [10]. In this research, literature and researches have been carried out and based on the opinion of experts, the effective factors in the implementation of timely production system in 5 dimensions and 18 indicators have been determined and specified. The following is a brief explanation of each dimension:

1- Technical factors of production: Technical factors of production is one of the most basic factors for the success of timely management systems of goods and timely equipment, which is those factors that lead the technical elements in production during production [10]. Given the support that technical factors of production provide for the timely management of goods and equipment and value production, the collection encourages the sharing and application of production knowledge [6]. The results of research conducted by Chiz show that the technical factors of production are one of the biggest obstacles facing organizations in creating an organization with a timely production system [16].

2- Process-related factors: One of the factors that play an important role in the application of new technologies in the timely management of goods and equipment is process-related factors and can define different tasks and coordinate these tasks, Define a structure for the organization [18]. One of the important indicators in the factors related to processes is formality and decentralization and complexity, which have a great impact on coordination and cooperation within the company and knowledge creation.

3- Educational factors and human resources: Individuals in organizations, as human tools including: skills, knowledge maps, motivation and strengthening of learning and creativity networks [10] On the other hand, they are the creators of knowledge in the organization because it is a significant part of the knowledge of the organization in the minds of people [32].

While training and manpower play a key role in the timely management of goods and equipment for a variety of reasons, the main focus is on staffing, development and maintenance. Effective staff recruitment is critical and should focus on the ability of volunteers to adapt to the culture of the organization in a specific way, rather than adapting them to job characteristics [13].

4. IT Infrastructure: Undoubtedly, one of the drivers of timely management of goods and equipment is information technology, which can play a set of plans to support the timely management processes of goods and equipment [27].

The role of technology infrastructure in timely management of timely goods and equipment is to support knowledge repositories, increase access, exchange and environmental facilities that provide individual, group and organizational interactions and as a tool to help knowledge creation processes in scientific and practical environments. Slow [33]. One of the most important things that should be considered in the implementation of timely management systems of goods and equipment is the simplicity of the technology used, appropriate to the needs of users, relevance of knowledge content, standardization of knowledge structure and ontology [29]. Without information technology, it is not possible to store in-

formation, and since storage is one of the main processes of timely management of goods and equipment, weakness in this process leads to inefficiency of the system of timely management of goods and equipment [8].

5 - Management factors of the level of supervision: An essential principle for success in timely management programs of goods and equipment is to create a continuous strategic commitment to knowledge production by senior and senior managers of the organization and leadership in the field of timely management of goods and equipment It should indicate certain characteristics that lead to timely management of goods and equipment in a timely manner [22]. Leaders in role modeling reflect the timely management behavior of goods and equipment in a timely manner and must constantly learn and seek new knowledge and ideas [23].

Senior managers play an effective role in other factors of success in implementing a timely management system of goods and timely equipment, such as creating a proper culture, designing training programs and encouraging employees to participate in these programs, and so on.

6 Findings

As shown in Table 1, the effective factors, along with the authoritative sources cited, indicate the validity of the specified factors and the frequency of reference. To them in other articles is the research of researchers in this field.

Table 1. Dimensions and effective factors in the implementation of timely management system of goods and timely equipment

	Dimensions	Indicators	Sources
Factors	Technical factors of production	Technology	([13,5,25,8,16,12,31,9,12,19,30])
		Transportation and maintenance	
		Operator ability	
		Management and maintenance	
		amount of deviation	
	Factors related to processes	Focus	([35,6,4,1,7,17,12,22,27,15,24,])
		Official	
		Complexity	
		Modeling	
	Educational factors and manpower	Participation	([30,11,29,4,32,16,7,3])
		Education	

Table 1. Dimensions and effective factors in the implementation of timely management system of goods and timely equipment

	Factors related to infrastructure and equipment	Network and hardware infrastructure	([8,23,12,8,19,16,32,25])
		Access to application software	
		IT staff	
		Collaborative technologies	
	Management factors of the level of supervision	Reward policies	([37,18,2,13,22,20])
		Knowledge and education strategy	
		Eliminate organizational restrictions	

7 Proposed Approach

The purpose of this study is to study the ranking of effective factors on how to implement timely management of goods and equipment (Just in time) and its evaluation criteria in the power distribution company of the whole country using Analytic Hierarchy (AHP). Be. Research literature and similar studies and surveys of experts were used to identify the factors. Based on this, a total of five dimensions were determined. Based on the identified factors, the research hierarchy tree was drawn (Figure 1). According to experts in the second and third levels of this tree, there are five dimensions to how to implement timely management of goods and equipment and its criteria interact with each other. Therefore, determining the weight of factors without considering their relationship matrix is not without problems. Therefore, the combined approach of fuzzy AHP and fuzzy DEMATEL will be used to determine their weight. In the following, the findings of prioritizing the effective factors using the combined decision of fuzzy AHP and fuzzy DEMATEL in two phases are discussed:

