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Designing a Human Resource Productivity Model for the Deaf Sports Federation: A Combined Delphi-Fuzzy and Interpretive Structural Modeling Approach

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A B S T R A C T

Objective: The objective of this study was to design a human resource productivity model for the Deaf Sports Federation using a combined Delphi-Fuzzy and Interpretive Structural Modeling approach.

Methods and Materials: The methodology of this research was mixed (qualitative and quantitative). Participants included managers and officials of committees within the Deaf Sports Federation of the Islamic Republic of Iran and elites in deaf sports, including coaches, referees, and athletes. The selection of these individuals was purposeful, based on criteria of expertise and experience, representation, diversity, and cooperation potential, with 18 individuals chosen. Data collection tools were a 41-question questionnaire and a 17x17 dimensional matrix, both validated for reliability and validity. Data analysis was conducted using Delphi-Fuzzy and subsequently Interpretive Structural Modeling. It is noteworthy that for these analyses, Excel macros and the SmartISM web program were utilized respectively.

Results: Findings identified 17 determinant factors related to human resource productivity in the Deaf Sports Federation, which were categorized into five levels based on interpretive structural analysis, forming a hierarchical relationship model that indicates the fundamental factors in optimizing human resources in the Deaf Sports Federation are the alignment of authority-responsibility and organizational culture, which ultimately lead to an individual's perception of their role.

Conclusions: Accordingly, in planning to enhance human resource productivity in the Deaf Sports Federation, the initial step should involve establishing a balance of authority-responsibility and promoting values that assist employees in understanding their roles.

Keywords: *Human resource productivity, Authority-responsibility alignment, Organizational culture, Deaf Sports Federation, Interpretive Structural Modeling.*

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1. Introduction

The goals of an organization cannot be achieved without the support of accessible resources, which include human resources, raw materials, equipment, and capital (1). It is widely accepted that the most important resources of an organization are its human resources, as they play a role in all activities of an organization and are planners, actors, and determinants in achieving organizational goals (2). However, if employees do not work effectively, the organization cannot optimally utilize other resources (1). Indeed, an organization that wants to succeed must have productive human resources, as unproductive human resources do not realize organizational goals (3). Consequently, human resource productivity is considered a key indicator of development among organizations (4) and determining how employees become productive is a crucial issue (5).

Sports federations are not exempt from this rule, as it has been reported that the productivity in sports federations in the country is below the standard level (6). Moreover, the unproductiveness of human resources is one of the barriers to professionalizing sports federations in the country (7). Investigations show that in Iran, most sports federations and boards are not at an acceptable qualitative and quantitative level, and face many problems that have led to decreased efficiency, effectiveness, and organizational productivity, including the lack of proper leadership and management in sports boards, lack of awareness both at high management levels and at operational and middle management levels, lack of proper planning, low productivity of human resources (8), and the absence of a foundational model of factors affecting human resource productivity (9, 10). In this regard, the Deaf Sports Federation, like other sports federations, faces such problems (11). While human resource productivity closely relates to clarification and resolution of ambiguity, performance improvement, increased trust factor, motivation enhancement, prevention of resource wastage, and effectiveness of actions (9).

Productivity generally refers to the efficiency and effectiveness with which individuals and teams produce output within a specific time frame, often measured in terms of tasks completed, goals achieved, or value created (1, 6). It is also defined as better utilization of resources and considered a performance measure that includes both efficiency and effectiveness (12). In this context, human resource productivity in an organization is defined as an employee's efficiency in carrying out assigned tasks or responsibilities over a specific period and is typically measured against the performance of employees doing similar work (13). This concept is multifaceted and not easily achieved in organizations (14) as employees must strive to meet the expectations the organization has of them, yet the productivity of human resources in organizations does not follow a single pattern because each organization has its own values, needs, resources, and priorities, and models human resource productivity according to its specific conditions and characteristics (15, 16).

