Customizing Trust Systems: Personalized Communication to Address AI Adoption in Smart Cities

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Abstract: Since it is challenging to tailor trust management systems to accommodate diverse individual preferences due to the evolving adoption of artificial intelligence (AI) in smart cities, through a comprehensive review of internal and external factors influencing trust levels, including personal values, personality traits, and cultural background, the paper highlights the crucial role of communications in human-machine interactions by emphasizing AI technologies. Based on the review, this paper proposes a Framework for AI Trust enHancement (FAITH). The FAITH framework integrates personalized communication strategies with individual preferences to enhance trust in smart city systems. To validate the proposed framework, the FAITH framework is applied in a use case scenario to demonstrate its potential effectiveness in fostering trust, collaboration, and innovation. The research results contribute not only to understand trust management systems in smart cities, but also offer practical insights for addressing the diverse preferences of individuals in smart cities.

1 INTRODUCTION

In today's urban landscape, smart cities integrate advanced technologies to redefine the urban living. As they undergo digital transformation, these cities evolve into complex ecosystems, demanding a sophisticated approach to data governance and seamless technology integration (Ge and Buhnova, 2022).

One significant challenge in this context is the diversity of individual preferences (Persia et al., 2020). Given that each user has unique perspectives on life and distinct personalities, it becomes challenging to create a universally applicable trust management system (Bangui et al., 2023). The interpretation of trust varies among individuals, adding complexity to the development of a system that can cater to everyone's needs. This underscores the need for an adaptive approach to trust management, considering the diverse human factors influencing perceptions of trust. Developing a system that resonates with the individual preferences of a diverse population poses a notable obstacle in the quest for effective trust management within smart cities (Ohnesorg et al., 2024).

The aim of the paper is to answer the research question of *How can trust management systems be tailored to accommodate diverse individual preferences in the evolving landscape of artificial intelligence adoption?*. We propose a framework to capture individual preferences and highlights the essence of communication, in turn it offers a practical framework for trustful applications in smart cities.

The rest of the paper is organized as follows, section 2 states the methodological approach, followed by providing an overview of previous research in respect to internal and external factors, which give insights about individual preferences of AI adoption. Moreover, section 3 focuses on the change in communication encompassing its understanding and its significance in contemporary contexts, particularly in scenarios involving human-machine-interactions. Section 4 is about the proposed framework, which will be evaluated and discussed in the section 5 by involving multiple previous investigations and highlight the correlations of certain elements. Finally, section 6 summarizes the research findings and outlines future directions.

2 METHODOLOGY

The methodology in this study involved a thorough investigation of research papers, utilizing various databases like Google Scholar, IEEE Xplore and our university library. This exploration began with the

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formulation of specific keywords covering key themes such as trust, individual preferences, communication, human-machine interaction, smart cities, and Artificial Intelligence. Employing stringent inclusion criteria, we ensured that identified sources were available in either English or German and offered open access to full-text articles.

To refine search results, advanced techniques such as Boolean operations were systematically applied, and a detailed examination was conducted across titles, abstracts, and full articles. The selection process embraced a broad range of publication years, while also focusing on recent investigations to offer a comprehensive perspective on the subject and a more detailed analysis of data related to customized trust systems landscape within smart cities.

In order to enhance the reliability and validity of the proposed framework including the proposed scenario, additional resources have been incorporated and correlated with specific elements of the framework to highlight different connections between our framework and previous investigations.

Figure 1: A set of individual preference factors.

3 RELATED WORK

Since it is challenging to precisely capture individual preferences, establishing a reliable environment is essential for maintaining trust among individuals in smart cities. However, two key factors underpin this challenge: while intelligent systems demand trust in specific situations, the absence of the human element raises concerns in real-world scenarios where individual preferences favor human interaction over smart systems. Another noteworthy challenge is the potential reluctance of some users to adopt the proposed trust mechanism. This emphasizes that a universal trust mechanism may not align with the diverse preferences and perspectives of individuals in smart cities (Ohnesorg et al., 2024).

(Davis et al., 1989) emphasized this concept in his Technology Acceptance Model, which assesses the factors influencing the acceptance of technology based on two prior aspect, which consist of the perceived usefulness and ease of use. The potential challenge of non-adoption occurred when individuals perceive a technology as not meeting their needs or being difficult to use.

