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Optimizing Islamic Boarding School Edupreneurship Through Internet of Things Adoption and Fuzzy Analytical Hierarchy Process

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ABSTRACT

Islamic boarding schools are the oldest Islamic Edupreneurshipal institutions that are deeply rooted in the history of the Indonesian nation. Since the 15th century, Islamic boarding schools have existed as a manifestation of the synergistic encounter between universal Islamic teachings and local wisdom. Islamic boarding schools can survive across time and generations, because the Islamic boarding school Edupreneurship system prioritizes the formation of spirituality, morality, noble morals and manners. The current study attempts to recommend a priority strategic in adopting Internet of Things (IoT) to create innovative services in islamic boarding School. **The processing technique** used to determine the strategy is the fuzzy Analytical Hierarchy Process (AHP). This research was conducted in Islamic Boarding School by Focus Group Discussion (FGD) with several experts. The expert is mayor of Depok, head of the Data and Information Center of the Ministry of Edupreneurship and Culture, Director of Edupreneurship Diniyah Islamic Boarding School, founder of Islamic boarding school Cendekia Amanah, Professor of Ushuluddin Faculty, IoT practitioner, alumni, and Islamic boarding school practitioner. The results show that the most dominant factor in improving services is human resources, and the actor is the islamic boarding management leader. The following **finding** is that the Increase organizational impact through service effectiveness and efficiency. The prior alternative strategy to recommend is by Building a technology culture among Islamic boarding school residents through Islamic boarding school values, habits and systems. **The results** of this study are presented and discussed, and the results of this study can be helpful for islamic boarding school in similar developing countries.

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1. INTRODUCTION

Islamic Boarding Schools have undergone significant transformations over the past decade due to globalization, competition, and shifting funding sources. Change is inevitable, and an institution ability to adapt is crucial for its success [1]. As the environment evolves, enterprises must continuously grow, requiring new skills, including resilience in challenging conditions [2, 3]. Organizational change, human development, and technological integration are key to navigating these shifts. The Islamic Boarding School, deeply rooted

in Indonesian history, has also been affected by this disruptive period [4, 5]. Despite its historical significance, limited research exists on IoT adoption in Islamic Boarding School. This study bridges that gap by exploring how IoT enhances Edupreneurshipal services and administrative efficiency in these institutions while maintaining their traditional values [6].

Islamic Boarding School Edupreneurship is evolving, integrating cultural strengths with global advancements to remain competitive. The interplay between Islamic boarding schools and technological progress highlights the importance of scientific and technological adaptation [7, 8]. This study applies fuzzy AHP to prioritize strategies for IoT adoption, a method not commonly used in Islamic Edupreneurship. Unlike general studies on technology adoption, this research uniquely aligns IoT implementation with Islamic Boarding School values, emphasizing human resources and organizational strategies. Maintaining Islamic Boarding School role as a moral and spiritual foundation while integrating digitalization is essential [9]. As digital transformation accelerates, Islamic Boarding School must modernize their systems to ensure relevance and sustainability [1, 10].

Innovation and creativity are vital for Islamic boarding schools in responding to rapid technological advancements [11, 12]. Some concerns exist regarding technology impact on student-teacher interactions, potentially diminishing respect. However, innovation in Islamic Boarding School involves applying new ideas and solutions to enhance Edupreneurship, management, and services. IoT implementation aims to boost Islamic Boarding School innovation by improving efficiency and Edupreneurshipal quality [13, 14]. IoT allows data transmission without human intervention, with rapid advancements driven by technological progress [15, 16]. Its infrastructure connects physical and virtual objects through global networks and data capture technologies [17, 18].

Multi-criteria decision-making (MCDM) techniques facilitate complex decision-making by considering multiple factors [19, 20]. Traditional AHP, which breaks down problems into hierarchical elements, has limitations due to its rigid comparison scales [21, 22]. Fuzzy AHP improves upon this by incorporating qualitative and quantitative inputs, addressing uncertainty in decision-making. By allowing decision-makers to provide assessments within a range rather than a fixed value, fuzzy logic enhances the flexibility and accuracy of strategic planning [23]. This study application of fuzzy AHP in IoT adoption within Islamic boarding schools provides a structured approach to integrating technology with Edupreneurship while preserving core values.

