Overcoming Challenges in Creating Cost-Effective Employee Benefits Solutions for Startups with Fuzzy ANP: A Study on Financial Instability and PF Management

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Abstract

Employee benefits play a vital role in attracting and retaining talent, but startups often struggle to offer competitive packages due to financial limitations and regulatory constraints. This study explores the difficulties startups face in creating cost-effective employee benefits solutions during times of financial instability. By employing a combination of Fuzzy ANP (Analytic Network Process) and DEMATEL (Decision-Making Trial and Evaluation Laboratory) methods, the research identifies and prioritizes key factors impacting employee benefits management. The study highlights that financial limitations, benefits design, and the scalability of implementation are the main challenges. It provides a structured approach to understanding the interrelationships between these factors and suggests practical solutions for startups to develop flexible, scalable, and affordable benefits programs. The findings offer actionable insights to help startups improve their employee benefits strategies, contributing to both organizational growth and employee satisfaction.

Keywords: Employee Benefits, Startups, Financial Constraints, Fuzzy ANP, Cost-Effective Solutions.

1. Introduction

In the business landscape, startups play a pivotal role in driving innovation and economic growth. However, these enterprises often face with unique challenges that can hinder their growth and sustainability [1]. One such challenge is the effective management of employee benefits. Employee benefits are crucial for attracting and retaining top talent, fostering employee satisfaction, and enhancing organizational performance [2]. Yet, for startups, offering competitive benefits packages presents a considerable challenge due to their limited financial resources, evolving regulatory requirements, and diverse workforce needs [3].

Startups typically operate under financial constraints that make it difficult to allocate sufficient resources for comprehensive employee benefits [4]. These constraints are needed to balance various business priorities, such as marketing, research and development, and operational costs. Furthermore, navigating regulatory compliance adds another layer of complexity, as startups must stay informed about labor laws and incorporate them into their benefits strategies while maintaining financial feasibility [5].

The dynamic and often unpredictable nature of startup environments necessitates a flexible approach to designing and managing employee benefits [6]. Startups need benefits packages that can adapt to changing conditions and

grow with the company. This includes addressing diverse employee needs and balancing innovative solutions with practical considerations [7]

This research aims to address the challenges faced by startups in developing cost-effective employee benefits solutions during periods of financial instability. The study employs a combination of Fuzzy ANP (Analytic Network Process) and DEMATEL (Decision-Making Trial and Evaluation Laboratory) methodologies to analyze and prioritize the factors influencing employee benefits management in startups. By applying these methodologies, the research seeks to provide a structured approach to understanding the interplay between various challenges and identifying effective strategies for managing employee benefits.

Research Objectives

1. Identify Key Challenges: To identify and categorize the primary challenges faced by startups in managing employee benefits, particularly under financial constraints. This includes understanding the impact of limited cash flow, high costs of mandatory contributions, and other financial pressures on benefits planning and implementation.

2. Evaluate Benefits Design: To evaluate the effectiveness of current benefits design practices in startups and explore how they can be improved. This involves analyzing the balance between innovation and practicality in benefits packages and identifying strategies for customizing benefits to meet diverse employee needs.

3. Assess Implementation and Scalability: To assess the challenges related to the implementation and scalability of employee benefits solutions in startups. This includes examining technological barriers, the scalability of benefits programs, and the ability to adapt benefits solutions as the company grows.

4. Prioritize Factors Using Fuzzy ANP and DEMATEL: To utilize Fuzzy ANP and DEMATEL methodologies to prioritize the factors influencing employee benefits management. This involves calculating the relative importance of various challenges and sub-challenges and understanding their interdependencies to develop effective benefits strategies.

5. Propose Practical Solutions: To propose practical solutions and recommendations for startups to develop cost-effective and scalable employee benefits programs. This includes strategies for overcoming financial constraints, designing flexible benefits packages, and ensuring compliance with regulatory requirements.

By achieving these objectives, the research aims to provide startups with actionable insights and tools to enhance their employee benefits management practices, contributing to their overall success and sustainability.

2. Literature Review

2.1 Challenges in Developing Employee Benefits in Startups

Managing employee benefits in startups is a complex task that involves balancing financial constraints, regulatory requirements, and employee needs [8]. Startups often face unique challenges compared to established companies, primarily due to their limited financial resources and unstable revenue streams. These constraints can impact their ability to offer competitive benefits packages, which are crucial for attracting and retaining talent [9].

Financial limitations are a significant barrier for startups, as they must prioritize spending across various critical areas, including salaries, marketing, and research and development [10]. This often leads to compromises in the quality and scope of employee benefits offered. The focus on maintaining financial stability and achieving profitability can overshadow investments in employee welfare, making it challenging for startups to provide comprehensive benefits [11].

Moreover, startups must navigate a complex landscape of regulatory requirements related to employee benefits [12]. Compliance with labor laws and regulations is essential to avoid legal issues and ensure fair treatment of employees [13]. Startups need to stay informed about changes in regulations and incorporate them into their benefits planning while maintaining flexibility and cost-effectiveness [14].

In addition to financial and regulatory challenges, startups need to design benefits packages that meet the diverse needs of their employees. This involves creating flexible and customizable benefits that can adapt to various preferences and life stages [15]. Innovative benefits solutions can enhance employee satisfaction and engagement, but they must be financially viable to avoid overextending the company's resources.