First phase. Determination of fuzzy weights by fuzzy AHP technique

Hierarchical analysis technique (AHP) is a decision-making method related to the decision makers' goal to solve complex multi-criteria problems. Recipients should make an even comparison between the factors and assign a relative score to each factor in terms of the extent to which they have an impact on the problem [27]. Fuzzy hierarchy is discussed, since uncertainty is one of the most common decision-making problems. Fuzzy decision-making methods have been developed to answer this problem [21]. This method allows decision makers to prioritize their ideas with fuzzy numbers. In these cases, fuzzy theory is a mathematical theory designed to understand ambiguous human behaviors and the decision maker expresses his opinion in a general way in an optimistic, pessimistic, mediocre, completely relevant, and so on. [37] The weight of the indicators is a fuzzy hierarchical method whose fuzzy numbers are triangular.

Step 1: Drawing a hierarchical diagram: A hierarchical structure consists of two levels, the upper level is the dimensions and the lower level is the indicators and features.

Step 2: Form a matrix of even comparisons using fuzzy numbers

At this stage, experts are asked to express their views on the pairwise comparison of factors affecting the implementation of human resource management based on Figure 1, using the verbal expressions of Table 2.

Table 2: Triangular Fuzzy Number Prioritization Scale [17]

Linguistic variables	Numerical relative importance scale AHP	Triangular fuzzy numbers	Inverted triangular fuzzy numbers
Equal importance	1	(1,1,1)	(1,1,1)
Equally important to relatively important	2	(1,2,3)	(0.33,0.5,1)
My relative	3	(2,3,4)	(0.25,0.33,0.5)
Relatively important to important	4	(3,4,5)	(0.2,0.25,0.33)
Important	5	(4,5,6)	(0.17,0.2,0.25)
Important to very important	6	(5,6,7)	(0.14,0.17,0.2)
Very important	7	(6,7,8)	(0.13,0.14,0.17)
Very important to extremely important	8	(7,8,9)	(0.11,0.13,0.14)
Extremely important	9	(8,9,10)	(0.1,0.11,0.13)

After gathering expert opinions and converting verbal data into fuzzy numbers, a pairwise comparison matrix is formed using Equation (1).

$$\tilde{A}=\begin{bmatrix} 1 & \tilde{a}_{12} & \cdots & \tilde{a}_{1n} \\ \tilde{a}_{12} & 1 & \cdots & \tilde{a}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{a}_{n2} & \tilde{a}_{n2} & \cdots & 1 \end{bmatrix}=\begin{bmatrix} 1 & \tilde{a}_{12} & \cdots & \tilde{a}_{1n} \\ 1/\tilde{a}_{12} & 1 & \cdots & \tilde{a}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/\tilde{a}_{1n} & 1/\tilde{a}_{2n} & \cdots & 1 \end{bmatrix} \quad (1)$$

Step 3: Check the compatibility of the matrix of pairwise comparisons:
Suppose the $A=\left[a_{ij}\right]$ reciprocal matrix is positive and $\tilde{A}=\left[\tilde{a}_{ij}\right]$ the reciprocal positive matrix is fuzzy. Now if $A=\left[a_{ij}\right]$ it is compatible then it $\tilde{A}=\left[\tilde{a}_{ij}\right]$ can also be compatible. To calculate the

consistency of the pairwise comparison matrix, we convert the fuzzy numbers to definite numbers, then the incompatibility rate is calculated for the definitive matrix of pairwise comparisons.
Step 4: Geometric mean of pairwise comparisons of experts: Geometric mean of pairwise comparisons of experts is obtained using Equation (2) [12].

$$a_{ij} = (a_{ij}^{1} \otimes a_{ij}^{2} \otimes ... \otimes a_{ij}^{n})^{\frac{1}{n}} \tag{2}$$

Step 5: Calculate Fuzzy Weights: The fuzzy weight of each index is obtained from Equation (3). Where is the number of experts?

$$\begin{aligned} &\tilde{w}_j = \tilde{a}_j \otimes (\tilde{a}_1 \oplus \tilde{a}_2 \oplus ... \oplus \tilde{a}_n)^{-1} \quad j = 1,2,...,n \\ &\tilde{a}_j = (\tilde{a}_{m1}^{1} \oplus \tilde{a}_{m2}^{2} \oplus ... \oplus \tilde{a}_{mn}^{n})^{-1} \end{aligned} \tag{3}$$

The number of indicators and the number is fuzzy.

Step 6: Calculation of complete fuzzy weights for indices and dimensions: Complete fuzzy weights are obtained by multiplying the weights obtained from the indices by the weight of the dimensions. Equation (4).

$$\tilde{T}W_j = \tilde{D}W_j \otimes \tilde{C}W_j \tag{4}$$

Where fuzzy weight $\tilde{C}W_j$ is the dimensions and $\tilde{D}W_j$ fuzzy weight obtained for the indices.