As a G20 member, Indonesia holds significant economic potential and represents the Islamic world and Southeast Asia [24, 25]. With a large and predominantly young population, Indonesia faces both opportunities and challenges in workforce development [26]. The effectiveness of training and skill development programs will determine whether this demographic advantage translates into economic productivity. Islamic schools must proactively develop strategies to equip students with relevant skills for the modern era [27]. Enhancing the competitiveness of Islamic Boarding School requires strengthening research capacities, improving Edupreneurship quality assurance, and encouraging empirical studies [28].

This study provides strategic recommendations for IoT adoption in Islamic boarding schools using fuzzy AHP, ensuring the optimal allocation of resources and enhancing service innovation. By exploring IoT applications beyond Islamic Edupreneurship, such as in rural and urban schools globally, this research highlights the scalability of technological integration across different Edupreneurshipal settings. Fuzzy AHP allows for a more nuanced decision-making process, particularly when balancing infrastructure needs with cultural adaptation. As Islamic boarding schools strive to blend religious Edupreneurship with digital advancements, a well-structured IoT adoption model is necessary [29, 30]. Implementing creative service strategies will ensure that Islamic Boarding School remain at the forefront of innovative Edupreneurship while preserving their cultural and spiritual identity.

2. LITERATURE REVIEW

The primary theoretical framework for understanding organizations is organizational contingency theory. Throughout organizational science history, the contingency theory has included numerous significant components [31, 32]. According to the contingency theory paradigm, an organization performance results from matching its structure and other organizational traits with contingencies that accurately represent its circumstances [33]. The environment [33], organizational scale, and organizational strategy are examples of contingencies. [34] Organizations work to accomplish the alignment of organizational traits with contingencies since it will lead to excellent organizational performance. Organizations are therefore driven to adopt new

traits or organizational structures that correspond with the new levels in order to prevent the inconsistencies that result from situational changes. As a result, organizations are shaped by circumstances because they must be modified to prevent a drop in performance.

Contingency theory states that fit determines performance, which propels adaptive organizational change. Organizations function in accordance with their contingencies, which leads to an alignment between the organization and the contingencies and a relationship between the contingencies and the organization nature [35]. Three contingencies are involved in several significant organizational contingency theories: strategy, organization size, and environment. The mechanistic structure is impacted by the environmental stability contingency [36]. The mechanistic (i.e., hierarchical) or participative nature of an organization structure depends on how quickly technology and the market evolve around it [35].

Divisional organization is influenced by contingency plans. Because all efforts are concentrated on a single good or service, the functional structure supports a non-diversified strategy and increases efficiency through function-based specialization. (For example, production department, sales, etc.). Conversely, the divisional structure is more in line with a variety of strategies since it includes a range of operations that cater to distinct product markets; as a result, efficiency is increased by organizing each good or service under its own division [37]. The three variables that need to be taken into account by organizational structure are strategy, size, and environment, according to the structural contingency theory. It is evident that each of these variables affects particular facets of the divisions, bureaucracy, and organic organization, in that order. According to their structural impact, one of these contingencies tends to change when the other one does [38].

3. RESEARCH METHOD

[21] created the AHP as a tool for decision-making. The Fuzzy AHP methodology was chosen because it integrates fuzzy logic, which addresses the inherent uncertainty in expert judgments. Unlike traditional AHP, which relies on crisp values, FAHP allows for the use of fuzzy numbers that can better capture the ambiguity present in decision-making. The integration of qualitative and quantitative data is accomplished by using fuzzy numbers to represent subjective expert opinions and combining them with quantitative data from the hierarchical model. This integration is vital in environments like Islamic boarding schools, where decisions are often based on both tangible metrics and subjective insights, ensuring that the resulting strategies are comprehensive and realistic.

Three principles are described by [21] as being used in problem resolution with extensive logical analysis underlying AHP: hierarchy, prioritization, and logical consistency. Subjective elements including perception, preference, experience, and intuition are taken into consideration by the AHP technique. One analytical method that managers employ to help them make decisions is the AHP approach. Therefore, these decision domains can be analyzed using AHP. In order to solve difficulties, analytical thinking relies on a thorough logical analysis [21]. The three fundamental tenets of AHP are as follows:

- The hierarchy principle
- The priority principle
- The logical consistency principle

The knowledge or information being observed is first identified, and then complex problems are broken down into their most basic components to create the hierarchical arrangement. The principal components are decomposed into their component pieces in a hierarchical manner. By using pairwise comparisons, each level of the hierarchy is evaluated.