As shown in Figure 1, trust levels in AI adoption are influenced by internal and external factors, which also impact the future of AI adoption in smart cities. In this section, we explore how certain factors impact trust. Personal values are recognized as influential in system/service adoption and trust; users are more inclined to adopt systems that align with their personal values. For example, environmental concerns and time consciousness have been shown to influence the adoption of e-governance services, where users who prioritize saving paper and value the convenience of service access without physical visits are more likely to utilize such services (Belanche et al., 2012).

Personality trait is another factor that can influence trust. Recent studies suggest that individual differences in personality traits lead to variations in trust levels. The Big Five personality model is commonly used to classify primary personality factors into five categories: Extroversion, Agreeableness, Conscientiousness, Neuroticism, and Openness. Some literature indicates that agreeableness and neuroticism have the most significant impact on trust, for example, (Zhou et al., 2020) demonstrates high levels of agreeableness or conscientiousness exhibiting greater trust in automation. (Böckle et al., 2021) concluded that high levels of extroversion and agreeableness lead to higher level of trusts while openness presents a negative relationship with trust.

Furthermore, personal experience significantly influences the formation of trust, where every accomplishment by the trustee results in higher trust levels. On the other hand, each setback reduces this trust. However, according to casual attribution theory, failure doesn't always result in a trust crisis; the interpretation of the cause of failure plays a crucial role in this situation. This theory similarly applies to success, where the way success is perceived can significantly enhance trust levels (Falcone and Castelfranchi, 2004).

Upbringing and family environment is suggested to affect trust, where individuals from less urbanized areas might have a protective mechanism that allows for a rapid increase in trust following positive social interactions (Lemmers-Jansen et al., 2020). Other studies suggest that people growing up in families where upper generations are dominant over the younger generation show less trust levels, alternatively horizontal extension households are more favorable for trust (Kravtsova et al., 2018).

Physiological factors are another vital factor influencing trust; some evidence suggests that a natural tendency to trust may have genetic origins to the extent that common genes had greater influence than growing up in the same environment. Trust based on physiology is of two types; person-based trust (considering the trustee as an individual) and depersonalized trust (considering trustee as a member of a group). Studies show that depersonalized trust has a great effect on the level of trust as a trustor is more likely to trust a person they perceive as socially familiar, coming from the same social group as the trustor, as depersonalized trust represents an agreement between the in-group members (Evans and Krueger, 2009). The other internal factor is education and knowledge, where evidence suggests that individuals living in countries with strong governments and having higher levels of education are more trusting while those living in less efficacious states show a negative relationship between education level and trust (Güemes and Herreros, 2019).

In terms of external factors, cultural background significantly influences trust where literature depending on Hofstede's six cultural dimensions (power distance (PDI), individualism (IDV), masculinity (MAS), uncertainty avoidance (UAI), long-term orientation (LTO) and indulgence (IND)) state that participants of a high IDV and LTO cultures are more likely to trust others while those from high PDI and UAI cultures are less likely to trust (Thanetsunthorn and Wuthisatian, 2019). Demographics represent another external factor, with research showing that females have less trust than males in terms of trusting autonomation; additionally, the more workload is required by the user the less the tendency to trust the autonomous agent; in addition, users tend to have more trust in more reliable agents (Hillesheim et al., 2017).

Media and its influence serve an additional external factor, research indicated that information on both social and traditional media have significant effect on trust (Lee et al., 2021). Moreover, geographical location is another factor where studies showed that the higher the absolute geographical latitude the lower the exposure to diseases, the lower the variety in languages and ethnic groups and the lower the income inequality which leads to greater trust (Le, 2013).

One critical element among the external factors is economic factor. Related research works demonstrated that the influence of economic wealth on institutional trust exists only among rural, less educated and economically disadvantaged individuals where this group of people tend to have more trust in institutions. On the other hand people in environments marked by significant diversity, advanced education, and wealth, personal wealth does not automatically lead to increased trust in government and institutional systems (Sechi et al., 2023).

Another important aspect that represents a crucial challenge in the context of interaction between human and machine is the trust management indicator "communication". The evolution of AI technologies from several mediators, through which people communicate, to interactive communicators, which engages in simultaneous conversations and presents communication researchers with both theoretical challenges and opportunities. Previous research highlighted that the primary challenge lies in the divergence of communicative AI in function and human interpretation from traditional technology roles in communication theory, which have been grounded in anthropocentric definitions (Guzman and Lewis, 2020).