2.2 Key challeges

2.2.1 Financial Constraints

Financial constraints are a primary challenge for startups in managing employee benefits [16]. Limited cash flow and the high costs of mandatory contributions, such as Provident Fund (PF), are significant obstacles [17]. Startups often struggle with inconsistent revenue streams, which complicates budgeting for employee benefits [18]. Research indicates that startups prioritize growth and survival over employee benefits, leading to underfunded or minimal benefits packages [19]. This focus on financial stability can result in lower employee satisfaction and higher turnover if benefits do not meet employee expectations [20].

2.2.2 Designing Effective Benefits Packages

Designing effective benefits packages is crucial for startups to address diverse employee needs while balancing innovation with practicality [21]. Startups often have a varied workforce with different needs and preferences, making one-size-fits-all solutions inadequate [22]. Effective benefits packages should offer flexibility, allowing employees to choose benefits that suit their individual needs, such as health insurance, retirement plans, and professional development opportunities [23].

Balancing innovation with financial feasibility is another critical factor. While innovative benefits can attract and retain talent, they must be affordable and sustainable [24]. Startups need to carefully design benefits programs that provide meaningful options without compromising their financial health [25]. This balance is essential for maintaining employee satisfaction and ensuring the long-term viability of the benefits program.

2.2.3 Implementation and Scalability

The implementation and scalability of benefits solutions pose significant challenges for startups. Technological barriers and limited resources can hinder the adoption of automated or tech-based benefits management solutions [26]. Startups need to implement scalable benefits programs that can grow with the company and adapt to changing conditions. As startups expand, their benefits solutions must accommodate increased employee numbers and evolving business needs [27]. Designing adaptable benefits programs that can scale effectively is crucial for maintaining an effective benefits strategy as the company grows.

Scalability also involves ensuring that benefits packages remain relevant and effective over time [28]. Startups must continuously review and adjust their benefits programs to reflect changes in the company's size, financial situation, and employee needs [29]. This ongoing reassessment helps ensure that benefits programs remain aligned with the company's goals and employee expectations, supporting long-term success and employee satisfaction [30]. Table 1 describes 15 key challenges under 3 catogories.

Table 1. Key challenges in developing Employee Benefits in Startups

S.No	Main Challenges	Sub Challenges	Description	Literature Review(s)
1	Financial Constraints in Startups(F)	Limited Cash Flow (F1)	Startups often have inconsistent revenue streams, making it difficult to fund employee benefits.	[16]
2		High Costs of PF Contributions(F2)	Ensuring mandatory PF contributions can be challenging when balancing limited liquidity.	[17]
3		Balancing Growth and Benefits(F3)	Startups prioritize growth over benefits, risking employee dissatisfaction.	[18]
4		Budget Allocation Conflicts(F4)	Conflicting priorities such as marketing and R&D make it difficult to allocate resources to benefits.	[19]
5		Sustainability of Benefits(F5)	Designing benefit programs that are financially sustainable during periods of instability is challenging.	[20]
6	Designing Effective Benefits Packages(D)	Customizing Benefits for Diverse Needs(D1)	Diverse startup workforces require customized benefits, making one-size-fits-all solutions impractical.	[21]
7		Lack of Established Frameworks(D2)	Startups often lack mature HR frameworks, complicating effective benefits management.	[22]
8		Innovation vs. Practicality(D3)	Startups struggle to balance between innovative benefits and financially viable options.	[23]
9		Retention through Benefits(D4)	Crafting a benefits package that helps retain talent in a competitive market is crucial but challenging.	[24]
10		Compliance with Regulatory Standards(D5)	Startups need to navigate labor law compliance while maintaining flexibility in benefits design.	[25]
11	Implementation and Scalability(S)	Technological Barriers(S1)	Implementing automated or tech-based solutions can be costly for startups facing financial instability.	[26]
12		Employee Awareness and Acceptance(S2)	Employees may not understand or value the offered benefits, reducing the impact of these initiatives.	[27]
13		Scalability of Solutions(S3)	Benefits solutions that work for a small startup may not be scalable as the company grows.	[28]
14		Continuous Reassessment(S4)	Startups must continuously adapt benefits packages as their financial situation evolves.	[29]
15		Vendor Reliability(S5)	Relying on external vendors for benefits solutions can pose risks, especially in times of financial stress.	[30]

3. Methodology

3.1 Study context

Startups often face financial and operational challenges, especially when it comes to providing employee benefits [31]. Balancing growth with limited funds and meeting legal requirements makes it difficult for startups to offer cost-effective benefits like Provident Fund (PF) management [32].

This study looks at the problems startups face in creating affordable employee benefits during times of financial uncertainty. Using the Fuzzy ANP method, the research identifies and prioritizes key challenges such as financial struggles, technology-related issues, and the difficulty of scaling benefits as the company grows. These factors are important for startups to provide valuable benefits while staying financially stable. The study aims to give startups guidance on how to better manage their resources to improve employee satisfaction and retention while remaining sustainable during tough financial times.

3.2 Sampling and data

For this study, data were collected from 40 individuals working in startups, including CEOs, HR Managers, and Finance Managers, profile given in Table 2. These participants were selected due to their direct involvement in decision-making related to employee benefits and financial management in startups. A structured questionnaire was designed to gather their insights. Initially, a 5-point Likert scale was used to evaluate the importance of various challenges in developing cost-effective employee benefits solutions. From this preliminary assessment, 15 key factors were identified and categorized into three main categories: Financial Constraints, Designing Effective Benefits Packages, and Implementation and Scalability.