[21] asserts that the ideal scale for expressing thoughts on a range of issues is from 1 to 9. When comparing pairs of items at each level of the hierarchy to an element at the top level, a scale ranging from 1 to 9 is established. The degree to which we are able to discern the strength of the link between items can be expressed on a nine-point scale. [21] states that if the consistency ratio (CR) of the pairwise comparison matrix is 10%, it is considered consistent. The 'crisp' level on the AHP scale is seen to be less capable of managing uncertainty. As a result, the original AHP scale ought to be comparable to the other techniques. One strategy is to apply fuzzy logic. A logic with ambiguity or fuzziness between two values is known as fuzzy logic. It is anticipated that the fuzzy technique will reduce uncertainty, particularly the Triangular Fuzzy Number (TFN) to the AHP scale. The verification process of enhancing entrepreneurial innovation methods in coastal areas

is expected to yield more precise outcomes. The shortcomings of AHP are addressed by combining the AHP method with the fuzzy idea approach, namely issues with criteria that have more subjective qualities [39]. Ratio comparisons can lead to choice inaccuracies, according to certain literature. Fuzzy AHP combines hierarchical structure analysis and fuzzy theory from a private university to select an alternative and modify the problem [39, 40].

The definition of the issue and choice of the ideal solution are the first steps in the fuzzy AHP method decision-making process. Next, a hierarchical structure is created. This involves developing a pairwise comparisons matrix that explains the relative contribution or effect between one element and another. Each stage of the hierarchy that has been assembled is then given weight. The following phase is data input, which involves entering the numbers acquired from Fuzzy AHP specialists' questionnaire responses after the scale has been determined. The pairwise comparison results from each criterion, sub-criteria, and alternative strategy will be generated in this section following data entry in the pairwise comparison tool for Fuzzy AHP. The priority vector for every element can be determined from this outcome.

There are just two potential memberships for a crisp set: membership and non-membership. On the other hand, fuzzy set members have an unclear fuzzy value that ranges from false to true. A fuzzy set can distinguish between black, gray, and white, unlike a firm set, which can only distinguish between black and white. A membership function, or curve, that displays the data input points into a fuzzy set membership with an interval between 0 and 1, can be used to define any fuzzy set. The membership value can be obtained using a function technique. Numerous functions are available for use, such as triangular, trapezoidal, and linear representation. For future research, it would be important to examine the long-term effects of IoT adoption on Edupreneurshipal outcomes and explore how such technologies can be adapted in different cultural and geographic contexts. Another area of future research could include evaluating the effectiveness of training programs for teachers and staff, as well as investigating the scalability of IoT solutions in more rural or economically disadvantaged regions. Challenges in the implementation of IoT could include overcoming resistance from traditional Edupreneurshipal stakeholders, addressing privacy and security concerns associated with IoT devices, and ensuring equitable access to the required technology. These considerations are crucial for the successful integration of IoT in Islamic boarding schools and similar Edupreneurshipal contexts.

3.1. Development of the Hierarchy Model

Before data collection, it is required to develop a conceptual model for a decision problem. A major limitation of the traditional AHP model is its reliance on crisp, numerical comparisons, which may not be sufficient when dealing with subjective expert judgments, particularly in qualitative areas such as cultural fit or leadership skills. Fuzzy logic, on the other hand, introduces flexibility by allowing expert opinions to be expressed in fuzzy numbers or ranges, thus capturing the inherent uncertainty and variability of human judgment. This is especially important in Edupreneurshipal contexts like Islamic boarding schools, where the decision-making process involves multiple subjective factors. By using fuzzy logic in conjunction with AHP, this study provides a more robust framework for decision-making, accommodating both quantitative and qualitative data more effectively.

A hierarchy is a specific type of system, based on the assumption that the entities can be grouped into disjoint sets, with the entities of one group influencing those of other groups. Establishing a hierarchical structure to evaluate Islamic Edupreneurship capabilities and ecosystem is necessary to select an appropriate change strategy. The central part of the qualitative component of Fuzzy AHP, as Figure 1, drives all criteria for the overall goal. The criteria used as experts are those who have experience leading Islamic Edupreneurship in Indonesia, including the mayor of Depok, head of the Data and Information Center of the Ministry of Edupreneurship and Culture, Director of Edupreneurship Diniyah Islamic Boarding School, founder of Islamic boarding school Cendekia Amanah, Professor of Ushuluddin Faculty, IoT practitioner, alumni, and Islamic boarding school practitioner.