Scholars in the field of human, machine, and communication are actively addressing this challenge by exploring how technology can be re-conceptualized as a genuine communicator. This novel perspective opens up avenues to pose innovative questions about three crucial aspects of communicative AI technologies: (1) understanding the functional dimensions that shape individuals' perceptions of these devices and applications as communicators, (2) examining the relational dynamics governing people's connections with these technologies and, subsequently, their relationships with themselves and others, and (3) delving into the metaphysical implications arising from the blurred ontological boundaries that challenge traditional definitions of what constitutes human, machine, and communication, which is presented in figure 2 (Guzman and Lewis, 2020).

According to previous research, society 5.0 is an evolving trend towards an information society. The transition to digital formats for producing, distributing, and consuming goods and services enhances value within the digital economy. Knowledge processing, relying on data aggregation from diverse sources, becomes essential for service delivery. Thus, it is crucial to have access to metadata, encompassing data quality, source identification, licensing, and usage rights, concerning private information, for ef-

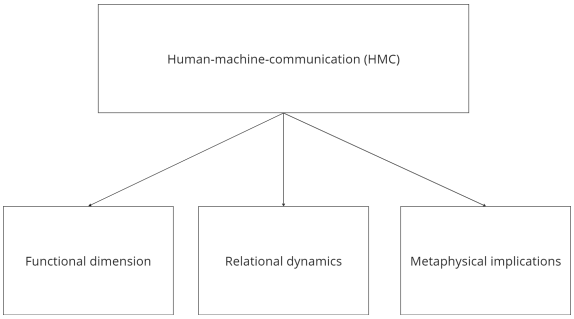

Figure 2: Constitution of human machine communication.

fective operations. Therefore, establishing Society 5.0 demands a heightened dedication to transparency and the seamless integration of information resources. This commitment may extend beyond standardization groups to encompass active participation from individuals and businesses involved in creating and implementing solutions (Frost and Bauer, 2018).

4 FAITH FRAMEWORK

After thoroughly understanding both external and internal individual preference factors, it's time to leverage them effectively. The framework outlined in the subsequent sections of this research revolves around integrating communication strategies with individual preferences, ultimately resulting in clear communication measures. These measures enable individuals to comprehend how systems function, thus bolstering their trust in the system.

As illustrated in Figure 3, FAITH operates as a cyclical process driven by AI. It begins by identifying personal traits and progresses through various steps, including selecting the suitable communication strategy based on individual factors, implementing a feedback and evaluation mechanism, and ultimately ensuring continuous learning and evolution.

Firstly, the framework starts by defining diverse individual preference factors, recognizing the importance of understanding the varied backgrounds and personal traits of users. This involves creating a comprehensive profile for each individual and identifying their preferences. These components are then organized within a machine learning system, which analyzes the profiles to select the suitable communication strategy for each individual. The goal is to ensure that information is accurately conveyed and systems are well understood. In the end it can be used to enhance the trust for the system.

The personalized communication strategies are then adapted based on the individual profile. This step

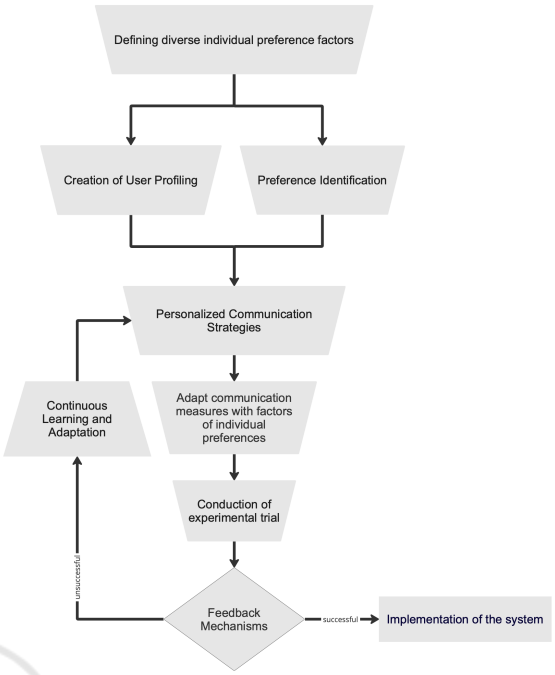

Figure 3: Framework for AI Trust enHancement (FAITH).

ensures that the communication approach aligns with the unique characteristics and preferences of each user. This is to enhance the effectiveness of the communication process. By tailoring the communication strategies, the framework aims to optimize the reception and comprehension of information, thereby bolstering trust in the system.