Step 7: Dephase and normalization of the obtained weights: Equation (5) is used to normalize the triangular fuzzy weights [35].

$$W_j = \frac{a+b+c}{3} \tag{5}$$

The second phase. Relationship between indicators with fuzzy DEMATEL technique.

The Demetel method was first proposed by two researchers, Fontella and Gabus, in 1976. This technique is one of the types of decision-making methods based on pairwise comparisons [14]. This technique examines the interrelationships between criteria, their impact and importance as a numerical score. The most important feature of Demethel method is multi-criteria decision making and its performance in creating relationships and structure between factors. In addition to transforming cause-and-effect relationships into a structural-visual model, this technique is also able to identify and understand the interdependencies between factors [34]. Especially in situations of uncertainty, it is very difficult, because the outcome of decision-making is highly dependent on inaccurate and vague mental judgments. This factor has led to the need for fuzzy logic in Dimtel [8].

As a result, in the fuzzy dimtel technique, triangular fuzzy linguistic variables are used. The steps of this technique are as follows.

Step 8: Creating the initial matrix of direct relations (): A questionnaire related to the level of penetration of each index to other indicators is prepared and distributed among experts and after collecting expert opinions and using Table 3, verbal data is converted into fuzzy numbers Equation (6) The initial matrix of direct relations is determined.

Table 3. Fuzzy Verbal Scale Pattern The effect of each variable on another variable

Verbal expressions	Effectless	Very little impact	Low impact	high impact	Too much impact
Numerical scale	0	1	2	3	4
Triangular fuzzy numbers	(۰/۳و۰/۱و۰)	(۰/۵و۰/۳و۰/۱)	(۰/۷و۰/۵و۰/۳)	(۰/۹و۰/۷و۰/۵)	(۱و۰/۹و۰/۷)

$$A_{ij} = \frac{1}{H}\sum_{k=1}^{H} x_{ij}^{k} \tag{6}$$

Step 9: Normalize the initial direct relations matrix (): The initial direct relations matrix is obtained using relations (7) and (8).

$$D = \frac{A}{S} \tag{7}$$

$$S = \max\left(\max_{1\le i\le n}\sum_{j=1}^{n} A_{ij}, \max_{1\le i\le n}\sum_{i=1}^{n} A_{ij}\right) \tag{8}$$

Step 10: Build the Matrix: The matrix is created using Equation (9).

$$Z_x = \begin{bmatrix} 0 & x_{12} & \cdots & x_{1n} \\ x_{21} & 0 & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & 0 \end{bmatrix} \tag{9}$$

Where is $x = (a,b,c)$ obtained from those three $n \times n$ matrices whose objects are non-fuzzy numbers. The reason D for writing a matrix in the form of three matrices is the ease of performing calculations in the next step. Note that the number of rows in the matrix is equal D to the number of columns $Z = [Z_x]$ in the matrix.

Step 11: Explain the Matrix of Total Relationships (T_x): The Matrix of Total Relationships Matrix We obtain the equations using Equation (10) in which the I matrix is the same.

$$T_x = Z_x (I - Z_x)^{-1} \tag{11}$$

Step Twelve: Analysis of Causal Relationships: The sum of the values of rows and columns is obtained for the analysis of causal relations $D-R$ and $D+R$ relations (11-13) are used to determine values and fuzzy.

$$T_X = \left\lfloor t_{ij} \right\rfloor_{m\times n} \qquad i, j = 1,2,...,n \tag{11}$$

$$D = r_X = \left[\sum_{j=1}^{n} t_{ij}\right]_{n\times 1=[t_i]n\times 1} \tag{12}$$

$$R = c_X = \left[\sum_{j=1}^{n} t_{ij}\right]_{1\times n=[t_i]1\times n} \tag{13}$$

Step 13: Calculate Fixed Values $E(w)$: For the values $D+R$ and $D-R$ fuzzy obtained in the previous step, the definite values are obtained using the area center method according to Equation (5).

$$E(w) = \frac{a+b+c}{3} \tag{14}$$

Where a, b, c are devices corresponding to fuzzy values $D+R$ and $D-R$.

Step Fourteen: Combining Fuzzy Weights and $E(w)$: Fuzzy Weights Obtained from Step Six of Phase 1) We multiply the weights obtained by the AHP method in the previous phase $E(w)$) by the values for each index and dimension to obtain new values for This uses Equation (15). (15)

$$E(W)new = w_j \otimes E(W)$$

Step 15: Design the causal diagram: The causal diagram related to the dimensions and all the indicators are drawn.

8 Research Findings

In the present section, the results of collecting research data are presented.

Phase 1: Determination of fuzzy weights with fuzzy AHP technique:

Step 1: As mentioned, in order to determine the factors affecting the implementation of timely management of goods and equipment in a timely manner, first by reviewing the research literature and similar studies, a set of factors was identified. Then, by conducting interviews with experts, the final effective factors were determined in the form of five indicators. Based on the identified factors, the research hierarchical tree was obtained as described in Figure 1.

