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ORIGINAL SCIENTIFIC PAPER

Mapping Agility Factor Dependencies in the IT Sector of Humanitarian Organizations Using the ISM Approach

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ABSTRACT
Organizations are gradually relying on Information Technology (IT) to assist them in addressing unexpected challenges they face in their daily operations. The reliance is particularly essential in humanitarian settings where agility and adaptability are crucial. To examine the factors influencing IT agility in the humanitarian context, Interpretive Structural Modeling (ISM), along with MICMAC analysis, were applied. After identifying interconnections among the factors, they were classified according to their driving and dependence power. This study emphasizes the importance of continuous monitoring and flexible strategies to maintain operational efficacy. While the diverse insights gained from the research are valuable, this diversity could also be considered a limitation. The IT experts, who participated in the study, hold diverse positions across different IT sectors within the organization. The consistency of the results may be impacted by differences in how these factors are seen and prioritized in their specific work settings, rather than a unified perspective on IT agility. Future studies can explore the dynamics across different sectors or with a larger sample size to validate the results in a broader context. This study contributes to the understanding of how IT agility can be managed and optimized in humanitarian contexts, providing valuable insights for practitioners and researcher.

Keywords: *IT agility, humanitarian organization, ISM, MICMAC analysis*

JEL Classification: L20, M54

INTRODUCTION

Over the past few years, the variety of studies on the topic of agility has increased remarkably. Under Agile Alliance (n.d.), agile practices are described as a form of action focused on delivering solutions through continuous cooperation, teamwork, and a foundation of trust, and are frequently followed by informal communication. The important elements of the term 'agility' are responsiveness and flexibility, with responsiveness implying the capacity to detect operational risks and respond to them properly, and flexibility referring to the ability to act quickly (L'Hermitte et al., 2015; Lee, 2017; Kirkpatrick et al., 202). Bambauer-Sachse and Helbling (2021) note that the focus is on its ambiguity, intermittent approach, and flexible reactions to change regardless of the project phase. Agile methods are based on the principles introduced in the *Manifesto for Agile Software Development* (Beck et al., 2001). In line with the same document, four main values were defined: prioritizing people and their interactions over procedures and tools; focusing on delivering functional software instead of extensive documentation; valuing

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collaboration with customers rather than adhering strictly to contracts; and being adaptable to change more than sticking rigidly to a predefined plan.

Given the fact that companies and non-profit organizations are faced with a fast-evolving environment, the decision to accept agility and keep up with it has become standard (Rigby, 2016). In agreement with that, Nguyen et al. (2024) assert that volatile and complex circumstances now prevail over structured approaches. To organizational performance, agility is deemed advantageous, but these advantages depend on a variety of factors, such as the form of agility, the outcome desired, and the conditions necessary for agility to achieve these outcomes (Wieland & Wallenburg, 2012).

The purpose of this paper is to identify the relationships between the factors affecting agility in IT and to determine relationships among these factors in the setting of humanitarian activity. The paper starts with an introduction to the concept of agility in different spheres, with a particular emphasis on the IT sector, providing an overview of its significance in IT operations. This is followed by a portrayal of the methodology applied, specifically the Interpretive Structural Modeling (ISM) and MICMAC analysis, explaining how these tools were used to identify and classify the relationships between the factors. The paper concludes with a discussion of the results, offering insights into the effects these factors have. Additionally, the article provides recommendations for future studies and suggests areas that could lead to new and invaluable discoveries.

The study's relevance stems from its increasing significance of agility in the IT management of humanitarian organizations. Although corporate agility in IT has been thoroughly examined in business environments, its role in humanitarian settings is still under research. Therefore, this research contributes to the humanitarian field by examining interactions between IT's agility variables in its settings. In doing so, it provides both academic insights and practical guidance on agility for improving operational efficacy in humanitarian organizations.

THEORETICAL BACKGROUND

Organizational Agility

To better understand the foundation of organizational agility, this section explains its core elements through different studies and industries.

Across numerous studies, organizational agility (OA) has been shown to have a great impact on organizational performance. Vázquez-Bustelo et al. (2007) consider OA a 'holistic concept' that necessitates attention to its specific segments. Organizational agility is described as flexibility, swiftness, velocity (Sing et al., 2013), and the capacity to react to change and increase opportunities (Ravichandran, 2018).