Fuzzy logic provides a crucial advantage in decision-making contexts that involve subjective elements such as cultural values and leadership qualities, which are difficult to quantify precisely. In Islamic boarding schools, where traditional values and modern Edupreneurshipal practices often intersect, decisions must take into account a wide range of qualitative factors. By integrating fuzzy logic into the AHP model, decision-makers can account for the inherent uncertainty and complexity of such decisions. This flexibility helps ensure that the decision-making process is more aligned with real-world scenarios, where exact numerical values are often unavailable. It also allows for a more nuanced approach to evaluating alternative strategies, ensuring that

all relevant factors, both tangible and intangible, are properly considered in the decision-making process.

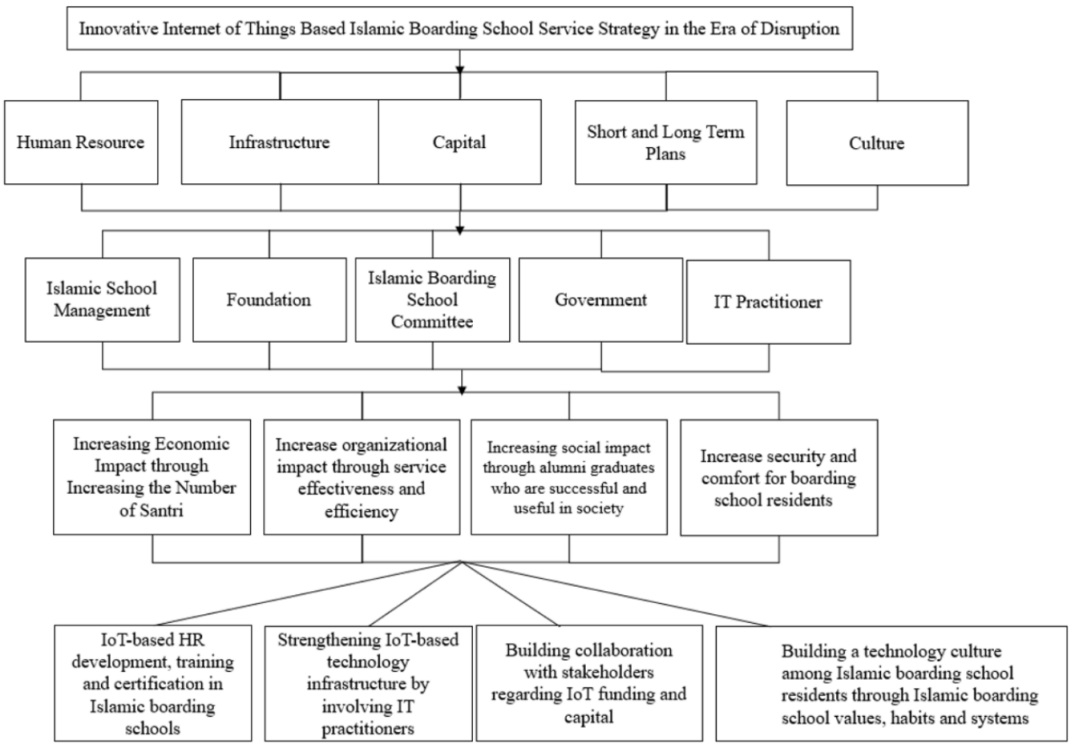

Figure 1. Analysis Framework Using Mactor

The diagram in Figure 1 outlines a strategic framework for implementing IoT-based services in Islamic boarding schools. It highlights key factors such as human resources, infrastructure, capital, plans, and culture, linking them to stakeholders like school management, foundations, committees, government, and IT practitioners. The strategy aims to enhance economic impact, improve organizational efficiency, boost security, and foster a technology-driven culture aligned with Islamic values. It also emphasizes collaboration for IoT funding, strengthening infrastructure, and developing human resources. The goal is to create a more efficient, secure, and innovative environment through IoT integration.