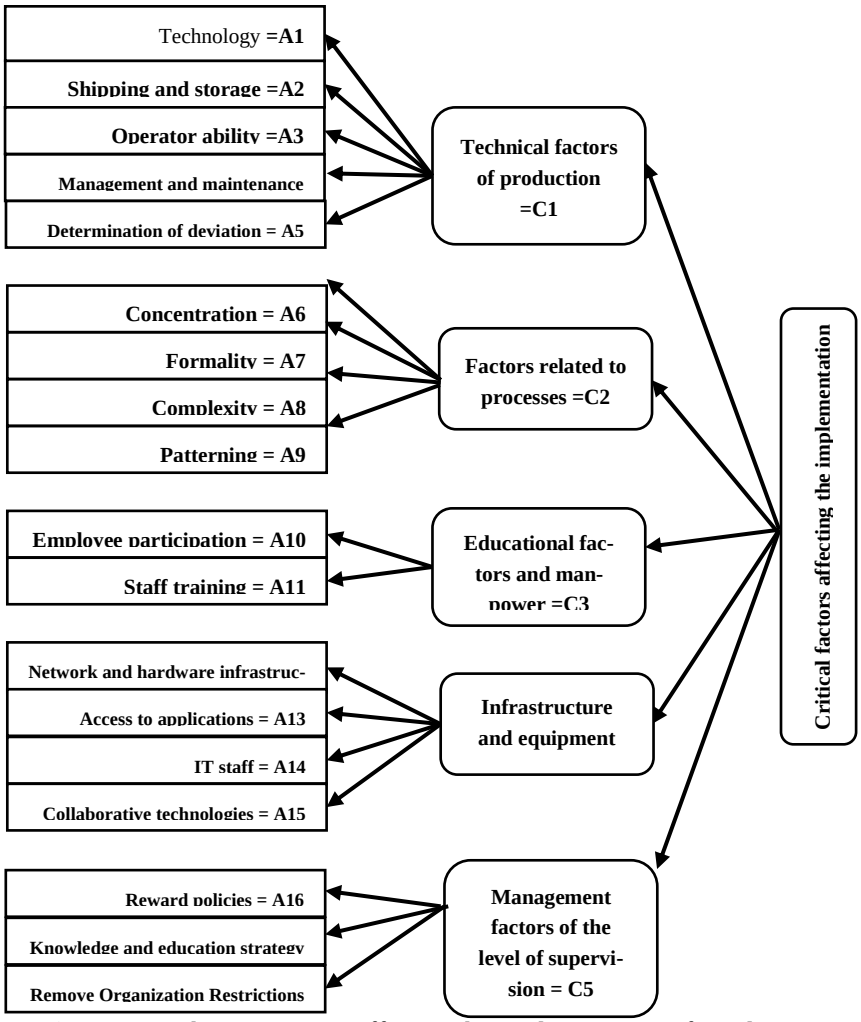

Fig.1: Hierarchy tree Factors affecting the implementation of timely management of goods and equipment

Step 2: Based on the research hierarchy tree, a pairwise comparison questionnaire was designed and distributed among experts. After collecting verbal data and using Table 1. Verbal data became fuzzy numbers. Expert pairwise comparison matrices are aggregated using Equation (1). For example, Table 4 shows the matrix of pairwise comparisons of dimensions.

Step 3: Evaluate the compatibility of the pairwise comparison matrix: In order to evaluate the compatibility of the pairwise comparison matrix, after determining the fuzzy numbers, the pairwise comparison matrices of dimensions and indices were determined. Then, the incompatibility rate of each matrix was investigated. The results showed that the incompatibility rate of all six pairs of comparison tables is less than 0.1.

Step 4 and 5: The geometric mean of pairwise comparisons of experts and their fuzzy weights are obtained using equations (2) and (3).

Step 6 and 7: Using Equations (4) and (5), complete fuzzy weights for the indices and dimensions are obtained and diffused.

Tables 5 and 6 show the fuzzy and determined weights of the dimensions and indicators, respectively.

Table 4. Matrix of pairwise comparisons of dimensions of timely management system of goods and equipment

Dimensions	C_1	C_2	C_3	C_4	C_5
C_1	(1,1,1)	(0.241,0.321,0.5)	(0.255,0.346,0.548)	(0.435,0.691,1.145)	(0.669,0.958,1.249)
C_2	(2,3.107,4.16)	(1,1,1)	(3.78,4.82,5.848)	(0.698,1.063,1.442)	(2.41,2.884,3.302)
C_3	(1.817,2.884,3.915)	(0.427,0.519,0.655)	(1,1,1)	(2.714,3.78,4.82)	(0.38,0.505,0.654)
C_4	(1.097,1.442,2.289)	(0.691,0.938,1.442)	(0.206,0.265,0.368)	(1,1,1)	(0.301,0.435,0.794)
C_5	(1.474,1.04,1.489)	(0.302,0.35,0.412)	(1.518,1.993,2.621)	(1.26,2.289,3.302)	(1,1,1)