Three components of OA were presented in Wendler's (2014) research: agile values, technology, and people. Leonhardt et al. (2016) conducted a quantitative meta-analysis and outlined the specifics of IT and OA. Puthenpurackal et al. (2021) present existing insights on how project portfolios facilitate IT agility while integrating agile practices. They present different meanings of OA depending on the dimension: customer, partnering, and operational agility — focused on supply chain, customer responsiveness, and internal processes (Chen & Siau, 2012; Zaini & Masrek, 2013; Mao et al., 2014); entrepreneurial and adaptive agility — highlighting the ability to be proactive, perceive and respond to changes (Chakravarty et al., 2013); market capitalizing and operational adjustment — presenting capability to tailor business processes to improve services or products (Cai et al., 2017; Panda & Rath, 2017; Zhou et al., 2018).

Over time, the concept of agility has been examined across diverse areas, with a focus on different elements. Various researchers have identified critical factors that enable organizations to effectively respond to change: agility enablers (Overby et al., 2006; Aravindraj et al., 2013); workforce agility (Sumukadas & Sawhney, 2004; Alavi et al., 2014), supply chain agility (Eckstein et al., 2015; Chen, 2019), implementation methodologies (Hazen et al., 2017; Nejatian et al., 2018), information systems agility (Rabah et al., 2015), strategic agility (Fourné et al., 2014; Morton et al., 2018).

While the theoretical foundation of organizational agility has been studied across many sectors, there remains a gap in recent literature on how these concepts relate to the nonprofit and humanitarian IT spheres. The need to better understand agility enablers in specific settings is emphasized in recent literature, especially considering emerging technologies and increasingly challenging environments. As a result, this research examines and analyzes agility factors more closely by looking at the interrelationships among them, enhancing the existing knowledge base, and identifying opportunities for future studies.

Agility in IT and the Humanitarian Sector

Nonprofit organizations play an essential role and are vital in providing services to communities. In their research on strategic IT alignment and OA in nonprofits, Azevedo et al. (2024) observe that nonprofits also face pressure for enhanced performance and value creation for stakeholders. Based on previous studies concerning the topic of OA, three practices shape agile organizations — perceiving, comprehending, and responding (Butler & Surace, 2015; Tallon et al., 2019), meaning that organizations must sense the change, grasp the information, and react accordingly. Tallon et al. (2019) illustrate how agility is perceived and draw attention to the critical role that IT plays in decision-making and managing challenges. The fusion of artificial and human intelligence is becoming increasingly relevant in today's world. For instance, Singh (2024) shows that digital platforms can significantly enhance agility by facilitating coordination among supply chain actors. Similarly, Wang et al. (2024), also highlight the importance of understanding the enablers of such integration for achieving faster and sharper response in volatile settings.

Marjerison et al. (2022) affirm that agile organizations are more inclined to nurture a culture of knowledge sharing, which has a positive impact on amplifying their adaptability and collaboration, but policies, activities, and strategies can affect organizational agility by restricting the organization's capacity to serve its stakeholders (Azevedo et al., 2024). Besides these factors, as noticed by the same authors, IT alignment, technologies, leadership, and the entire organizational structure can impact organizational agility. Lee (2017) emphasizes the significance of IT alignment with an organization's strategic roadmap process. In addition to that, Setiawati et al. (2022) emphasize the vital role of top management, while also acknowledging the equally important role in fostering the agility of other employees across HR, operations, IT, and different departments.

It's crucial for both humanitarian organizations and for-profit companies to identify and implement best practices to enhance organizational agility and achieve sustainable performance in rapidly changing environments.

Recent empirically based frameworks developed for evacuation agility underline the complex nature of agility in humanitarian contexts. Achieving operational responsiveness has been found to depend highly on core elements such as stakeholder engagement, staff empowerment, information flow, and inter-organizational collaboration. These elements reflect the interconnected factors examined in this study, reinforcing the relevance of a systems-based approach in managing IT agility in humanitarian settings (Rodríguez-Espíndola et al., 2021). In line with that, Tickle et al. (2024) argue that embracing fourth-party logistics models can enhance adaptability and responsiveness in the humanitarian chain.