On the other hand, productivity is related to various aspects including managerial, psychological, organizational, environmental, personal, among others. These factors are usually examined separately, indicating a knowledge gap in the field as these factors find their true meaning in relation to one another, and isolating them might obscure the desired outcomes (8, 17). For example, Barani and Talebpour (2021) showed a positive and significant relationship between total quality management and components such as support and leadership of top management, strategic planning, and identification and training of employees with productivity. Conversely, this research indicated that there is no significant relationship between service delivery, customer orientation, empowerment, and employee participation, and measurement and analysis of quality with productivity (14). Another study by Shamshipour and Taheri Rouzbahani (2023) showed that organizational anomie hinders human resource productivity, whereas organizational commitment improves it (7). Also, Aghel Azad et al. (2023) concluded that organizational citizenship behavior and organizational productivity have a significant positive impact on employee productivity. Moreover, Al-Alwosi, Mirwald, and Shabakhati (2024) by examining the impact of internet communication quality on human resource management and productivity showed that internet communication quality increases workforce productivity (15). Nie (2024) also demonstrated through studying the impact of human capital on productivity: An analysis of the mediating role of innovation that human capital, training, technical skills, and work experience have a positive impact on productivity, and innovation plays a significant mediating role in the relationship between human capital and human resource productivity (18). In another study by Erica et al. (2024), examining the impact of work discipline and job training on employee productivity reported that work discipline and job training significantly impact employee productivity simultaneously (17). Finally, Kwarteng et al. (2024) concluded that recognizing employees, employee

participation, employee commitment, and the ability of transformational leaders to induce a sense of self-worth in followers are the main drivers of improving productivity in employees (10).

What becomes clear from reviewing the background of the topic is that a variety of factors play a role in human resource productivity in organizations, specifically in sports federations. Some of these factors are facilitators and accelerators, while others are inhibitors and considered barriers. It was also determined that the factors affecting productivity are dynamic and can change depending on organizational conditions as the impact of these factors on productivity is not uniform. Moreover, a review of the literature indicates that despite the existence of research in this area, a comprehensive study that has examined the factors affecting human resource productivity holistically and explored the internal relationships between factors in detail has not been conducted. Furthermore, studies conducted have not addressed the productivity of human resources in the Deaf Sports Federation and similar federations. This is while the aforementioned federation, like other sports federations in the country as previously mentioned, is facing issues with productivity.

One reason for this problem could be that there is no comprehensive and complete model of human resource productivity in the Deaf Sports Federation. Moreover, human resource productivity in this federation is often regarded as a static system, while human resource productivity consists of interacting components and has a dynamic nature. This fixed and non-adaptive approach prevents the Deaf Sports Federation from effectively utilizing the capacity and capabilities of its human resources, as it cannot consider the varying yet necessary needs for making resources productive in the development of productivity. It is noteworthy that this problem is solvable and controllable provided that a model can be presented that, while indicating the factors affecting human resource productivity, shows the reciprocal influence and susceptibility among them at different levels. Such a model would lead to a better understanding of the decision-making environment by the managers of the Deaf Sports Federation; through it, one can identify the influence and dependence of factors affecting human resource productivity. Additionally, by presenting such a model, it can be specified which underlying variables are involved in defining human resource productivity in the Deaf Sports Federation. Despite this, the background of the topic shows that no modeling has been done in this area to date, and the gap is evident in the Deaf Sports Federation, thus making this research necessary for simulating the complex nature of the development of human resource productivity and the factors that make it possible. Therefore, the aim of this research, considering the total factors mentioned, is to present a modeling of the factors affecting human resource productivity in the Deaf Sports Federation, through which one can answer the question of what the model of human resource productivity in the Deaf Sports Federation is like.

2. Materials and Methods

2.1 Study Design and Participants

The methodology of this research is mixed (qualitative and quantitative). In the qualitative part, the approach is Delphi-Fuzzy and in the quantitative part, it is Interpretive Structural Modeling, both of which are within the interpretive paradigm. Participants of this study consisted of managers and officials from committees within the Deaf Sports Federation of the Islamic Republic of Iran and elites from deaf sports, including coaches, referees, and athletes. The selection of these individuals was purposeful and based on criteria of expertise and experience (choosing individuals with expertise and experience in deaf sports), representation (selecting individuals representing different groups and organizations within the deaf sports field, such as managers and officials of committees), diversity (forming a diverse team in terms of gender, age, expertise, and different roles in deaf sports, such as coaches, athletes, referees), and collaboration potential, resulting in the selection of 18 individuals.

In this study, the determinants of human resource productivity were identified based on the research background and theoretical foundations by the research team (41 factors were considered). Subsequently, to ensure the accuracy of the identified factors, the Delphi-Fuzzy method was used in one round, as a single round can lead to reliable results in Delphi-Fuzzy. However, for the application of Delphi in forecasting expert opinions with the average of opinions, the Delphi cycle needs to be repeated; since this study used Delphi with a screening approach, one stage of Delphi analysis was conducted. In the algorithm for implementing the Delphi-Fuzzy technique in this research, an appropriate fuzzy spectrum was first created for fuzzifying the verbal responses of the participants. This spectrum was based on a five-point Likert scale to express the importance of the indicators, as shown in the table below (Table 1):