Subsequently, a second questionnaire was developed to conduct a pairwise comparison of both the main challenges and the sub-challenges under each category. This comparison process was crucial for applying the Fuzzy ANP methodology, allowing for a detailed analysis of the interrelationships and priorities among the identified factors. The responses provided by the participants formed the basis for constructing the fuzzy pairwise comparison matrices, which were later used to calculate the priority weights for each factor.

Table 2. Profile of Start-up Experts

S.No	Designation	Number of Experts	Field of Expertise	Role in Startups	Years of Experience
1	CEO/Founder	10	Business Strategy & Operations	Overall decision-making and strategy	5-10 years
2	HR Manager	12	Human Resources Management	Employee benefits design and management	3-7 years
3	Finance Manager	8	Financial Planning & Management	Financial resource allocation	4-8 years
4	Operations Manager	5	Operations & Process Optimization	Managing operations and ensuring scalability	3-6 years
5	Marketing Manager	5	Marketing & Business Development	Resource prioritization between growth and benefits	3-7 years

3.3 Fuzzy ANP-DEMATEL Method

This section outlines the methods used to conduct the study, combining Fuzzy ANP and DEMATEL methodologies to address the challenges in developing cost-effective employee benefits solutions for startups.

The Fuzzy ANP (Analytic Network Process) is a decision-making method that incorporates fuzzy logic to handle uncertainty in human judgments [33]. In this study, Fuzzy ANP is used to prioritize and assess the interdependencies among various challenges faced by startups in designing employee benefits. The ANP allows for the consideration of feedback and interrelationships between factors, which is crucial when dealing with complex decision environments [34].

To further enhance the analysis, the DEMATEL (Decision-Making Trial and Evaluation Laboratory) method is combined with Fuzzy ANP. DEMATEL helps in identifying and understanding the cause-and-effect relationships among the factors [35]. By combining Fuzzy ANP with DEMATEL, the study aims to identify the key challenges that have the most significant impact on the others, providing a clear understanding of the underlying causal relationships.

3.3.1 Weight Calculation of Main Challenges and Sub-Challenges

To calculate the weights of the main challenges and sub-challenges, the following steps and associated mathematical equations were employed.

Fuzzy Pairwise Comparison

A pairwise comparison questionnaire was distributed to the 40 experts. The experts assessed the relative importance of the main and sub-challenges using linguistic terms. These linguistic assessments were then converted into triangular fuzzy numbers (TFNs) to account for the uncertainty and variability in the judgments. Let $\tilde{a}_{ij} = (l_{ij}, m_{ij}, u_{ij})$ represent the fuzzy comparison of factor i over factor j, where:

- l_{ij}: lower bound (pessimistic value),
- m_{ij}: middle value (most likely value),
- u_{ij}: upper bound (optimistic value).

Fuzzy Synthetic Extent Analysis

After collecting pairwise comparisons from the experts, the fuzzy pairwise comparison matrices were constructed. The fuzzy synthetic extent values for each factor were calculated using the following equation:

$$F_i = \sum_{j=1}^{m} P_{gi}^j \otimes \left[\sum_{i=1}^{n} \sum_{j=1}^{m} P_{gi}^j \right]^{-1}$$

Where F_i is the fuzzy synthetic extent value.

These fuzzy synthetic extent values were then defuzzified using the centroid method to obtain crisp scores F_i. The defuzzified crisp score S_i was calculated as:

$S_i = l_i + m_i + u_i / 3$

This defuzzification process yielded precise numerical values representing the priority of each factor.

For $\sum_{j=1}^{m} P_{gi}^j$ carryout fuzzy addition operation of p extent analysis.

$$\sum_{j=1}^{m} P = \left(\sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j \right)$$

Where all P_{gi}^j are triangular fuzzy numbers; l_j is the lower fuzzy value; m_j is the middle fuzzy value; u_j is the upper fuzzy value.

Similarly, for $\left[\sum_{i=1}^{n} \sum_{j=1}^{m} P_{gi}^j \right]^{-1}$ carryout fuzzy addition operation.

$$\sum_{i=1}^{n} \sum_{j=1}^{m} P_{gi}^j = \left(\sum_{i=1}^{n} l_i, \sum_{i=1}^{n} m_i, \sum_{i=1}^{n} u_i \right)$$

Where all P^j_{gi} are triangular fuzzy numbers; l_j is the lower fuzzy value; m_j is the middle fuzzy value; m_j is the upper fuzzy value

Now, calculate the inverse vector, as shown below.

$$\left[\sum_{i=1}^{n}\ \sum_{j=1}^{m}\ P^j_{gi}\right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i}\right)$$

Where all P^j_{gi} are triangular fuzzy numbers; l_j is the lower fuzzy value; m_j is the middle fuzzy value; u_j is the upper fuzzy value

Supermatrix Construction

The defuzzified pairwise comparison data were used to build a weighted supermatrix W. The supermatrix incorporates all relationships and interdependencies among the main challenges and sub-challenges.