Novel studies aim to examine the concept of agility in the humanitarian sector, whereas former studies were focused on understanding agility in corporate settings. Pereira and Shafique (2024), for example, illustrate how emerging technologies like AI and real-time data analytics are transforming the agility of the humanitarian supply chain. Similarly, Abou-AL-Ross and Shatali (2022) discuss the potential of workforce agility when operating in unpredictable circumstances.

In keeping with Kelly et al. (2022), these practices underscore the crucial role of flexibility in responding to evolving humanitarian needs.

Despite these contributions, the structural relationships among agility enablers have not been thoroughly examined, principally in IT departments of humanitarian organizations. This study aims to shed light on that by implementing ISM and MICMAC methodologies to unveil the agility factor dynamics in such a unique operational context. Therefore, it not only deepens our theoretical understanding but also offers practical insights that can help organizations respond more effectively to change.

DATA AND METHODOLOGY

The analysis begins with a determination of factors that affect agility. Interpretive Structural Modeling (ISM) was applied to identify the relationship among the factors influencing agility in IT operations within a humanitarian organization. After various factors were determined, a Structural Self-Interaction Matrix (SSIM) was developed to establish how these factors influence or interact with each other. This matrix is then converted into a Reachability Matrix (RM), where its transitive relationship is tested. MICMAC analysis has been used to classify factors based on their driving and dependence power.

Sl. No	Enablers	Definition	Factors-meanings
1	Flexibility	Ability to change or react with little penalty in time, effort, cost, or performance.	Volume flexibility (F1) – ability to change the level of aggregated output. Delivery flexibility (F2) – ability to change planned or assumed delivery time.
2	Responsiveness	Ability to respond to changes within an appropriate time frame.	Reactivity (F3) – ability to evaluate and take needs into action quickly. Velocity (F4) – ability to cover needs quickly
3	Effectiveness	Doing all the right things at the right place and at the right time.	Reliability (F5) – ability to deliver the correct product at the correct place at the correct time. Completeness (F6) – ability to realize goals.
4	Skills and learning	Requirement for greater skills to overcome linguistic and contextual differences.	Multi-skilled and flexible people (F7) – ability to work at different phases of the event. Informal learning and development (F8) – learning from the previous events/ancestors.
5	Change	Ability to improve oneself by updating towards improvement.	Change of culture (F9) – paradigm shifting and culture changes. Continuous improvement (F10) – use of lessons learned from the previous events practices.

Figure 1. *Enablers affecting agility identified by Suresh et al. (2019)*

Source: Suresh, Ganesh & Raman (2019)

A survey was conducted among 25 IT experts, specifically heads and managers of various IT departments within a humanitarian organization. Twenty-one people responded to the survey, which represents 84% of the total participants. While quantitative studies usually require larger samples to achieve statistical generalization, the nature of ISM, as a qualitative method with quantitative elements, relies on expert knowledge and judgment rather than probability-based sampling. Literature, along with recent studies, suggests that a sample of 10–25 experts is considered justifiable for ISM research (Qazi et al., 2022; Tasnim et al., 2023; Dohale et al., 2024; Niazi et al., 2024), considering that respondents possess relevant expertise in the area of research. This study assures a strong level of representativeness and diversity of insights from IT professionals within a humanitarian organization, as depicted by the 84% response rate.

The survey was presented as a questionnaire containing 90 statements, utilizing a 5-point Likert scale with possible responses (Strongly Agree, Agree, Neither Agree nor Disagree, Disagree, Strongly Disagree). The statements were designed as pairwise comparisons of factors, with the most frequently chosen response among the experts being identified as the prevailing opinion. They were formulated based on the question model used by Suresh et al. (2019) in their research, where the ISM model has also been used to identify and analyze relationships between the factors. The agility enablers and the corresponding factors, which we have adopted, were originally identified and derived from the literature survey and expert interviews conducted in the same work. Those factors are presented in Figure 1. By analyzing the interaction of each factor with the others, as well as their direct and transitive relationship, we can determine the driving and dependent power of each factor.

The extract of the questionnaire used in this research is presented in Figure 2.