Table 1. Triangular Fuzzy Numbers Corresponding to a Five-Point Likert Scale

Very Important	Important	Average	Unimportant	Very Unimportant
(1, 1, 0.75)	(1, 0.75, 0.5)	(0.75, 0.5, 0.25)	(0.5, 0.25, 0)	(0.25, 0, 0)

After selecting the fuzzy spectrum, participants' views were collected and recorded in fuzzy terms. In the second step, these views were aggregated. Various methods have been proposed for aggregating fuzzy opinions. In this research, the method introduced by Habibi et al. (2015) was used. In this method, each individual's view was recorded as a triangular fuzzy number (l, m, u) and the fuzzy average of individuals' views was calculated using the following formula (19):

$$F_{AVE} = \frac{\sum l}{n}, \frac{\sum m}{n}, \frac{\sum u}{n}$$

Subsequently, after the fuzzy aggregation of participants' views, the obtained values were defuzzified. There are various complex methods for defuzzification. One of the simple methods for defuzzification, according to Habibi et al. (2015), is the average of triangular fuzzy numbers, used in this research (19):

$$F_{ave} = (L, M, U)$$
$$x_m^1 = \frac{L+M+U}{3};\ x_m^2 = \frac{L+2M+U}{4};\ x_m^3 = \frac{L+4M+U}{6}$$
$$\text{Crisp number} = Z^* = \max(x_{max}^1, x_{max}^2, x_{max}^3)$$

After selecting an appropriate method and defuzzifying the values, a tolerance threshold of 0.7 was considered for screening factors. As a result, 17 final factors were selected and 24 factors were excluded from the analysis process. The tolerance threshold is usually set at 0.7 but this value can vary from one research to another based on the researcher's view. If the crisp value from the defuzzified aggregated expert opinion is greater than the tolerance threshold, the indicator is confirmed. If this value is less than the tolerance threshold, the indicator is removed (Habibi et al., 2015).

After these steps, a 17x17 square matrix was created and used to evaluate the correlation between factors using four symbols (O, X, A, V):

V: if factor i influences factor j.

A: if factor i is influenced by factor j.

X: if factors i and j influence each other.

O: if factors i and j do not influence each other.

To validate the matrix, its face and content validity were reviewed and confirmed by eight university professors, and the reliability coefficient of the measurement tool was calculated using the split-half method (dividing the questionnaire into two halves). According to the results of this method, the correlation between the scores of the two halves was evaluated. Subsequently, after placing this number in the Spearman-Brown formula, the overall reliability coefficient of the test was evaluated and confirmed.

Overall test reliability coefficient=(0.76+1)/2×0.76=0.86

For data analysis, as mentioned, Delphi-Fuzzy and subsequently Interpretive Structural Modeling were used. It is noteworthy that for the implementation of these analyses, Excel macros and the SmartISM web program were used sequentially.

3. Results

Based on a tolerance threshold of 0.7 and through defuzzification of the values, it was determined that there are 17 factors of significant and very significant importance related to human resource productivity in the Deaf Sports Federation. Another 24 factors classified as of average importance, unimportant, and very unimportant were excluded from the analysis process (Table 2).

Table 2. Screening Results of Indices Using Fuzzy Delphi

Identifier	Index	Fuzzy Mean	Defuzzification	Result
S1	Training	(0.58, 0.83, 1.00)	0.81	Accepted
S2	Motivation of Human Resources	(0.40, 0.58, 0.72)	0.57	Rejected
S3	Organizational Support	(0.71, 0.93, 0.99)	0.87	Accepted
S4	Organizational Culture	(0.61, 0.76, 0.81)	0.73	Accepted
S5	Management and Leadership	(0.29, 0.47, 0.68)	0.48	Rejected
S6	Work Conscience	(0.46, 0.65, 0.82)	0.64	Rejected