The supermatrix W=[w$_{ij}$] is represented as follows:

$$(W) = \begin{pmatrix} W_{11} & W_{12} \dots \dots & W_{1n} \\ W_{21} & W_{22} \dots \dots & W_{2n} \\ W_{n1} & W_{n2} \dots \dots & W_{nn} \end{pmatrix}$$

Here, each block W$_{ij}$ represents the relationship between criteria i and j.

Normalization

To ensure comparability of the relationships across the different factors, the supermatrix W was normalized. The normalization of each element W$_{ij}$ in the supermatrix was performed as follows:

$$W_{ij} = \frac{W_{ij}}{\sum_{i=1}^{n} W_{ij}}$$

This step guaranteed that each column of the supermatrix sums to one.

The limiting supermatrix provided the global priority weights for each main challenge and sub-challenge, showing their overall influence on the decision-making process.

Ranking

Finally, based on the global priority weights obtained from the limiting supermatrix, the challenges were ranked according to their relative importance.

The ranking of the challenges helps identify which challenges should be prioritized by startups when developing cost-effective employee benefits solutions during periods of financial instability.

3.3.2 Establishing Causal Relationships

Step 1: After the criteria evaluation by expert team, fuzzy evaluation matrix was designed from the data obtained. For this, linguistic scale variables were used given in Table 2.

Step 2: Converting direct relation matrix to triangular fuzzy numbers to get crisp values. The triangular fuzzy numbers are given in Table 2 &3.

Step 3: Triangular fuzzy numbers are transformed to initial direct relation matrix M using the formulas given below

$$F = L \times M$$

$$F = \frac{1}{\min_{1 \leq i \leq n} \sum_{j=1}^{n} M_{ij}}, i,j = 1,2,..,n$$

$$L^e_{ij} = \left[L\ ls^e_{ij}\left(1 - L\ ls^e_{ij}\right) + L\ rs^e_{ij}P\ rs^e_{ij}\right]/\left[1 - L\ ls^e_{ij} + L\ rs^e_{ij}\right]$$

$$C^e_{ij} = minl^e_{ij} + P^e_{ij}\Delta^{max}_{min}$$

Where, C is the number of factors, e is the number of experts.

Step 4: Establishing normalized matrix N from initial direct relation matrix.

Step 5: Finally, total relation matrix T is obtained by using the formula (5)

$$T = L(I - L)^{-1}$$

Step 6: Causal diagram is obtained using row and column values of total relation matrix.

3.3.3 Sensitivity analysis

Sensitivity analysis was conducted to assess the robustness and stability of the results derived from the Fuzzy ANP and DEMATEL methodology. The goal of the sensitivity analysis was to examine how variations in the input data, particularly the weights assigned to the challenges and sub-challenges, affect the overall ranking and prioritization of these factors. This step ensures that the final conclusions are reliable and can withstand reasonable changes in expert judgments. Fig 1 illustrates the sensitivity analysis of sub challenges.

4. Application of Methodology

The application of the Fuzzy ANP and DEMATEL methodology in the context of developing cost-effective employee benefits solutions for startups provides a structured approach to decision-making. This methodology helps identify and prioritize the main challenges and sub-challenges startups face, enabling them to design and implement effective benefits programs despite financial constraints. The following outlines how this methodology can be applied in practice:

Step 1: Expert Consultation and Data Collection

Engage with key stakeholders in startups, including CEOs, HR Managers, and Finance Managers, to gather insights on the challenges they face in employee benefits management.

Use a pairwise comparison questionnaire where experts evaluate the importance of various challenges and sub-challenges using linguistic terms given in Table 2 & 3.

Table 2. Linguistic scale of importance

Linguistic scale	Triangular fuzzy scale
Just as challenging	(1,1,1)
Comparably challenging	(1/2, 1, 3/2)
Slightly more challenging	(1, 3/2, 2)
Noticeably more challenging	(3/2, 2, 5/2)
Significantly more challenging	(2, 5/2, 3)
Extremely more challenging	(5/2, 3, 7/2)

Table 3. Linguistic terms for positive and negative subfactors and mean fuzzy numbers

Linguistic terms for positive sub-factor	Linguistic terms for negative sub-factor	Mean fuzzy number
Very low (VL)	Very high (VH)	1
Low (L)	High (H)	0.75
Medium (M)	Medium (M)	0.5
High (H)	Low (L)	0.25
Very high (VH)	Very low (VL)	0

Step 2: Fuzzy Pairwise Comparison

Convert the linguistic evaluations into triangular fuzzy numbers to capture the uncertainty and subjectivity of expert judgments.

Construct fuzzy pairwise comparison matrices based on these fuzzy numbers given in table.

Step 3: Fuzzy Synthetic Extent Analysis

Calculate the fuzzy synthetic extent values for each challenge to assess their overall importance.

Defuzzify these values to obtain crisp scores that represent the priority of each challenge.

Step 4: Supermatrix Construction and Normalization

$$\begin{bmatrix} 1 & 0.538 & 0.588 \\ 0.550 & 1 & 0.412 \\ 0.450 & 0.462 & 1 \end{bmatrix} \ X \ \begin{bmatrix} 0.38465 \\ 0.32672 \\ 0.28862 \end{bmatrix} = \begin{bmatrix} 0.36512 \\ 0.32858 \\ 0.30316 \end{bmatrix}$$

Form a weighted supermatrix from the defuzzified pairwise comparison data.