Next, the framework proceeds with the conduction of experimental trials. Certain standards are established for these experiments, and the results are entered into an AI-driven machine learning system. This system analyzes the outcomes of the trials to determine their success. If the results are deemed successful, the system is implemented accordingly. However, if the results are not desired, the system redirects its approach and leverages the feedback mechanism to learn from the outcomes.

Continuous learning and adaptation are integral components of the framework. Regardless of the trial outcome, the system continually evolves and adapts based on the feedback received. This iterative process allows for ongoing refinement and improvement, and ensures that the communication strategies remain effective and responsive to users' needs.

The framework operates on the principles of understanding individual preferences, tailoring communication strategies accordingly, conducting experimental trials, and iterative learning and adapting based on feedback. By prioritizing personalized communication and continuous improvement, the frame-

work can effectively enhance trust management systems in smart cities.

5 EVALUATION AND DISCUSSION

After investigating the determinants influencing trust levels in AI adoption, we identified that certain factors were interrelated. Among these interconnected determinants education and knowledge may affect the trust (Labonne et al., 2007). Furthermore, economic factors and geographical location were found to be interrelated where locations of higher geographical latitude tend to have less income inequality and thus leading to more trust (Le, 2013).

In addition, personality traits and psychological factors were found to be interlinked in terms of personality traits being considered part of the psychology of the brain, as evidences suggest that personality traits have significant genetic components (Evans and Krueger, 2009). The connection is the relation between demographics and education and knowledge where some literature considered education level as part of demographics and indicated that college graduates have more trust in automated agents when compared to less educated individuals (Hillesheim et al., 2017).

To further validate the FAITH framework, we have simulated a case scenario to validate the proposed framework. This framework aligns its elements with the narrative's components. The scenario illustrates an international workplace setting and highlights a particular individual preference connected with a communication strategy deemed potentially successful.

Consider that a leading tech company is on the verge of introducing an innovative AI-driven system designed to streamline workflow processes. As the firm is committed to inclusiveness and recognizing the diverse needs of its workforce, this company understands the significance of catering to individual preferences and communication styles.

Within its diversity, the company acknowledges the diversity in cultural backgrounds, where each is with its unique values, beliefs, and communication preferences. Recognizing this diversity is crucial for effective communication and collaboration within the company. This company is aware that adopting a one-size-fits-all approach to communication might not yield the desired results and could potentially lead to misunderstandings or disengagement among employees. Thus, the company is dedicated to defining and adapting communication measures that resonate with the diverse preferences of its workforce.

The company's strategy lies the Human-Machine-Human (HMH) interaction concept, emphasizing collaborative engagement between humans and machines. One of the primary components of this strategy involves utilizing machines to enhance transparency. By providing clear explanations of processes and outcomes, this company aims to enhance the trust and understanding among its workforce. This approach not only improves communication but also facilitates a culture of openness and accountability within the organization (Lansing et al., 2023; Küçüktabak et al., 2021).

As the company progresses with the development and implementation of its AI-driven system, it remains committed to evaluating its effectiveness through experimental trials. Through thorough assessments, the company can assess the impact of its communication measures on employee satisfaction, productivity, and overall organizational performance. With a commitment to understanding diverse individual preferences, implementing effective communication measures, and leveraging HMH interaction, this company aims to cultivate a workplace culture characterized by trust, collaboration, and innovation.

In alignment with this vision, the proposed framework illustrates how these principles can be effectively applied within the context of company operations. This framework outlines the steps for defining diverse individual preference factors, creating user profiles, identifying preferences, developing personalized communication strategies, adapting measures based on individual preferences. It also includes experimental trials by implementing feedback mechanisms, and embracing continuous learning and adaptation.