S7	Salaries and Wages	(0.53, 0.76, 0.93)	0.74	Accepted
S8	Empowerment	(0.46, 0.71, 0.93)	0.70	Accepted
S9	Meritocracy	(0.60, 0.85, 0.96)	0.80	Accepted
S10	Teamwork	(0.19, 0.33, 0.57)	0.37	Rejected
S11	Discipline	(0.63, 0.86, 0.94)	0.81	Accepted
S12	Commitment and Empathy	(0.29, 0.47, 0.66)	0.48	Rejected
S13	Knowledge Management	(0.58, 0.83, 0.99)	0.80	Accepted
S14	Organizational Justice	(0.21, 0.36, 0.59)	0.39	Rejected
S15	Information Technology (AI)	(0.54, 0.78, 0.90)	0.74	Accepted
S16	Individual Skills	(0.36, 0.51, 0.69)	0.52	Rejected
S17	Job Awareness	(0.39, 0.56, 0.71)	0.55	Rejected
S18	Feedback	(0.53, 0.76, 0.90)	0.73	Accepted
S19	Responsibility	(0.42, 0.61, 0.75)	0.59	Rejected
S20	Needs Assessment	(0.33, 0.53, 0.71)	0.52	Rejected
S21	Strategic Planning	(0.38, 0.58, 0.75)	0.57	Rejected
S22	Time Management	(0.58, 0.83, 0.90)	0.77	Accepted
S23	Organizational Policies	(0.42, 0.64, 0.81)	0.62	Rejected
S24	Job Enthusiasm	(0.42, 0.58, 0.74)	0.58	Rejected
S25	Intra-organizational Communications	(0.64, 0.86, 0.94)	0.81	Accepted
S26	External Communications	(0.33, 0.46, 0.60)	0.46	Rejected
S27	Professional Competencies	(0.36, 0.54, 0.69)	0.53	Rejected
S28	Talent Management	(0.67, 0.82, 0.87)	0.78	Accepted
S29	Organizational Innovation	(0.40, 0.54, 0.69)	0.55	Rejected
S30	Process Operation	(0.43, 0.57, 0.69)	0.56	Rejected
S31	Employee Flexibility	(0.38, 0.56, 0.71)	0.55	Rejected
S32	Control and Supervision	(0.42, 0.60, 0.75)	0.59	Rejected
S33	Goal Setting	(0.56, 0.81, 0.94)	0.77	Accepted
S34	Organizational Structure	(0.51, 0.68, 0.79)	0.66	Rejected
S35	Job Satisfaction	(0.49, 0.68, 0.87)	0.68	Rejected
S36	Individual Perception of Role	(0.65, 0.83, 0.88)	0.79	Accepted
S37	Group Thinking	(0.39, 0.57, 0.72)	0.56	Rejected
S38	Critical Thinking	(0.39, 0.61, 0.79)	0.60	Rejected
S39	Human Capital	(0.18, 0.26, 0.49)	0.31	Rejected
S40	Psychological Security of Employees	(0.60, 0.85, 0.94)	0.80	Accepted
S41	Authority-Responsibility Alignment	(0.61, 0.85, 0.97)	0.81	Accepted

Following the identification of the final factors, a structural self-interaction matrix was constructed based on the 17 final factors and four symbols (O, X, A, V) derived from the opinions of participants in the research (Table 3).

Table 3. Structural Self-Interaction Matrix

Factor	S1	S3	S4	S7	S8	S9	S11	S13	S15	S18	S22	S25	S28	S33	S36	S40	S41
S1	A	O	X	A	A	V	A	A	X	V	A	A	V	V	V	A	
S3		A	V	V	X	O	V	V	V	O	V	X	O	O	O	A	
S4			V	V	V	V	V	V	V	V	V	V	V	V	X		
S7				A	A	V	A	A	X	V	A	A	V	V	V	A	
S8					A	O	X	X	V	O	X	A	O	O	O	A	
S9						O	V	V	V	O	V	X	O	O	O	A	
S11							A	A	A	X	A	O	X	V	X	A	
S13								X	V	O	X	A	O	O	O	A	
S15									A	O	X	A	O	O	O	A	
S18										V	A	A	V	V	V	A	
S22											A	O	X	V	X	A	
S25												A	O	O	O	A	
S28													O	O	O	A	
S33														V	X	A	
S36															A	A	
S40																A	

When the structural self-interaction matrix was obtained, the symbols (O, X, A, V) were converted into a binary matrix (i.e., 1S and 0S), which is referred to as the initial reachability matrix. The rules for converting symbols to binary numbers were as follows:

If the entry (i, j) in the structural self-interaction matrix is V, the entry (i, j) in the reachability matrix will be 1, and the entry (j, i) will be 0.

If the entry (i, j) in the structural self-interaction matrix is A, the entry (i, j) in the reachability matrix will be 0, and the entry (j, i) will be 1.

If the entry (i, j) in the structural self-interaction matrix is X, both entries (i, j) and (j, i) in the reachability matrix will be 1.

If the entry (i, j) in the structural self-interaction matrix is O, both entries (i, j) and (j, i) in the reachability matrix will be 0.

Following these rules, the relationship symbols for all factors in the structural self-interaction matrix were completely changed to binary numbers 0 and 1 as shown in Table 4.