Normalize the supermatrix to ensure consistency and comparability of relationships among challenges.

Compute the limiting supermatrix by raising the normalized supermatrix to a sufficiently high power until it converges.

The local weights were calculated given in Table 5 using supermatrix with the values increases from 0.1 to 0.9. Derive the global priority weights given in Table 4 and rank the challenges and sub-challenges based on their importance given in Table 6.

Table 4. Global weights of sub categories.

Factor	Local weight of factor	Sub-factor	Local Weight	Global Weight
F	0.3651	F1	0.207	0.07565
		F2	0.228	0.083073
		F3	0.209	0.076456
		F4	0.185	0.067476
		F5	0.171	0.062446
D	0.328583	D6	0.202	0.066235
		D7	0.151	0.049482
		D8	0.227	0.074484
		D9	0.177	0.058076
		D10	0.244	0.080306
S	0.306316	S11	0.166	0.050806
		S12	0.208	0.063589
		S13	0.182	0.055701
		S14	0.213	0.065315
		S15	0.231	0.070905

Analyzing Cause-and-Effect Relationships

Step 1: Construct Direct-Relation Matrix

Collect expert opinions on the influence of each challenge on others to create a direct-relation matrix.

Step 2: Normalize and Calculate Total Relation Matrix

Normalize the direct-relation matrix to make the values comparable.

Calculate the total relation matrix to assess both direct and indirect effects of each challenge.

Step 3: Causal Diagram Construction

Set a threshold value to filter out less significant relationships.

Construct a causal diagram to visualize and understand the cause-and-effect relationships among the challenges.

Table 4. Causal relationship

Challenge	R	C	R+C	R-C
F	10.5714	6.9173	17.4887	3.6541
D	9.2857	10.2331	19.5188	-0.9474
S	8.0000	10.7068	18.7068	-2.7068

Table 5. Local weights of Factors

F	0.3651	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
D	0.32858	0.46578	0.41402	0.36227	0.31052	0.25876	0.20701	0.15526	0.10350	0.05175
S	0.30631	0.43421	0.38597	0.33772	0.28947	0.24123	0.19298	0.14473	0.09649	0.04824

Table 6. Ranking of sub-factors by sensitivity analysis value increases from 0.1 to 0.9

	0.3623	**0.1000**	**0.2000**	**0.3000**	**0.4000**	**0.5000**	**0.6000**	**0.7000**	**0.8000**	**0.9000**
F1	0.0276	0.0076	0.0151	0.0227	0.0303	0.0378	0.0454	0.0530	0.0605	0.0681
F2	0.0303	0.0083	0.0166	0.0249	0.0332	0.0415	0.0498	0.0582	0.0665	0.0748
F3	0.0279	0.0076	0.0153	0.0229	0.0306	0.0382	0.0459	0.0535	0.0612	0.0688
F4	0.0246	0.0067	0.0135	0.0202	0.0270	0.0337	0.0405	0.0472	0.0540	0.0607
F5	0.0228	0.0062	0.0125	0.0187	0.0250	0.0312	0.0375	0.0437	0.0500	0.0562
D6	0.0242	0.0066	0.0132	0.0199	0.0265	0.0331	0.0397	0.0464	0.0530	0.0596
D7	0.0181	0.0049	0.0099	0.0148	0.0198	0.0247	0.0297	0.0346	0.0396	0.0445
D8	0.0272	0.0074	0.0149	0.0223	0.0298	0.0372	0.0447	0.0521	0.0596	0.0670
D9	0.0212	0.0058	0.0116	0.0174	0.0232	0.0290	0.0348	0.0407	0.0465	0.0523
D10	0.0293	0.0080	0.0161	0.0241	0.0321	0.0402	0.0482	0.0562	0.0642	0.0723
S11	0.0185	0.0051	0.0102	0.0152	0.0203	0.0254	0.0305	0.0356	0.0406	0.0457
S12	0.0232	0.0064	0.0127	0.0191	0.0254	0.0318	0.0382	0.0445	0.0509	0.0572
S13	0.0203	0.0056	0.0111	0.0167	0.0223	0.0279	0.0334	0.0390	0.0446	0.0501

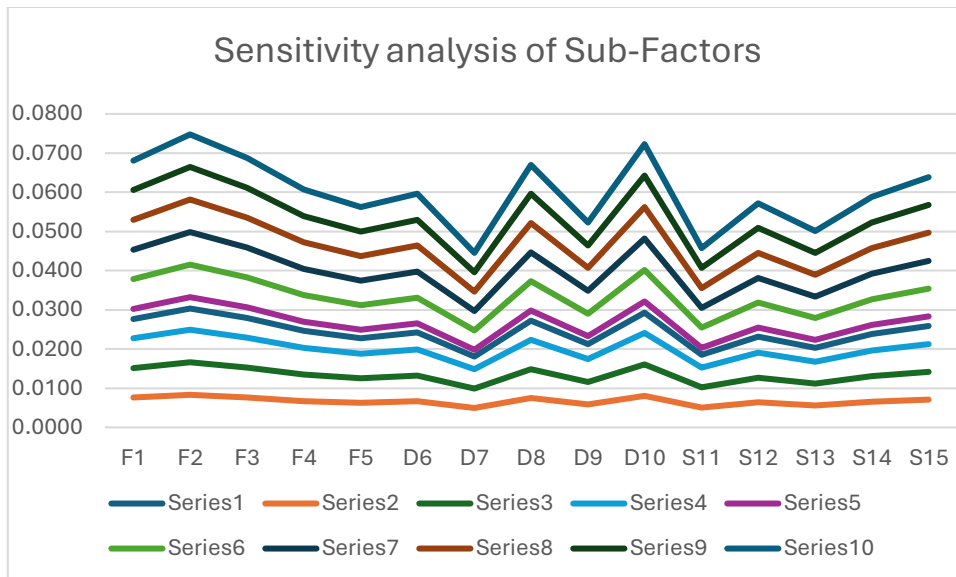| S14 | 0.0238 | 0.0065 | 0.0131 | 0.0196 | 0.0261 | 0.0327 | 0.0392 | 0.0457 | 0.0523 | 0.0588 |
| S15 | 0.0259 | 0.0071 | 0.0142 | 0.0213 | 0.0284 | 0.0355 | 0.0425 | 0.0496 | 0.0567 | 0.0638 |