3.2. Pairwise Comparison Matrix

Following the creation of the hierarchy, the seven experts are requested to assess the relative relevance of the elements at each level by comparing them pairwise. A scale of ratios was employed. The significance level is defined as follows: 1 indicates equally significant, 3 means slightly more important, 5 means more critical, 7 means very clearly more crucial, and 9 implies absolutely more important [41]. The ratio scale that is employed is a scale of 9.

Table 1. Fuzzy Number Conversion

No	AHP Scale	Information	Triangular Number
1	1	Equally Important	(1,1,3)
2	3	A Little More Important	(1,3,5)
3	5	Obviously More Important	(3,5,7)
4	7	Very Obviously More Important	(5,7,9)
5	9	Absolute More Important	(7,9,9)

In Table 1 the structured and dynamic numerical estimators are fuzzy systems. According to [23], this system is capable of developing intelligent systems in an unsettling and unsuitable environment. This system uses fuzzy logic to anticipate a function. Boolean logic, which holds the notion of degrees of truth that is,

the truth value ranging from true to false includes fuzzy logic. Fuzzy logic frequently makes use of verbal and linguistic data. There are various procedures in fuzzy logic, including fuzzy inference, fuzzy collection, and the application of if then rules [42, 43]. A function rule in a TFN, which is arranged according to a linguistic set, is utilized to ascertain the degree of membership in fuzzy AHP. The set of TFN scales is derived from the number at the intensity of interest in the AHP. The lowest value (l), the median value (m), and the greatest value (u) are the three membership functions that make up TFN. Using language or linguistics, the TFN, a fuzzy set theory, is used to quantify human subjective judgments. Fuzzy AHP is primarily concerned with pairwise comparisons that are represented by a ratio scale that is connected to the fuzzy scale [44].

4. RESULT AND DISCUSSION

This study shows that nine specialists with knowledge and experience in running an Islamic school boarding are involved in the private university priority strategy analysis. The integration of IoT technology can significantly improve operational efficiency, leading to cost reductions that could be redirected toward improving community services, such as healthcare and infrastructure. Additionally, by enhancing the quality of Edupreneurship, IoT adoption can contribute to building a more skilled workforce, which could drive local economic growth and prosperity. The study also suggests that this model could be applied globally, especially in regions with similar socio-economic conditions, demonstrating the adaptability of IoT in improving Edupreneurshipal outcomes. The successful implementation of IoT in Islamic boarding schools could provide a blueprint for schools in developing countries, promoting more inclusive and innovative Edupreneurship worldwide. Experts were interviewed in-depth to develop a number of crucial factors that will help determine which strategic changes should be prioritized in order to improve quality service in higher Edupreneurship. Priority strategies are set using the fuzzy AHP approach. The primary component that can facilitate the attainment of these objectives is the caliber and competencies of human resources (HR), as indicated by Table 2 with 0.210. Thus, the primary tactic in creating IoT-based Islamic boarding school services must be human resource-related.

Islamic boarding schools must devote time and resources to training staff and students in the usage of IoT in order to make successful use of this technology. Both non-technical and technical topics, such cooperation and communication, can be covered in training. Examples of technological topics include programming, data analysis, and network management. Islamic boarding schools can make sure they can manage and use IoT technology to enhance the quality of instruction and learning services by strengthening HR expertise. Aside from that, HR plays a critical role in team collaboration in Islamic boarding schools, which fosters synergy in the implementation of IoT. Each person needs to play a distinct yet complementary role in the endeavor to accomplish shared objectives. Islamic boarding schools can make the most of their current human resources to develop more potent IoT-based solutions by assembling a team of professionals with a range of expertise, including educators, IT specialists, and administrative managers.

Islamic boarding schools may provide parents and students with higher-quality services by leveraging the IoT. For instance, Islamic boarding schools can improve parent-student communication, give prompt feedback, and track students' academic progress in real time with an IoT-based management system. Information technology-savvy human resources professionals can automate repetitive processes and lighten the administrative burden. Administrators of Islamic boarding schools will be able to concentrate on both improving overall operational efficiency and strategic areas of institutional management as a result. IoT presents opportunities to develop more creative and engaging teaching strategies for pupils. Islamic boarding schools can provide learning experiences that are more dynamic and pertinent to the needs and interests of students in the digital age by incorporating technology into the teaching and learning process.