Table 4. Initial Reachability Matrix

Factor	S1	S3	S4	S7	S8	S9	S11	S13	S15	S18	S22	S25	S28	S33	S36	S40	S41
S1	1	0	0	1	0	0	1	0	0	1	1	0	0	1	1	1	0
S3	1	1	0	1	1	1	0	1	1	1	0	1	1	0	0	0	0
S4	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S7	1	0	0	1	0	0	1	0	0	1	1	0	0	1	1	1	0
S8	1	0	0	1	1	0	0	1	1	1	0	1	0	0	0	0	0
S9	1	1	0	1	1	1	0	1	1	1	0	1	1	0	0	0	0
S11	0	0	0	0	0	0	1	0	0	0	1	0	0	1	1	1	0
S13	1	0	0	1	0	0	1	0	0	1	1	0	0	1	1	1	0
S15	1	0	0	1	1	0	0	1	1	1	0	1	0	0	0	0	0
S18	1	0	0	1	0	0	1	0	1	1	1	0	0	1	1	1	0
S22	0	0	0	0	0	0	1	0	0	0	1	0	0	1	1	1	0
S25	1	0	0	1	0	0	1	0	1	1	1	0	0	1	1	1	0
S28	1	1	0	1	1	1	0	1	1	1	0	1	1	0	0	0	0
S33	0	0	0	0	0	0	1	0	0	0	1	0	0	1	1	1	0
S36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S40	0	0	0	0	0	0	1	0	0	0	1	0	0	1	1	1	0
S41	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 4 represents the initial reachability matrix where the conversion of the relationship symbols into binary numbers is outlined, facilitating the structural analysis of the factors involved in the study. Each entry in the matrix indicates whether one factor can directly reach or be reached by another, setting the groundwork for further analysis of the interactions and dependencies among the factors.

Subsequently, the final reachability matrix was calculated by incorporating transitivity. Transitivity means that if variable A is related to B and B to C, then A is necessarily related to C. The measure of transitivity was calculated by performing a power set analysis. In the final reachability matrix, each factor has a set of dependencies and a set of influences; levels for each factor were then assigned, and a conical matrix was produced. Intersections between factors in terms of reach (impact or outputs) and prerequisites (influences or inputs) were determined. The first variable for which the intersection of the two sets equals the reachable set was considered level one. Therefore, elements at level one will have the most significant impact on the model.

Table 5. Division of the Final Reachability Matrix into Different Levels

Factor	Reach (Ri)	Prerequisite (Ai)	Intersection (Ci)	Level
S1	1, 4, 5, 8, 9, 10, 12	1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 17	1, 4, 5, 8, 9, 10, 12	3
S3	2, 6, 13	2, 3, 6, 13, 17	2, 6, 13	4
S4	3, 17	3, 17	3, 17	5
S7	1, 4, 5, 8, 9, 10, 12	1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 17	1, 4, 5, 8, 9, 10, 12	3
S8	1, 4, 5, 8, 9, 10, 12	1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 17	1, 4, 5, 8, 9, 10, 12	3
S9	2, 6, 13	2, 3, 6, 13, 17	2, 6, 13	4
S11	7, 11, 14, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17	7, 11, 14, 16	2
S13	1, 4, 5, 8, 9, 10, 12	1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 17	1, 4, 5, 8, 9, 10, 12	3

S15	1, 4, 5, 8, 9, 10, 12	1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 17	1, 4, 5, 8, 9, 10, 12	3
S18	1, 4, 5, 8, 9, 10, 12	1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 17	1, 4, 5, 8, 9, 10, 12	3
S22	7, 11, 14, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17	7, 11, 14, 16	2
S25	1, 4, 5, 8, 9, 10, 12	1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 17	1, 4, 5, 8, 9, 10, 12	3
S28	2, 6, 13	2, 3, 6, 13, 17	2, 6, 13	4
S33	7, 11, 14, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17	7, 11, 14, 16	2
S36	15	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	15	1
S40	7, 11, 14, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17	7, 11, 14, 16	2
S41	3, 17	3, 17	3, 17	5

The primary structural output was then visually represented by replacing numbers with variable names and displaying nodes in rectangular shapes in the conical matrix phase, leading to the final model. In this direction, to improve the readability of the model, additional pathways were established while preserving the levels and structures of factors and access to factors, and the final model was presented.