Fig 1. Sensitivity analysis of sub challenges

5. Result analysis and discussion

The application of Fuzzy ANP and DEMATEL methodologies provided comprehensive insights into the relative importance of various challenges and sub-challenges faced by startups in managing employee benefits. The global weights for the main factors and sub-factors were derived through a detailed process involving fuzzy pairwise comparisons, fuzzy synthetic extent analysis, and the construction of a weighted supermatrix. The results are summarized as follows:

Interdependent Weights of Factors: The matrix calculation yielded the following global weights for the main categories:

- o Factor F (Financial Constraints): 0.36512

- o Factor D (Designing Effective Benefits Packages): 0.32858

- o Factor S (Implementation and Scalability): 0.30632

This indicates that financial constraints are the most critical challenge, followed by issues related to benefits design and implementation.

Global Weights of Sub-Factors: The local weights of sub-factors were integrated into the global weights using the supermatrix approach. The key findings include:

- o Factor F:

  - ▪ F2 (High Costs of PF Contributions): 0.08307

  - ▪ F1 (Limited Cash Flow): 0.07565

  - ▪ F3 (Balancing Growth and Benefits): 0.07646

  - ▪ F4 (Budget Allocation Conflicts): 0.06748

- F5 (Sustainability of Benefits): 0.06245

- o Factor D:

  - D10 (Retention through Benefits): 0.08031

  - D8 (Innovation vs. Practicality): 0.07448

  - D6 (Customizing Benefits for Diverse Needs): 0.06624

  - D9 (Compliance with Regulatory Standards): 0.05808

  - D7 (Lack of Established Frameworks): 0.04948

- o Factor S:

  - S15 (Scalability of Solutions): 0.07091

  - S14 (Continuous Reassessment): 0.06532

  - S12 (Employee Awareness and Acceptance): 0.06359

  - S13 (Technological Barriers): 0.05570

  - S11 (Vendor Reliability): 0.05081

These results provide a detailed picture of the relative importance of each sub-factor in the context of the main challenges.

The sensitivity analysis was conducted to evaluate how changes in the local weights of factors (ranging from 0.1 to 0.9) influence the global weights of sub-factors. This analysis revealed the following:

Effect of Increasing Factor Weights:

- o **For Factor F**: As the weight of Factor F increases, sub-factors like F2 and F1 show a significant increase in their global weights, emphasizing their criticality in financial management.

- o **For Factor D**: Sub-factors such as D10 and D8 become more prominent, highlighting the importance of effective benefits design and retention strategies.

- o **For Factor S**: Sub-factors like S15 and S14 show increased importance, stressing the need for scalable and adaptable benefits solutions.

Variation in Global Weights:

- o The global weights of sub-factors vary with different levels of importance assigned to the factors. For example, F2's global weight increases from 0.0276 to 0.0681 as the factor weight rises from 0.1 to 0.9. Similarly, D10's weight changes from 0.0293 to 0.0723, and S15's weight varies from 0.0259 to 0.0638.

This sensitivity analysis helps to identify which sub-factors are more sensitive to changes in factor weights and are therefore more critical in different scenarios.

Discussion

The results of this study reveal significant insights into the challenges faced by startups in managing employee benefits. Financial constraints emerged as the most pressing issue, with a notable emphasis on sub-factors such as the high costs of PF contributions and limited cash flow. These findings underscore the critical need for startups to navigate financial pressures while balancing employee benefits. The global weight of Factor

F, representing financial constraints, highlights that startups must find innovative ways to manage costs without compromising employee satisfaction.

In addition to financial challenges, the design of benefits packages (Factor D) is crucial. Sub-factors like retention through benefits and innovation versus practicality are particularly important. This indicates that startups should focus on developing benefits programs that not only address diverse employee needs but also contribute to long-term retention. The ability to innovate while ensuring that benefits are practical and feasible is key to creating a competitive edge in attracting and retaining talent.

The third major challenge identified is related to implementation and scalability (Factor S). Startups need benefits solutions that can grow with the company and adapt to changing financial conditions. The significant global weights for sub-factors like scalability of solutions and continuous reassessment emphasize the importance of designing flexible and adaptive benefits programs. This adaptability is essential for startups to effectively manage their benefits as they expand and evolve.