Table 5. Fuzzy and definite weights of effective dimensions in the implementation of timely management system of goods and equipment on time

Dimensions	Fuzzy geometric mean	Fuzzy weight	Diphasic weight
C_1	(0.447,0.593,0.829)	(0.061,0.103,0.181)	0.115
C_2	(1.663,2.15,2.587)	(0.227,0.372,0.565)	0.388
C_3	(0.957,1.234,1.519)	(0.131,0.214,0.332)	0.225
C_4	(0.543,0.689,0.993)	(0.074,0.119,0.217)	0.137
C_5	(0.968,1.107,1.396)	(0.132,0.192,0.305)	0.21
$a_1 \oplus a_2 \oplus ... \oplus a_n$	(4.578,5.773,7.324)		
$\left(a_1 \oplus a_2 \oplus ... \oplus a_n\right)^{-1}$	(0.137,0.173,0.218)		

Step 8: Creating the initial matrix of direct relations (6): After determining the final weights of the indicators, a questionnaire related to the level of penetration of each index was prepared and distributed among the experts and after collecting the opinions of experts and using Table 3, data Verbal became

fuzzy numbers. Then the initial matrix of direct relations was determined using equation (6). For example, in Table 7, the initial matrix of direct relationships related to the effective dimensions in the implementation of the timely management system of all equipment is updated.

Table 6. Fuzzy and definite weights of effective indicators in the implementation of timely management system of goods and equipment

Dimensions	Indicators	Fuzzy geometric mean	Fuzzy weight	Diphasic weight
C_1	A_1	(2.182,2.664,3.085)	(0.301,0.442,0.632)	0.458
	A_2	(0.76,1,1.236)	(0.105,0.166,0.253)	0.175
	A_3	(0.604,0.742,0.944)	(0.083,0.123,0.193)	0.133
	A_4	(0.341,0.424,0.582)	(0.047,0.07,0.119)	0.079
	A_5	(0.995,1.191,1.409)	(0.137,0.198,0.289)	0.208
C_2	A_6	(0.725,0.894,1.116)	(0.139,0.21,0.323)	0.224
	A_7	(1.355,1.721,2.081)	(0.261,0.404,0.602)	0.422
	A_8	(0.572,0.658,0.786)	(0.11,0.155,0.227)	0.164
	A_9	(0.806,0.981,1.217)	(0.155,0.231,0.352)	0.246
C_3	A_{10}	(0.858,1.07,1.258)	(0.354,0.534,0.762)	0.55
	A_{11}	(0.792,0.933,1.165)	(0.327,0.466,0.706)	0.5
C_4	A_{12}	(0.223,0.249,0.282)	(0.032,0.044,0.061)	0.046
	A_{13}	(1.523,1.859,2.334)	(0.22,0.326,0.505)	0.35
	A_{14}	(0.659,0.765,0.908)	(0.095,0.134,0.197)	0.142
	A_{15}	(2.213,2.837,3.386)	(0.32,0.497,0.733)	0.517
C_5	A_{16}	(0.267,0.295,0.337)	(0.054,0.069,0.092)	0.072
	A_{17}	(2.289,2.737,3.141)	(0.466,0.641,0.861)	0.656
	A_{18}	(1.092,1.236,1.435)	(0.222,0.29,0.393)	0.302

Phase 2: Relationship between indicators using fuzzy demitel technique

Step 9: Normalize the initial matrix of direct relations: The normalized matrix is determined using relations 7 and 8. Table 8 shows the normalized dimension matrix.

Table 7. Initial direct relationship matrix of effective dimensions in the successful implementation of timely management system of goods and equipment on time

Dimensions	C_1	C_2	C_3	C_4	C_5
C_1	(0,0.1,0.3)	(0.6,0.8,0.95)	(0.4,0.6,0.8)	(0.6,0.8,0.95)	(0.4,0.6,0.8)
C_2	(0.2,0.4,0.6)	(0,0.1,0.3)	(0.4,0.6,0.8)	(0.5,0.7,0.85)	(0.4,0.6,0.8)
C_3	(0.4,0.6,0.8)	(0.5,0.7,0.85)	(0,0.1,0.3)	(0.6,0.8,0.95)	(0.4,0.6,0.8)
C_4	(0.4,0.6,0.8)	(0.4,0.6,0.8)	(0.2,0.4,0.6)	(0,0.1,0.3)	(0.4,0.6,0.8)
C_5	(0.6,0.8,0.95)	(0.6,0.8,0.95)	(0.6,0.8,0.95)	(0.6,0.8,0.95)	(0,0.1,0.3)

Table 8. Matrix related to the effective dimensions in the implementation of timely management system of goods and equipment