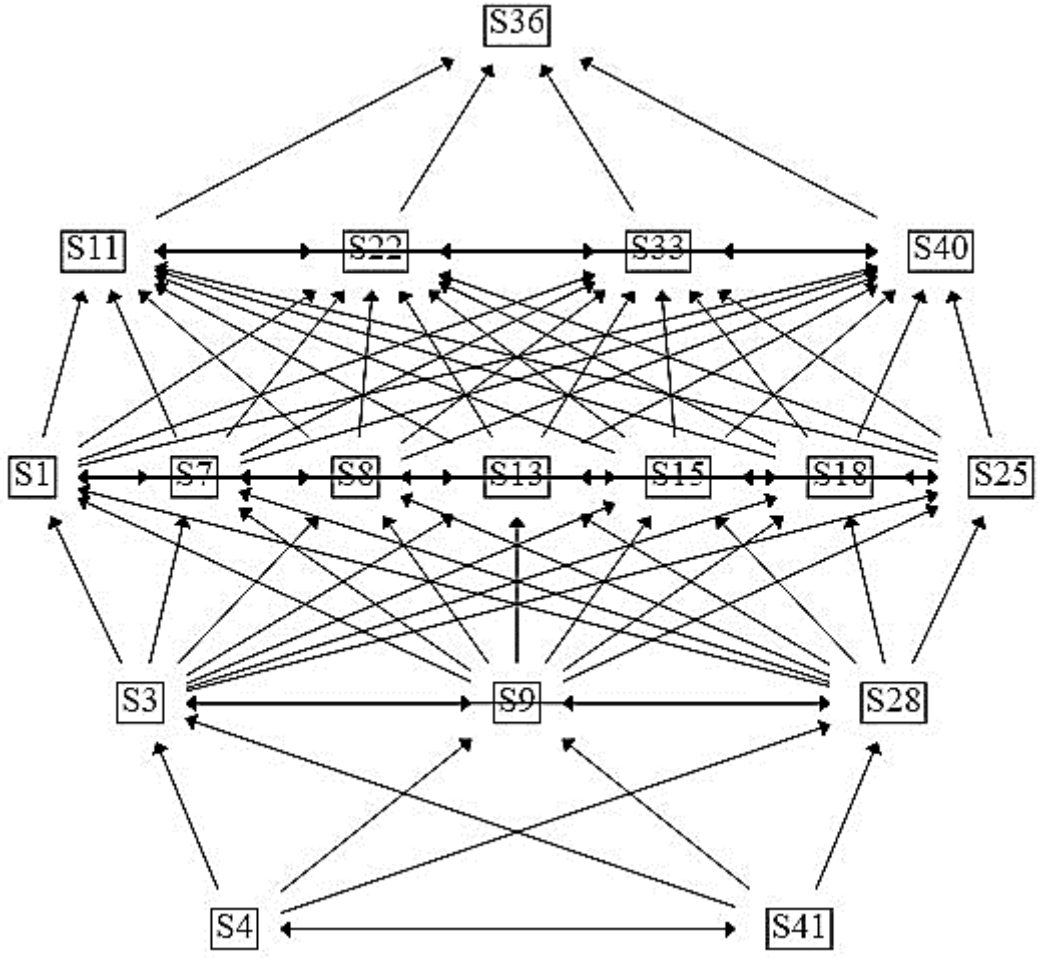

Figure 1. Human Resource Productivity Model of the Deaf Sports Federation

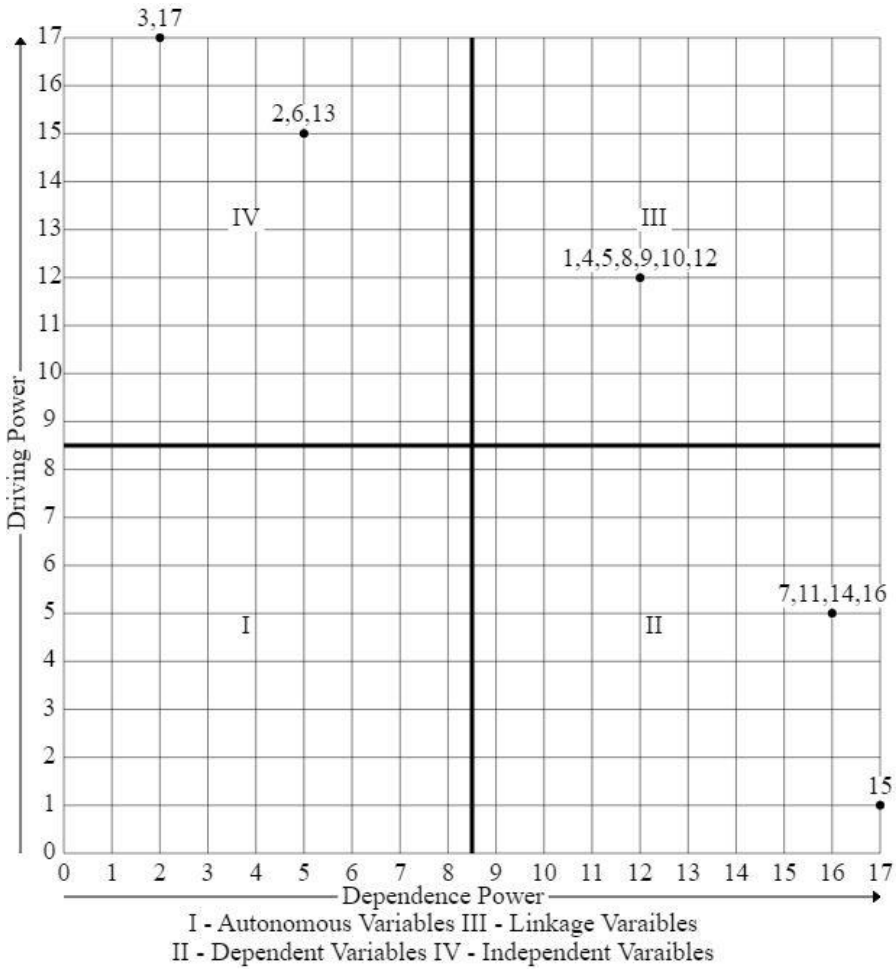

Figure 2. Results of MICMAC Analysis

Ultimately, to determine key variables, MICMAC analysis was used. With MICMAC analysis, factors can be classified into four clusters, namely: (1) Autonomous cluster, which includes factors that have weak influence and dependence. (2) Dependent cluster, which has low influence power but high dependence power. (3) Independent cluster, consisting of factors with strong influence power and weak dependence. (4) Linkage cluster, which includes factors with strong influence and dependence.

Using MICMAC analysis, the 17 factors affecting human resource productivity in the Deaf Sports Federation can be classified into three clusters based on their influence and dependence (Table 6).

Table 6. Characteristics of Participants in the Study

Cluster Name	Factors in the Cluster
Independent	Organizational Support, Meritocracy, Talent Management, Organizational Culture, Authority-Responsibility Fit
Dependent	Psychological Security of Employees, Goal Setting, Time Management, Discipline, Individual Perception of Role
Autonomous	Lacking Factors
Linkage	Training, Salaries and Wages, Feedback, Empowerment, Knowledge Management, Intra-organizational Communications, Information Technology

4. Discussion and Conclusion

The purpose of this study was to design a model of human resource productivity for the Deaf Sports Federation using a combined Delphi-Fuzzy and Interpretive Structural Modeling approach. Based on the research findings, out of 41 factors related to human resource productivity in the Deaf Sports Federation, 17 factors were identified as significant and very significant. These factors include training, organizational support, organizational culture, salaries and

wages, empowerment, discipline, knowledge management, information technology, feedback, time management, internal communications, talent management, goal setting, individual perception of role, psychological security of employees, and authority-responsibility fit, some of which were previously mentioned in prior studies (8, 16-18).