Factor i – factor j	*Pair wise questions*	*V*	*A*	*X*	*O*
F1–F2	Sudden change in volume requirement impacts the flexibility of delivery time.				
F1–F3	Sudden change in volume requirement impacts the decision-making capability.				
F1–F4	Sudden change in volume requirement impacts the ability to quickly cover the needs of the customers.				
F1–F5	Sudden change in volume requirement impacts the capability to produce the right output at the right place and at the right time.				
F1–F6	Sudden change in volume requirement impacts the members' ability to realize goals.				
F1–F7	Sudden change in volume requirement impacts the effectiveness of IT professionals.				
F1–F8	Sudden change in volume requirement impacts the informal learning and development in IT teams.				
F1–F9	Sudden change in volume requirement impacts the ability to implement changes in IT culture.				
F1–F10	Sudden change in volume requirement impacts the continuous improvement of IT processes and solutions.				

Figure 2. A sample of the questionnaire used in the research

Source: Author's questionnaire

A structural self-interaction matrix (SSIM) was created based on the contextual relationships identified between the pairs of factors using the symbols listed below:

- V: Factor i influences or alters factor j,
- A: Factor j influences or alters factor i,
- X: Factors i and j influence or alter each other,
- O: Factors i and j are not related.
- Conversion steps are explained below:

Table 1. SSIM conversion steps

SSIM (i, j) entry	Initial reachability matrix (i, j) entry	Initial reachability matrix (j, i) entry
V	1	0
A	0	1
X	1	1
O	0	0

Source: Suresh, Ganesh & Raman (2019)

Based on that, Table 2 illustrates SSIM for agility in the IT sector of a humanitarian organization.

Table 2. Structural Self-Interaction matrix (SSIM)

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
F1	1	X	V	X	V	X	X	V	X	X
F2		1	X	X	X	X	X	O	X	X
F3			1	V	X	V	X	X	X	X
F4				1	X	X	X	A	X	X
F5					1	A	X	A	X	A
F6						1	X	A	X	X
F7							1	X	X	X
F8								1	X	X
F9									1	X
F10										1

Source: Author's calculation

The initial reachability matrix (IRM) is presented in Table 3.

Table 3. Initial Reachability Matrix (IRM)

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
F1	1	1	1	1	1	1	1	1	1	1
F2	1	1	1	1	1	1	1	0	1	1
F3	0	1	1	1	1	1	1	1	1	1
F4	1	1	0	1	1	1	1	0	1	1
F5	0	1	1	1	1	0	1	0	1	0
F6	1	1	0	1	1	1	1	0	1	1
F7	1	1	1	1	1	1	1	1	1	1
F8	0	0	1	1	1	1	1	1	1	1
F9	1	1	1	1	1	1	1	1	1	1
F10	1	1	1	1	1	1	1	1	1	1

Source: Author's calculation

The final reachability matrix (FRM) shown in Table 4 was derived from the initial reachability matrix through transitivity analysis, where:

- First-level transitivity (for 1*): if A = B, and B = C, then A = C
- Second-level transitivity (for 1**): if A = B, B = C, and C = D, then A = D

The final reachability matrix table includes both driving power and dependence power. Driving power is determined by summing the entries in the rows, while dependence power is calculated by summing the entries in the columns.

Table 4. Final Reachability Matrix (FRM)

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
F1	1	1	1	1	1	1	1	1	1	1
F2	1	1	1	1	1	1	1	1*	1	1
F3	1*	1	1	1	1	1	1	1	1	1
F4	1	1	1*	1	1	1	1	1*	1	1
F5	1*	1	1	1	1	1*	1	1*	1	1*
F6	1	1	1*	1	1	1	1	1*	1	1
F7	1	1	1	1	1	1	1	1	1	1
F8	1*	1*	1	1	1	1	1	1	1	1
F9	1	1	1	1	1	1	1	1	1	1
F10	1	1	1	1	1	1	1	1	1	1

Source: Author's calculation

Table 5. Level Partitioning - 1st iteration

Factors	Reachability set	Antecedent set	Intersection set	Level
1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	I
2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	
3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	
4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	
5	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	
6	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	
7	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	
8	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	
9	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	
10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	

Source: Author's calculation

The final reachability matrix is composed of three categories: the reachability set, the antecedent set, and the intersection set. The reachability set contains elements from the rows of the matrix, while the antecedent set consists of elements from the columns. The intersection set contains elements that are shared between both rows and columns, thereby placing them at the same level. Therefore, there is no need for further iterations to eliminate elements that are shared among all factors within the reachability set.