In order to evaluate our framework we conducted research on how AI and machine learning are reliable in terms of using machine learning to obtain the suitable communication strategy. (Pagliaro and Sangiorgi, 2023) suggests that AI has become essential in activities such as real-time monitoring and data analysis. In addition, machine learning and AI have revolutionized data analysis, enabling us to identify hidden trends and uncover new phenomena. These findings demonstrates that the initial steps of the FAITH framework are applicable.

Further findings indicate that AI is capable of enabling computers and machines to perform functions such as problem-solving, decision-making and comprehension of human communication profile (Sarker, 2022). This acts as a proof of the validity of FAITH framework in terms of deciding which communication strategy fits the best with each individual.

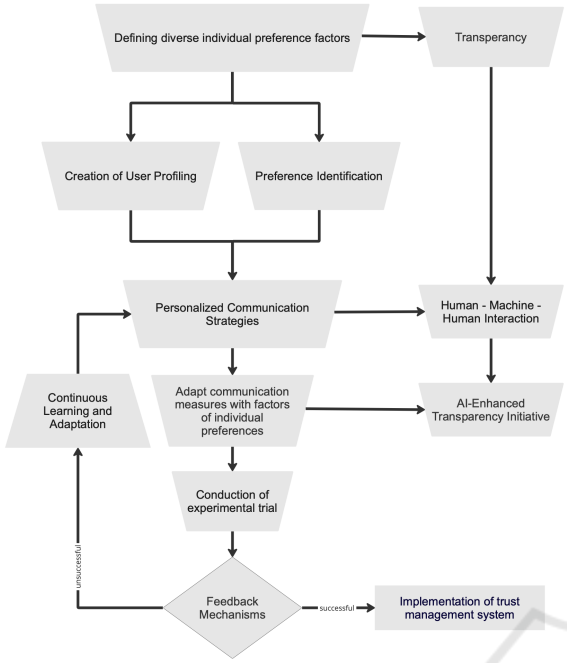

Figure 4: Validation of the FAITH framework.

Another previous study introduced an AI-driven tool designed to offer real-time guidance during data collection in experiments. This tool aims to make experiments more efficient and accelerate research in material science (Sundermier, 2023). This approach aligns with our idea that it suggests the potential integration with the proposed framework. By incorporating this tool, the experimental process could embody more reliable results and increase the likelihood of a more effective implementation of the system.

As advanced technologies become integrated into smart cities, they reshape the way people live, work, and interact socially (Walletzký et al., 2022). This digital transformation of urban landscapes requires complex administrative structures and seamless technology integration (Blanco et al., 2023). However, among this transformation, one significant challenge is the diversity of individual preferences.

Each user brings unique perspective, value, and personality traits to the table, making it challenging to develop a universally applicable trust management system. The varied interpretations of trust by individuals further complicates this task and highlights the need for an adaptive approach to trust management that takes into account different human factors.

Addressing this challenge requires a detailed understanding of internal and external factors shaping individual preferences. Personal values, personality traits, cultural background, and personal experiences all play crucial roles in shaping trust levels. Moreover, external factors such as demographics and economic status further influence trust dynamics within smart city environments.

To address this challenge, the proposed Framework for AI trust enhancement presents a practical solution. FAITH integrates personalized communication strategies with individual preferences, aiming to enhance trust in smart city systems. By aligning communication measures with diverse preferences, FAITH seeks to foster trust, collaboration, and innovation within smart city environments.

6 CONCLUSIONS

In this paper, we have proposed a FAITH framework to provide a pathway towards building trust, collaboration, and innovation within the evolving landscape of artificial intelligence adoption in smart cities. By integrating personalized communication strategies with individual preferences, this framework has addressed the question how trust management systems can be tailored to accommodate diverse individual preferences in the evolving landscape of artificial intelligence adoption. The framework has offered practical insights for dealing with various user preferences in the digital age and can also help to create more inclusive and resilient smart city environments.

In order to validate the framework, we have applied the FAITH framework in a use case scenario, which showcases how personalized communication measures can effectively address to the diverse preferences of employees. In the scenario, a company's commitment regarding individual preferences and leveraging effective communication strategies highlights the importance of adapting trust management approaches to suit diverse populations.

Further research is planned to comprehensively resolve the challenges associated with trust management in smart cities and can explore innovative strategies and solutions to ensure the trustworthy use of artificial intelligence technologies in urban environments. Specifically, research could focus on developing and implementing standardized trustworthy profiles to enhance trust assessment in both emerging and established business relationships.

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