The data analysis revealed that these factors do not equally contribute to explaining the productivity of human resources in the Deaf Sports Federation. According to the levels assigned, these factors can be categorized into five levels. The lowest level (fifth level) includes organizational culture and authority-responsibility fit. The fourth level includes organizational support, meritocracy, and talent management; the third level includes empowerment, knowledge management, internal communications, training, and salaries and wages; the second level includes discipline, time management, goal setting, and psychological security of employees; and finally, the first level includes individual perception of role. This result indicates that the most foundational factors in the productivity of human resources in the Deaf Sports Federation are the fit between authority and responsibility and organizational culture. The balance between authority and responsibility means the balance and harmony between the powers given to individuals and the responsibilities they bear (20). This balance is important from two aspects. Firstly, the balance of authority and responsibility increases motivation and improves employee performance, and secondly, authority and responsibility are closely and dependently related. Without authority, an individual may not have the power to make decisions or act, while without responsibility, there may be no accountability for those decisions and actions (21). Organizational culture refers to the values, beliefs, assumptions, and shared symbols that shape how an organization is run. It includes patterns of values and beliefs that people in the organization understand and use as norms for their behavior (22). Organizational culture is important in human resource productivity because it is one of the main infrastructures for change and transformations in organizations and plays an adaptive and facilitating role in individual and organizational productivity. Moreover, organizational culture integrates attitudes, thoughts, and performance of employees, enabling them to accept responsibilities and align their actions effectively with the desires and goals of the organization.

It was also found that an individual's perception of their role has the greatest impact on the human resource productivity process in the Deaf Sports Federations. This is because if an individual is satisfied with their role in the organization, they are likely to work more productively and have more motivation to improve their performance. Conversely, if they feel that their role in the organization is not valued or justifiable, their productivity may decrease, and they may even decide to leave the organization.