Dimensions	C_1	C_2	C_3	C_4	C_5
C_1	(0,0.024,0.073)	(0.146,0.195,0.232)	(0.098,0.146,0.195)	(0.146,0.195,0.232)	(0.098,0.146,0.195)
C_2	(0.049,0.098,0.146)	(0,0.024,0.073)	(0.098,0.146,0.195)	(0.122,0.171,0.207)	(0.098,0.146,0.195)
C_3	(0.098,0.146,0.195)	(0.122,0.171,0.207)	(0,0.024,0.073)	(0.146,0.195,0.232)	(0.098,0.146,0.195)
C_4	(0.098,0.146,0.195)	(0.098,0.146,0.195)	(0.049,0.098,0.146)	(0,0.024,0.073)	(0.098,0.146,0.195)
C_5	(0.146,0.195,0.232)	(0.146,0.195,0.232)	(0.146,0.195,0.232)	(0.146,0.195,0.232)	(0,0.024,0.073)

Step 10: Build the Matrix Z_x : Using Equation (16) $n \times n$, describe three matrices from D the matrix Z_a, Z_b Z_c so that the next step can be easily calculated. Table 9 shows the Z_a matrix for example.

Table 9: Matrix related to dimensions

$$Za = \begin{bmatrix} 0 & 0.146 & 0.098 & 0.146 & 0.098 \\ 0.049 & 0 & 0.098 & 0.122 & 0.098 \\ 0.098 & 0.122 & 0 & 0.146 & 0.098 \\ 0.098 & 0.098 & 0.049 & 0 & 0.098 \\ 0.146 & 0.146 & 0.146 & 0.146 & 0 \end{bmatrix}$$

Step 11: Explain the total relations matrix (8): The total relations matrix was obtained using equation (10). The total relationship matrix for the dimensions affecting the success of the total timely management system and timely equipment is shown in Table 11. Based on the mentioned relation, the matrix of relations of all indicators was determined as a matrix.

Table 10. Matrix of Total Dimension Relations

Dimensions	C_1	C_2	C_3	C_4	C_5
C_1	(0.074,0.288,1.457)	(0.224,0.482,1.739)	(0.162,0.395,1.564)	(0.232,0.501,1.792)	(0.165,0.4,1.59)
C_2	(0.107,0.319,1.383)	(0.074,0.288,1.441)	(0.146,0.356,1.42)	(0.19,0.432,1.608)	(0.148,0.359,1.443)
C_3	(0.16,0.389,1.536)	(0.2,0.454,1.686)	(0.07,0.279,1.424)	(0.228,0.492,1.757)	(0.162,0.392,1.558)
C_4	(0.144,0.35,1.408)	(0.16,0.389,1.536)	(0.103,0.311,1.367)	(0.077,0.296,1.473)	(0.145,0.352,1.428)
C_5	(0.217,0.469,1.696)	(0.242,0.523,1.85)	(0.217,0.468,1.694)	(0.253,0.544,1.907)	(0.091,0.326,1.584)

Step Twelve and Thirteen: The sum of the values of the rows and columns were calculated in order to obtain the analysis of causal relationships. Equations (13-11) were used to $D+R$ determine $D-R$ the values and fuzzy. Equation (14) was also used for diphasis $D-R$ and $D-R$ to obtain diphasic values. The related results are shown in Tables 11 and 12, respectively.

Table 11: $D+R$ and $D-R$ fuzzy and definite values of the dimensions of implementation of timely management system of goods and equipment

Dimensions	$D+R$	$D-R$	$E(w)$	
			$D+R$	$D-R$
C_1	(1.558,3.881,15.622)	(0.155,0.25,0.66)	7.021	0.355
C_2	(1.563,3.889,15.547)	(-0.236,-0.381,-0.957)	7	-0.525
C_3	(1.518,3.816,15.429)	(0.121,0.196,0.492)	6.921	0.27
C_4	(1.609,3.962,15.75)	(-0.35,-0.566,-1.323)	7.107	-0.747
C_5	(1.73,4.158,16.334)	(0.31,0.501,1.129)	7.408	0.646

Table 12: $D+R$ and $D-R$ fuzzy and definite values of indicators of implementation of timely management system of goods and equipment on time

Dimensions	Indicators	$D+R$	$D-R$	$E(w)$	
				$D+R$	$D-R$
C_1	A_1	(1.66,4.258,22.407)	(0.257,0.429,1.394)	9.442	0.693
	A_2	(1.611,4.177,22.101)	(-0.123,-0.206,-0.535)	9.297	-0.288

Table 12: $D+R$ and $D-R$ fuzzy and definite values of indicators of implementation of timely management system of goods and equipment on time