The sensitivity analysis further underscores the dynamic nature of benefits management. As the importance of different factors fluctuates, the global weights of sub-factors also shift, highlighting their varying impact under different scenarios. For instance, increases in the weight of financial constraints lead to a higher global weight for sub-factors related to cost management, reflecting the need for startups to continuously reassess their strategies in response to changing financial conditions.

6. Practical Implications

Financial Management Strategies

Given that financial constraints are the most significant challenge identified in the study, startups need to adopt strategic financial management practices. This includes exploring cost-effective benefits solutions to address high costs associated with PF contributions and managing limited cash flow. Startups should consider negotiating with service providers for more favorable terms or seeking alternative, lower-cost benefits options that align with their budget constraints. Implementing robust financial planning and forecasting can also help startups better manage their resources and allocate funds more effectively towards employee benefits.

Benefits Package Design

The findings highlight the importance of designing benefits packages that cater to diverse employee needs while remaining practical and innovative. Startups should focus on creating flexible benefits programs that can adapt to the varying requirements of their workforce. This may involve offering a range of benefits options that employees can choose from based on their preferences and needs. Incorporating features that enhance employee retention, such as performance-based incentives or career development opportunities, can also add value to the benefits package and contribute to long-term employee satisfaction.

Scalability and Adaptability

As startups grow, their benefits solutions must be scalable and adaptable to changing conditions. It is essential for startups to design benefits programs that can expand and evolve alongside the company. This involves building a benefits structure that can accommodate increased employee numbers and changing financial situations. Regularly reviewing and updating the benefits package to reflect the company's growth and financial stability will ensure that the benefits remain relevant and effective.

Continuous Monitoring and Adjustment

The dynamic nature of employee benefits management, as revealed by the sensitivity analysis, underscores the need for continuous monitoring and adjustment of benefits programs. Startups should implement mechanisms for regularly assessing the effectiveness of their benefits strategies and making necessary adjustments

based on feedback from employees and changes in the company's financial status. This proactive approach will help startups stay responsive to evolving needs and maintain a competitive edge in attracting and retaining talent.

Regulatory Compliance

Navigating regulatory standards is another critical aspect of benefits management. Startups must ensure that their benefits programs comply with relevant labor laws and regulations while maintaining flexibility. Keeping abreast of regulatory changes and incorporating them into benefits planning will help startups avoid compliance issues and mitigate potential legal risks.

7.Conclusion

This study has provided valuable insights into the challenges and solutions related to employee benefits management for startups, employing Fuzzy ANP and DEMATEL methodologies to analyze these complexities. The research highlighted that financial constraints are the foremost challenge, with specific concerns such as high PF contribution costs and limited cash flow. These financial issues underscore the need for startups to adopt innovative and cost-effective solutions for managing employee benefits. The findings also emphasized the importance of designing effective benefits packages that cater to diverse employee needs while balancing innovation and practicality. The ability to retain talent through well-designed benefits and to adapt benefits programs as startups grow and evolve is crucial for long-term success. Furthermore, the study revealed that scalability and adaptability are essential for implementing benefits solutions that can adjust to changing financial conditions and company growth. Continuous monitoring and reassessment of benefits programs are necessary to maintain their effectiveness and relevance.

References

1. Abbas, S. M., & Liu, Z. (2022). Orchestrating frugal eco-innovation: the plethora of challenges and diagnostics in lean startups of emerging economies. Innovation & Management Review, 19(4), 339-367.
2. Venkat, M. V. V., Khan, S. R. K., Gorkhe, M. D., Reddy, M. K. S., & Rao, S. P. (2023). Fostering Talent Stability: A Study on Evaluating the Influence of Competency Management on Employee Retention in the Automotive Industry. Remittances Review, 8(4).
3. Nunes, A. K. D. S., Morioka, S. N., & Bolis, I. (2022). Challenges of business models for sustainability in startups. RAUSP Management Journal, 57(4), 382-400.
4. van Rijnsoever, F. J. (2022). Intermediaries for the greater good: How entrepreneurial support organizations can embed constrained sustainable development startups in entrepreneurial ecosystems. Research Policy, 51(2), 104438.
5. Lucas, D. S., Fuller, C. S., & Packard, M. D. (2022). Made to be broken? A theory of regulatory governance and rule-breaking entrepreneurial action. Journal of Business Venturing, 37(6), 106250.
6. Becker, S. D., & Endenich, C. (2023). Entrepreneurial Ecosystems as Amplifiers of the Lean Startup Philosophy: Management Control Practices in Earliest-Stage Startups. Contemporary Accounting Research, 40(1), 624-667.
7. Sreenivasan, A., Suresh, M., & Tuesta Panduro, J. A. (2023). Modelling the resilience of start-ups during COVID-19 pandemic. Benchmarking: An International Journal, 30(6), 2085-2109.
8. Sreenivasan, A., & Suresh, M. (2022). Modeling the enablers of sourcing risks faced by startups in COVID-19 era. Journal of Global Operations and Strategic Sourcing, 15(2), 151-171.
9. Alawamleh, M., Francis, Y. H., & Alawamleh, K. J. (2023). Entrepreneurship challenges: the case of Jordanian start-ups. Journal of Innovation and Entrepreneurship, 12(1), 21.
10. Ma'aji, M. M., Barnett, C., Han, K. T., Islam, M., & Haruna, A. A. (2024). Challenges Cambodian Startups Face when Scaling up their operations. Kurdish Studies, 12(1), 600-613.
11. Jelonek, R., & Eriksson, B. (2024). Start-up Eco-nomics-A Qualitative Study on Exploring How Funding. Harvard Business Review, 73(1), 43-53.