Based on the data analysis, the factors that shape this perception are discipline, time management, goal setting, and psychological security. The presence of structure and order in an organization can give an individual a sense of security and stability. An individual working in an organization with appropriate discipline is likely to have a better perception of their role and feel that the work environment is suitable and stable for them. Additionally, if an individual can manage their time well and complete their tasks on time, they are likely to have a better perception of their role and responsibilities. Proper time management can help increase an individual's self-efficacy and confidence. Having clear and measurable goals in work and life can strengthen an individual's perception of their role. Concrete and measurable goals can provide an individual with more motivation and flexibility in performing their duties. Finally, when an individual feels secure and stable psychologically, they are likely to see themselves better in their role in the organization and feel a greater sense of self-efficacy.

Based on the data analysis, the first and second level inputs mentioned are directly influenced by training, salaries and wages, feedback, empowerment, knowledge management, information technology, and internal communications, which are according to the MICMAC results, part of the linkage factors. Thus, it can be noted that achieving productivity in human resources and the upper half of the model depends on changes in these factors. Because of their high impact and susceptibility, they are relatively important in the research topic and act as intermediaries between lower-level and higher-level factors.

Subsequently, it was determined that organizational support, meritocracy, and talent management, which are at the fourth level, along with the fifth-level factors located in the upper left quadrant of the impact-susceptibility map, are specifically the impactful factors of this research (having high impact and low susceptibility). The notable feature of impactful indices is that they have the most influence in the system and, as the "most critical" indices, the system's condition and its changes are dependent on them and are not easily controllable by the system because their susceptibility in the research topic (human resource productivity) is relatively low, and changing them depends on changes in

many other factors. Overall, these factors should be recognized as key environmental forces affecting future activities and interactions of human resource productivity in the Deaf Sports Federation and always monitored for policy and program adjustment. Because changes in these factors can lead to changes in other factors.

Finally, it was determined that psychological security of employees, goal setting, time management, discipline, and individual perception of role, located in the lower right part of the matrix, are specifically the susceptible factors of the human resource productivity system. The notable feature of susceptible factors is that they are very sensitive to the evolution of influential and two-way factors. Because these are factors that have a higher susceptibility and can be coordinated and influenced to strive for and plan for a desirable future or reduce their negative effects. In this regard, these factors are, technically, an output index for human resource productivity in the Deaf Sports Federation.

In general, the results of this research showed that through 17 factors, the productivity of human resources in the Deaf Sports Federation can be predicted. The most fundamental factors are the fit between authority and responsibility and organizational culture, which according to the interpretive structural model presented are at the highest level leading to an individual's perception of their role. Based on this, it is recommended that managers and heads of committees of the Deaf Sports Federation consider the following points to make human resources productive:

Managers and committee heads should distribute authorities and responsibilities in the federation appropriately and balanced. They should trust federation employees and delegate tasks commensurate with their abilities and experiences.

The Deaf Sports Federation should create a strong organizational culture based on its values and principles around productivity. This culture should recognize the importance of human resources and pay attention to the role and value of each individual in the organization. Creating an environment that encourages colleagues to respect and value each other is the basis of success in human resource productivity.

Federation employees should believe that the role and duty assigned to them are important and valuable. Managers should clarify for each organization member the connection between their duty and the organization's long-term goals to increase satisfaction and commitment to the organization.

It is worth mentioning that this research was accompanied by limitations that should be considered when generalizing the results. The first limitation is that productivity has various types such as individual, organizational, national, etc., and this research focused on human resource productivity. Therefore, the results of this research are not generalizable to other types of productivity. Another limitation is that this study used both interpretive structural modeling and MICMAC analysis simultaneously to assess the interrelationships between identified factors, which are based on mathematical equations and this aspect might lead to a difficult understanding of the relationships. Therefore, future researchers are advised to evaluate the model presented in this research using a survey study and polling from human resources of the Deaf Sports Federation.

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Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

M.F. led the overall research project, designed the study's methodological framework, and supervised the data collection and analysis processes. M.N., the corresponding author, was primarily responsible for the data analysis using Delphi-Fuzzy and Interpretive Structural Modeling methods, and played a major role in writing and revising the manuscript. H.K. contributed to the development and validation of the data collection tools, assisted in the recruitment and coordination of participants, and participated in preliminary data analysis. All authors actively participated in the discussion of results, reviewed the manuscript critically for important intellectual content, and approved the final version for publication.

Data Availability Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Ethical Considerations

Informed consent was obtained from all individual participants included in the study.

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