Table 2. Factor Weight on a Strategy to Improve Performance

No	Factor	Weight	Priority
1	Human Resources	0.210	1
2	Infrastructure	0.195	5
3	Capital	0.198	3
4	Short and Long Term Plans	0.199	2
5	Culture	0.198	4

Then the actors that play a role in Table 2. in improving service quality in ministries are Foundations (0.242), Islamic boarding school management (0.293), Islamic boarding school committees (0.148), Government (0.190), IT practitioners (0.127). This study supports earlier research that demonstrated leaders may use technology to affect behavior, which improves performance. [26] state that owners and senior managers need to be dedicated to playing a significant yet difficult part in creating an innovative culture that is, a digital culture fit for the digital age. Management must take a proactive role in implementing the IoT in Islamic boarding schools. Planning, executing, and assessing the use of modern technology to raise the standard of instruction and services in Islamic boarding schools are critical tasks for management.

It is crucial to work in tandem with the management of Islamic boarding schools to develop IoT deployment. Management can guarantee the successful implementation of IoT and its substantial benefits to Edupreneurship and services in Islamic boarding schools by creating a vision and strategy, providing resources, creating policies, offering training, fostering innovation, fostering collaboration, and conducting monitoring and evaluation. Putting IoT into practice will improve operational effectiveness while also giving students access to a more creative and dynamic learning environment.

The Foundation is a major contributor to the development and upkeep of the IoT in Islamic boarding schools. Through the provision of financial resources, policy development, training facilitation, partnership building, innovation encouragement, monitoring, and evaluation, foundations can assist Islamic boarding schools in keeping up with technology advancements and enhancing the quality of services offered. Using IoT is not just about implementing technology; it also a calculated move toward improving and innovating the learning environment.

Table 3. Actor Weight on the Strategy to Improve performance

No	Actor	Weight	Priority
1	Islamic Boarding School Management	0.293	1
2	Foundation	0.242	2
3	Boarding School Committee	0.148	3
4	Government	0.190	4
5	IT Practitioner	0.127	5

One measure used to assess the efficacy of Edupreneurship across national borders is the degree of success attained by its alumni [45, 46]. These findings align with those of [2, 47, 48]. Gaining transferrable skills and engaging in a range of off-campus learning opportunities, such as communication and leadership development, are essential for academic success [49, 50]. The main priority targets derived from the analysis of the ministry performance digital competency development strategy are as follows: increasing security and comfort for residents of Islamic boarding schools (0.232); increasing organizational impact through service effectiveness and efficiency (0.288); increasing social impact through alumni graduates who are successful and useful in society (0.216); and increasing economic impact through an increase in the number of Santri (0.264). The particular results of the primary objectives are shown in Table 3, together with their weights and priorities. The research indicates that in order to provide different kinds of value, IoT-based service systems need make use of effective resources [51, 52].

Table 4. Objective Weight on the Strategy to Improve Performance

No	Objective	Weight	Priority
1	Increasing Economic Impact through Increasing the Number of Santri	0.264	2
2	Increase organizational impact through service effectiveness and efficiency	0.288	1
3	Increasing social impact through alumni graduates who are successful and useful in society	0.216	4
4	Increase security and comfort for boarding school residents	0.232	3

As seen from Table 4, the implementation of IoT in Islamic Boarding Schools has a clear objective, namely to increase the impact of the organization by increasing the effectiveness and efficiency of services [53]. Implementation of the IoT in Islamic boarding schools aims to increase organizational impact through service effectiveness and efficiency. By improving service quality, operational efficiency, decision making,

collaboration, innovation, and sustainability, Islamic boarding schools can create a better, more responsive, and more connected Edupreneurshipal environment [54, 55]. Implementing IoT is not just about technology, but also about creating added value for the entire Islamic boarding school community and improving the quality of Edupreneurship provided.

Table 5. Alternative strategies for changing private universities in achieving higher Edupreneurship Performance

No	Alternative Strategy	Weight	Priority
1	IoT-based HR development, training and certification in Islamic boarding schools	0.270	2
2	Strengthening IoT-based technology infrastructure by involving IT practitioners	0.189	4
3	Building collaboration with stakeholders regarding IoT funding and capital	0.246	3
4	Building a technology culture among Islamic boarding school residents through Islamic boarding school values, habits and systems	0.295	1