12. Joel, O. S., Oyewole, A. T., Odunaiya, O. G., & Soyombo, O. T. (2024). Navigating the digital transformation journey: strategies for startup growth and innovation in the digital era. International Journal of Management & Entrepreneurship Research, 6(3), 697-706.

13. Ikhsan, M. M., Nuraeni, N., & Meiriyanti, D. (2024). Integrating Islamic Business Ethics in Labor Protection and Minimum Wage Determination In Indonesia. Mu'amalah: Jurnal Hukum Ekonomi Syariah, 3(1), 105-114.

14. Ahmad, N., & Tripathi, N. (2023, November). Benefits, Challenges, and Implications of Open-Source Software for Health-Tech Startups: An Empirical Study. In International Conference on Software Business (pp. 265-282). Cham: Springer Nature Switzerland.

15. Roach, M., & Sauermann, H. (2024). Can technology startups hire talented early employees? Ability, preferences, and employee first job choice. Management Science, 70(6), 3619-3644.

16. Lee, S., & Kim, J. D. (2023). When do startups scale? Large-scale evidence from job postings. Strategic Management Journal.

17. Loganathan, M. (2022). Competing for technology talent: Listed companies versus funded startups in India. International Journal of Global Business and Competitiveness, 17(1), 64-72.

18. Galustian, A. (2024). Stock-Based Compensation in Startups: Employee Implications & Potential Solutions. UC Law Business Journal, 20(2), 239.

19. Pavlatos, O., & Kostakis, H. (2021). Budgeting in start-up companies: European survey-based evidence. In Advances in Management Accounting (pp. 97-125). Emerald Publishing Limited.

20. Horne, J., & Fichter, K. (2022). Growing for sustainability: Enablers for the growth of impact startups–A conceptual framework, taxonomy, and systematic literature review. Journal of Cleaner Production, 349, 131163.

21. Corvello, V., Cimino, A., & Felicetti, A. M. (2023). Building start-up acceleration capability: A dynamic capability framework for collaboration with start-ups. Journal of Open Innovation: Technology, Market, and Complexity, 9(3), 100104.

22. Zahra, S. A. (2021). The resource-based view, resourcefulness, and resource management in startup firms: A proposed research agenda. Journal of Management, 47(7), 1841-1860.

23. Battistella, C., Dangelico, R. M., Nonino, F., & Pessot, E. (2021). How social start-ups avoid being falling stars when developing social innovation. Creativity and Innovation Management, 30(2), 320-335.

24. Mukul, K., & Saini, G. K. (2021). Talent acquisition in startups in India: the role of social capital. Journal of Entrepreneurship in Emerging Economies, 13(5), 1235-1261.

25. Harlin, U., & Berglund, M. (2021). Designing for sustainable work during industrial startups—the case of a high-growth entrepreneurial firm. Small Business Economics, 57, 807-819.

26. Van Opstal, W., & Borms, L. (2023). Startups and circular economy strategies: Profile differences, barriers and enablers. Journal of Cleaner Production, 396, 136510.

27. Štefko, R., Fedorko, R., Svetozarovová, N., & Nastišin, Ľ. (2021). Start-up Management and the Relationship between the Level of Awareness among Potential Young Entrepreneurs and the Motivation to Start Own Business. Quality-Access to Success, 22(183).

28. Oguanobi, V. U., & Joel, O. T. (2024). Scalable business models for startups in renewable energy: strategies for using GIS technology to enhance SME scaling. Engineering Science & Technology Journal, 5(5), 1571-1587.

29. Nigbor-Drożdż, A. (2022). Startup and the economy 4.0. International Journal for Quality Research, 16(3), 749-766.

30. Silva, E., Beirão, G., & Torres, A. (2023). How startups and entrepreneurs survived in times of pandemic crisis: Implications and challenges for managing uncertainty. Journal of Small Business Strategy, 33(1), 84-97.

31. Kijkasiwat, P. (2021). Opportunities and challenges for Fintech Startups: The case study of Thailand. ABAC Journal, 41(2), 41-60.

32. Bazarbash, M., Griffin, N. N., Una, G., & Verma, A. (2023). Emerging ideas for fintech applications in public finance. In Research Handbook on Public Financial Management (pp. 31-56). Edward Elgar Publishing.

33. Ghasempoor Anaraki, M., Vladislav, D. S., Karbasian, M., Osintsev, N., & Nozick, V. (2021). Evaluation and selection of supplier in supply chain with fuzzy analytical network process approach. Journal of fuzzy extension and applications, 2(1), 69-88.

34. Quezada, L. E., Aguilera, D. E., Palominos, P. I., & Oddershede, A. M. (2022). An ANP model to generate performance indicators for manufacturing firms under a balanced scorecard approach. Engineering Management Journal, 34(1), 70-84.

35. Mahdinia, M., Sadeghi Yarandi, M., Fallah, H., & Soltanzadeh, A. (2022). Modeling cause-and-effect relationships among variables affecting work stress based on fuzzy DEMATEL method. Journal of Public Mental Health, 21(4), 341-356.