RESULTS AND DISCUSSION

The analysis results are presented through a diagram (Figure 1) that displays a linear hierarchy of factors. The diagram illustrates how each factor influences or relates to the next, starting from the initial factor and continuing to the last, without any branching or feedback loops. It shows a direct line from one factor to the next, illustrating a chain of influence where each factor sets off the next one in line. In the context of ISM, this kind of diagram suggests that each factor relies on the one before it, with the final factor at the top, dependent on all the preceding ones. Since the diagram is linear, all factors are connected in one direction with no possibility of reciprocal interaction. In practical terms, this framework suggests that interventions aimed at improving agility should consider sequencing, ensuring that fundamental elements such as leadership commitment and information flow are addressed promptly, as they build the stage for improvements in responsiveness and adaptability.

These findings align with the earlier work of Suresh et al. (2019), confirming a high level of structural dependence among agility factors in humanitarian settings. However, unlike prior research that emphasizes singular drivers such as leadership or technology (Lee, 2017; Azevedo et al., 2024), this study demonstrates that all ten factors act simultaneously as drivers and dependents. This points to a more intricate system, where no single enabler dominates.

Moreover, while studies like Wang et al. (2024) and Singh (2024) highlight the role of technology and the use of platforms to improve responsiveness, findings in this article suggest that these cannot be effective without synchronous attention to less tangible elements, like the culture of knowledge sharing and leadership alignment. In a humanitarian context, this provides a more holistic framework for IT agility.

In contrast to corporate environments, where certain factors tend to demonstrate independent influence, the humanitarian context appears to require greater mutual coordination, likely as a result of higher environmental volatility and stakeholder diversity (Ravichandran, 2018). The need to develop context-specific agility models for nonprofit sectors is highlighted by this distinction.

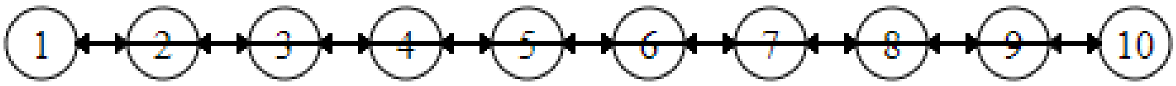

Figure 1. Diagraph

Source: Author's calculation

MICMAC Analysis

The MICMAC analysis categorizes factors into four clusters based on their driving and dependence power: autonomous, dependent, linkage, and independent. Quadrant I, for example, holds the autonomous factors, which have little influence on others and don't depend much on them either. Quadrant II consists of dependent factors — they rely heavily on other factors but don't influence them much in return. Quadrant III contains linkage factors. They both influence a lot of other factors and are heavily influenced in return, indicating that any change to them could have a dynamic and wide-ranging impact across the system. Finally, Quadrant IV includes independent factors, which have a strong influence on other factors but are not easily influenced in return.

This analysis helps identify areas for focus, especially when it comes to strategic planning and decision-making. In our case, as shown in Table 5 and the MICMAC graph, all factors fall within Quadrant III, implying that they should be closely monitored, as they can both trigger changes and be affected by them, impacting overall performance. This underscores their importance in maintaining stability.

Table 6. Classification of factors

Zones	Measures	Contents	Factors falling in the zone
Zone 1	Autonomous factors	Weak driving power and weak dependence power	None
Zone 2	Dependent factors	Weak driving power and strong dependence power	None
Zone 3	Linkage factors	Strong driving power and strong dependence power	F1-F10
Zone 4	Independent factors	Strong driving power and weak dependence power	None