Alternative strategies for building a technological culture among Islamic boarding school residents through values, habits, and IoT utilization systems are listed in Table 5. Islamic boarding schools have an important role in the Edupreneurship and character development of students [56, 57]. In the current digital era, expanding the use of technology, especially the IoT, can provide significant benefits for management and services in Islamic boarding schools. However, to achieve these benefits, it is important to build a strong technology culture among Islamic boarding school residents. Alternative strategies that are considered the most priority and reliable. Building a technology culture among Islamic boarding school residents through Islamic boarding school values, habits and systems (0.295) [58]. Development, training and certification of IoT-based human resources in Islamic boarding schools (0.270). And the third is Building Collaboration with stakeholders regarding IoT funding and capital (0.246) and the fourth is Strengthening IoT-based technology infrastructure by involving IT practitioners (0.189).

Building a technology culture among Islamic boarding school residents through values, habits and systems for using IoT is an important step to exploit the potential of technology in Edupreneurship. By instilling positive values, forming supportive habits, creating effective systems, encouraging collaboration, and carrying out continuous evaluations, Islamic boarding schools can create an environment that is adaptive to technology, and improve the quality of Edupreneurship and services provided to students. Through this holistic approach, technology culture can grow and develop, bringing a positive impact to the entire Islamic boarding school community. The following are several stages for building a technology culture through values, habits and systems in using IoT.

5. MANAGERIAL IMPLICATIONS

The implementation of innovative service models in Islamic boarding schools, particularly those leveraging technology such as IoT, has significant implications for students, administrators, and the surrounding community. By incorporating smart tools like interactive boards, learning applications, and e-learning platforms, the Edupreneurshipal process becomes more engaging, allowing students to participate actively in their learning journey. Additionally, data collection on student performance and interests enables personalized teaching methods, ensuring a more effective and tailored learning experience. Beyond academics, IoT-based solutions assist administrators in efficiently managing resources such as energy, water, and raw materials, leading to cost savings and sustainability. Automating administrative tasks like attendance tracking and student data management enhances transparency and accuracy while reducing manual workload. Moreover, wearable health-monitoring devices contribute to student welfare by enabling early detection of health issues, while environmental sensors maintain optimal living and learning conditions within dormitories and classrooms.

Beyond direct Edupreneurshipal benefits, innovative service models foster a culture of innovation among students and administrators, equipping them with the skills to think creatively and solve problems using technology. These advancements also extend beyond the school environment, allowing Islamic boarding schools to play a more active role in social entrepreneurship by utilizing technology to address local issues in

Edupreneurship, health, and environmental sustainability. The integration of IoT in Islamic boarding schools serves as a model for broader applications, demonstrating its potential in social and health entrepreneurship, particularly in resource-constrained settings. By improving efficiency, communication, and resource allocation, these innovations can support community-based projects and healthcare services in developing countries. Ultimately, by adopting technology-driven approaches, Islamic boarding schools not only enhance the learning environment but also establish themselves as agents of positive social change, strengthening their reputation and influence within society.

6. CONCLUSION

The results revealed that the implications of innovative service strateies in Islamic boarding schools are very broad and have a significant impact on various aspects, from the quality of Edupreneurship to the welfare of students and resource management. By utilizing technology and innovative approaches, Islamic boarding schools can create a better learning environment, meet the needs of students holistically, and contribute to society more broadly. Good implementation of this model will not only strengthen Islamic boarding schools as Edupreneurshipal institutions, but also as agents of positive social change.

The Fuzzy AHP shows that developing digital competence requires the main factor in the form of the availability of human resources. Furthermore, according to the results of the Fuzzy Interpretative Structural Modeling (ISM) analysis, the development of innovative IoT-based services must also be supported by the main behavior of a technology-based culture. This is an element of change that may be carried out by organizations based on ISM. The availability of an IoT-based main service system can start with the application of digital culture that is integrated with Islamic boarding school values as controlled input from the service development system.

The challenges of each country have their own characteristics. Future research can try to differentiate the application of fuzzy AHP in other countries' emerging countries. And future research can test and prove the success rate of this strategy.

7. DECLARATIONS

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7.2. Author Contributions

Conceptualization: KL; Methodology: MS; Software: YH; Validation: LD and KL; Formal Analysis: MS and YH; Investigation: MS; Resources: LD; Data Curation: KL; Writing Original Draft Preparation: YH and LD; Writing Review and Editing: KL and MS; Visualization: LD; All authors, KL, MS, YH, and LD, have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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