	A_3	(1.776,4.452,22.908)	(0.052,0.086,0.318)	9.712	0.152
	A_4	(1.306,3.667,20.259)	(-0.344,-0.575,-2.1)	8.411	-1.007
	A_5	(1.645,4.233,22.19)	(0.159,0.266,0.923)	9.356	0.45
C_2	A_6	(1.643,4.142,20.07)	(-0.001,-0.001,0.128)	8.618	0.042
	A_7	(1.772,4.356,20.73)	(0.146,0.24,0.59)	8.953	0.325
	A_8	(1.257,3.511,18.12)	(-0.053,-0.087,-0.157)	7.629	-0.099
	A_9	(1.533,3.962,19.587)	(-0.092,-0.152,-0.561)	8.361	-0.269
C_3	A_{10}	(1.074,2.878,16.684)	(0.271,0.407,1.316)	6.879	0.665
	A_{11}	(1.074,2.878,16.684)	(-0.271,-0.407,-1.316)	6.879	-0.665
C_4	A_{12}	(1.536,3.509,11.244)	(-0.215,-0.326,-0.727)	5.43	-0.423
	A_{13}	(1.219,3.026,10.268)	(0.018,0.029,0.09)	4.838	0.046
	A_{14}	(1.243,3.062,10.367)	(-0.096,-0.146,-0.346)	4.891	-0.196
	A_{15}	(0.946,2.612,9.375)	(0.292,0.443,0.983)	4.311	0.573
C_5	A_{16}	(1.626,4.343,34.117)	(-0.066,-0.111,-0.662)	13.362	-0.28
	A_{17}	(1.479,4.094,33.075)	(-0.071,-0.12,-0.341)	12.883	-0.177
	A_{18}	(1.692,4.453,34.445)	(0.137,0.23,1.003)	13.53	0.457

Table 13: New Values $D+R$ $D-R$ for Dimensions

Dimensions	$E(w)$	
	$newD+R$	$newD-R$
C_1	0.807	0.041
C_2	2.716	-0.204
C_3	1.557	0.061
C_4	0.974	-0.102
C_5	1.556	0.136

Step Fourteen: Combining Fuzzy Weights $E(w)$ and w_j : Using Equation (14), the fuzzy weights obtained in Step 7 are combined with the definite values obtained in Step Thirteen. The results are shown in Tables 13 and 14.

Step Fourteen: The causal diagram for the dimensions and success indicators of the timely implementation of the goods and equipment management system is shown in Figures 2 and 3, respectively.

Table 14: New D + R and D-R Values for Indicators

Dimensions	**Indicators**	$E(w)$	
		$D+R$	$D-R$
C_1	A_1	4.324	0.317
	A_2	1.627	-0.05
	A_3	1.292	0.02
	A_4	0.664	-0.08
	A_5	1.946	0.094
C_2	A_6	1.93	0.009
	A_7	3.778	0.137
	A_8	1.251	-0.016
	A_9	2.057	-0.066
C_3	A_{10}	3.783	0.366
	A_{11}	3.44	-0.333
C_4	A_{12}	0.25	-0.019
	A_{13}	1.693	0.016
	A_{14}	0.695	-0.028
	A_{15}	2.229	0.296
C_5	A_{16}	0.962	-0.02
	A_{17}	8.451	-0.116
	A_{18}	4.086	0.138

9 Conclusion

Today, many managers of organizations seek to establish a timely production system to facilitate the timely management of goods and equipment while knowing and using it; Given the importance of timely management of goods and equipment in a timely manner, pay special attention to the implemen-

tation and development of timely production system, attention to issues and challenges and factors affecting the success of timely production system implementation [23] Organizations must therefore integrate the timely production system and make the organization's knowledge aggregate, categorize, organize, store, share, and available at the organization level. As a result, the implementation of timely production management in the organization causes the knowledge and products produced by individuals to remain in the organization forever [32].