Source: Author's calculation

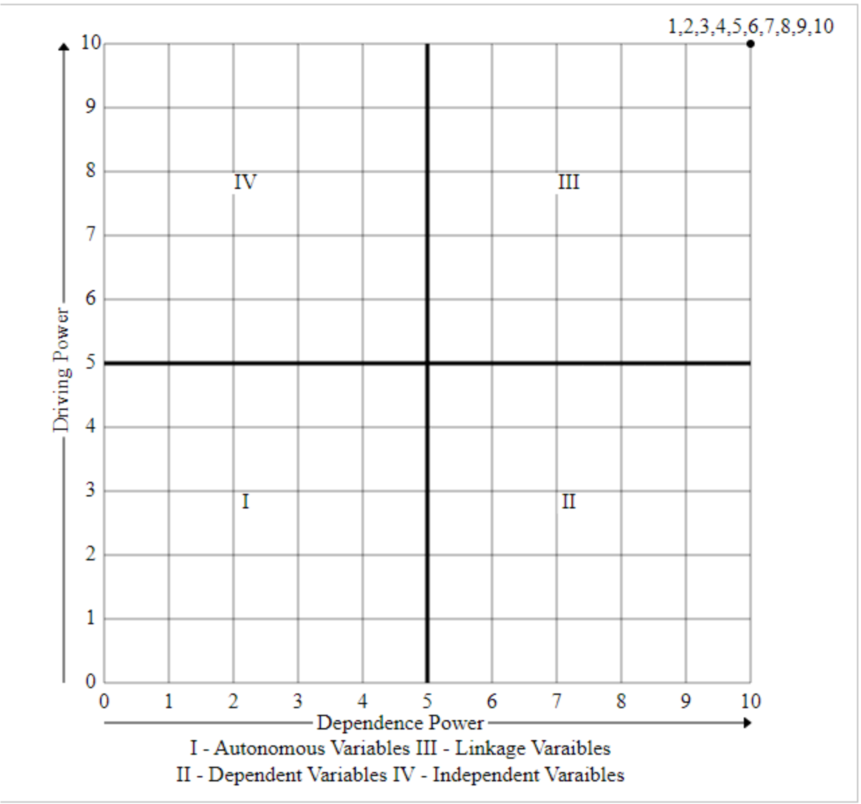

Figure 1. MICMAC graph

Source: Author's calculation

CONCLUSION

In this study, Interpretive Structural Modeling (ISM) was applied to explore the factors that influence agility in IT operations within a humanitarian organization. We categorized them based on their driving and dependence power by examining how they connect and interact with each other. The findings demonstrate that all factors are interlinked, underscoring a significant degree of interdependence within the system. This highlights the need to take a more holistic approach when managing IT agility, considering that any change in a single factor can have a cascading effect on others. The study also emphasizes the importance of continuous monitoring and flexible strategies to maintain efficiency and responsiveness, especially in the humanitarian field characterized by dynamic environments.

While this study provides significant insights into the elements impacting IT agility, it comes with certain limitations. Primarily, the IT experts, who participated in the study, occupy different roles across various sectors within the organization, and their responses may reflect specific demands and practices of their specific work settings rather than a unified perspective on IT agility. This context-specific framework could result in discrepancies in how the determinants are observed and prioritized, potentially affecting the consistency of the results. While this diversity can provide a broad range of insights, it may also limit the focus to certain areas.

Another possible limitation is that the use of the ISM framework is derived from subjective perceptions, which might influence the correctness of detected relationships. Also, the research is centered exclusively on the IT sector within a humanitarian organization, plausibly reducing the application of the findings to other sectors or industries. Although significant progress has been made in research on agility and its impact on organizational performance, there are still gaps that are inevitable given the daily changes in the time we live in. Future research could extend the sample size, include a greater range of organizations, and implement other methods to verify the findings. Moreover, incorporating external factors and conducting longitudinal studies, especially considering the potential offered by new technologies, could provide a more holistic understanding of IT agility across different scenarios.

This paper fills a research gap and offers practical guidance for applying agility in nonprofits by framing agility factors through ISM and MICMAC within a humanitarian IT context. Strong connections between factors reduce simple, step-by-step models and show the need for more flexible strategies. As such, the study contributes to the broader knowledge supporting tailored ways to manage organizational agility in highly uncertain and changing environments. From a practical perspective, this research demonstrates that initiatives to increase agility should be carried out in a specific order that prepares the ground for better responsiveness and flexibility, starting with essentials like leadership support and communication systems, as they enable further progress.

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