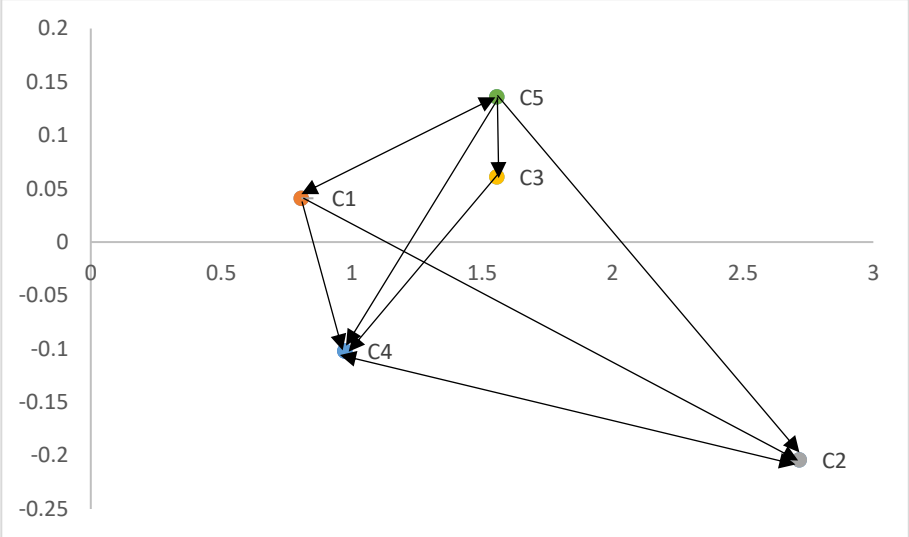

Fig. 2: Diagram on the Main Dimensions

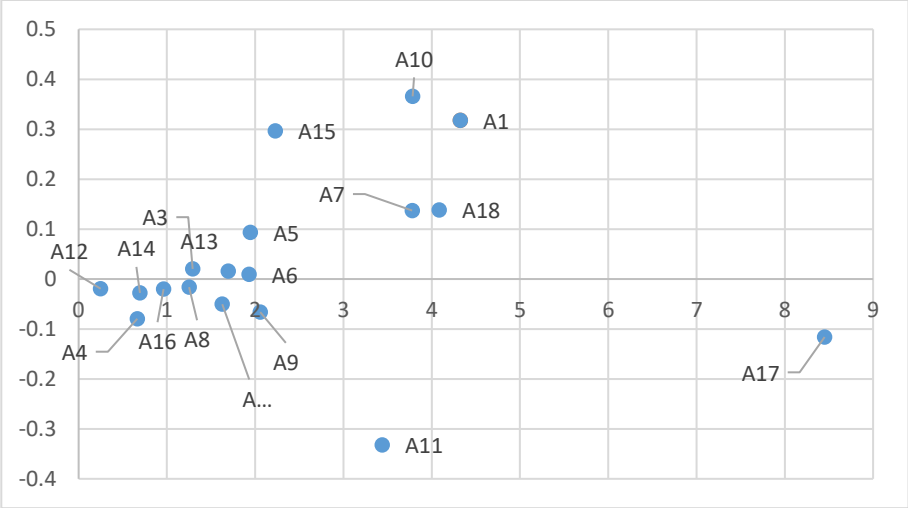

Fig.3: Causal Diagram of Indicators

Since the main condition in the implementation of the organization missions is ¬ and uncertainty is one of the most common decision problems in this research , in order to identify and prioritize the factors affecting the implementation of the updating system , fuzzy ahp and fuzzy dematel was used .after the weight of each index was obtained by fuzzy ahp method , by multiplying the values of fuzzy dematel method , the status of each dimension and indicator was investigated in terms of cause or effect . ~~~

so that indicators that have positive values are effective factors or cause and negative values are the effect or effect .the structure of this approach is in such a way that the effective factors in the successful implementation of the updating system can be classified into two categories in terms of influence and affect .it means that in addition to the possibility of prioritizing the factors , it will also enable the managers and decision - makers to manage their capital and time to deal with the results of the study and continue to be smart and customised .in other words , decision - makers in the field of research and according to the results , are trying to achieve the results of quick , but superficial , can focus on priorities in group .however , if the purpose of these decision - makers is to perform basic actions or focus on the principle and basis of the issue , they can focus on priorities in the˩ or causes and develop their plans accordingly .this problem is more accurate and more accurate when mixed with fuzzy approach and provides more accurate results .

according to the results obtained from the above approach in figure 2 and, it can be stated that technical factors of production, management factors are effective factors and factors and the dimensions of factors related to processes and infrastructure of information technology are dependent on effects or effects of effects. In technical factors , production index , operator 's ability and the amount of diversion are effective indicators and index of transportation and maintenance and the amount of deviation is the indicator of affected ¬ .in factors related to processes , concentration and formalization indicators are effective indicators and indicators of complexity and benchmarking are among the factors that are effect and variable .in educational and human resources factors , employee participation indicators are among the indicators of cause and effect and training of employees are among the effect and affected indicators .in the next step , the infrastructure of information infrastructure , accessibility indicators to applications software and technologies are among the effective indicators and indicators of network infrastructure and hardware and employees of information are the factors that are effect or affected .finally , in the management factors , the index of removal of the organization 's constraints is an effective indicator and indicators of reward policies and knowledge strategy are among the factors that are effect or affecting factors [37-38].

Technical factors are the factor that is related to the management factors of the supervision level. it also affects the factors related to processes and infrastructure of information technology. due to the positive effect of this factor, it can be stated that this factor is the causal factor. The factors related to processes are factors that influence the technical factors of production and management factors of the supervision level and it has a mutual relationship with the infrastructure and information infrastructure. due to the negative effect of this factor, it can be stated that this factor is of effect. Educational factors and human resources are factors that affect the infrastructure of information technology and affect the management factors of the supervision level. The infrastructure of information is a factor that affects the technical factors of production, training and human resources and management factors of the supervision level and is related to processes related to processes. due to the negative effect of this factor, it can be stated that this factor is of effect. management factors are the factors that effect on factors related to educational factors and human resources and infrastructure of information technology. ~~~ it is associated with technical factors of production and it can be stated that this factor is the causal agent.

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