



A STUDY OF INFLUENTIAL FACTORS ON FIREFIGHTERS' TASK PERFORMANCE OF FIRE DISPATCH SYSTEMS: A CONSERVATION OF RESOURCES THEORY PERSPECTIVE

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Abstract

Amid the growing demand for public safety, the expansion of firefighting personnel has failed to keep pace, thereby placing increasing pressure on frontline firefighters in the course of performing their duties. To address this challenge and to better leverage technological advancements, fire departments have progressively implemented innovative digital dispatch systems designed to enhance the efficiency and accuracy of operational deployment. These digital dispatch systems integrate diverse information resources, enabling firefighters to respond more rapidly in emergencies and thereby strengthening overall response capacity. Grounded in the Conservation of Resources (COR) theory, the Information Systems Success Model, and Task–Technology Fit concept, this study investigates how dispatch system quality, information quality, and service quality influence firefighters' satisfaction and usage intention. Furthermore, it explores the alignment between task requirements and technological tools, when taking into consideration the effect of perceived risk on user attitudes.

A paper-based survey was conducted, with valid samples distributed to firefighters in Taiwan. The findings indicate that a supportive working environment, teamwork, personality traits, and system performance contribute positively to user satisfaction, thereby influencing both usage intention and actual task performance. In contrast, temporal and physical risks may reduce firefighters' attitude to adopt the system. Based on these results, this study offers practical insights and managerial recommendations for fire service administrators to improve system implementation and workforce well-being.

Keywords

Fire Dispatch System, Information Systems Success Model, Perceived Risk Theory, Resource Conservation Theory, Task-Technology Fit Theory

1. Introduction

With the rapid advancement of digital technologies, mobile devices, and cloud computing, have profoundly transformed the operation of public services in government. Since the launch of Taiwan's "E-Government" initiative, digital governance policies have steadily progressed, with the "Smart Government" program explicitly emphasizing data integration and service innovations (Kushwaha, 2021). This transformation not only enhances administrative efficiency but also strengthens the decision-making quality of public safety agencies (Hsieh et al., 2013). As the frontline department within the public safety system, the fire service plays a critical role in protecting citizens' lives and property, where its dispatching and information integration capabilities are of decisive importance. Under a high-frequency and -pressure operational environment, traditional paper-based dispatch methods can no longer meet the demands of modern emergency response. Consequently, the implementation of a digital fire dispatch system—with real-time, interactive, and decision-support functions—has become a crucial component of digital governance (Meissner & Eck, 2007). By integrating geographic information, communication positioning, and mobile terminal technologies, the system enhances the immediacy and accuracy of command center decisions while effectively reducing human errors (Lan et al., 2010). Thus, digital transformation not only represents an upgrade in governmental information governance but also marks a fundamental shift in the core practices of public safety in the digital era.

Firefighting operations are inherently characterized by urgency and unpredictability. Callers often report incidents under intense stress, providing incomplete or fragmented information that requires dispatchers to make rapid and accurate judgments within seconds (Chen et al., 2022). To address these challenges, modern dispatch systems have adopted automation and modular technologies to assist personnel in real-time disaster assessment, vehicle allocation, and workforce deployment. Nevertheless, the long-standing structural issue of insufficient frontline firefighting workforce has yet to be addressed. According to statistics from the National Fire Agency, Ministry of the Interior (Taiwan), most counties and cities still face an inadequate ratio of firefighters to the population they serve, leading to escalating operational pressure (Lan et al., 2009). In this context of limited workforce and heavy workloads, the effective utilization of technological support tools has become a crucial concern. The implementation of a digital fire dispatch system is therefore expected to help frontline personnel access mission information in real time, optimize route planning, and enhance resource allocation efficiency, thereby sustaining operational performance and decision quality even under high-pressure emergency conditions.

Firefighters operate in highly risky and stressful environments. In addition to long working hours, night shifts, and exposure to dangerous disaster scenes, prolonged engagement in high-pressure tasks often leads to physical and mental fatigue as well as accumulated stress. As the types of disasters have become increasingly diverse, firefighters are now responsible not only for fire suppression but also for emergency medical services and other unexpected incidents, resulting in heavier workloads and greater job demands (Cuenca-Lozano & Ramírez-García, 2023). When system operations are unstable or information updates are delayed, on-site decision-making accuracy and response efficiency may be easily compromised, thereby reducing firefighters' overall job performance and endangering their safety. In such high-risk situations, firefighters must simultaneously endure time pressure, physical strain, and safety threats (Yuvendra et al., 2022). Therefore, developing a stable and precise fire dispatch system to better assist personnel in managing operational challenges, alleviating stress, and enhancing mission performance has become a crucial issue warranting further exploration in the field of public safety.

During the stressful emergency operations, frontline firefighters primarily rely on tablet computers as mobile terminals to receive and process real-time information transmitted by the conventional fire dispatch system. When the command center receives a report, the system immediately transmits case details—such as the incident location, disaster type, and relevant notes—to the duty desk computer of the assigned fire station. After the duty officer confirms the case and activates the dispatch procedure by pressing the “dispatchable” button, the system triggers an alarm to notify field personnel. It simultaneously sends mission information to their tablets, allowing them to understand the situation and prepare en route. Equipped with a Geographic Information System (GIS) and navigation functions, the tablets can automatically plan the shortest or optimal driving routes and display real-time traffic and distance data, enabling fire vehicles to reach the scene more efficiently (Ayub et al., 2024). Furthermore, the tablets support disaster reporting and two-way communication, allowing firefighters to upload on-site images and situation updates in real time, which helps the command center monitor ongoing conditions and coordinate subsequent dispatches promptly (Monares et al., 2011).

The fire dispatch system represents a significant achievement in the digitalization of firefighting operations. However, during its actual implementation, differences in users' use habits and levels of technological adaptability could have resulted in varying degrees of system acceptance (Teng et al., 2013). This study investigates the use of the fire dispatch system among frontline firefighters, analyzing key factors that influence their usage attitude, satisfaction, and intention to continue using the system, as well as evaluating the system's impact on operational performance. The specific objectives are as follows: (1) to understand firefighters' actual usage patterns of the fire dispatch system and their perceptions of the system's compatibility with task execution; (2) to examine the risk factors that firefighters face during duty and assess whether the system's resources effectively reduce operational stress; and (3) based on the empirical findings, practical recommendations are proposed for improving system design and user interface, as well as for optimizing the allocation of firefighting resources and personnel capabilities in the fire service.

2. Literature Review

2.1 Research Inference and Hypotheses

As discussed in the previous section, the factors influencing firefighters' use of the fire dispatch system cannot be adequately explained by a single-dimensional perspective. Firefighting operations are characterized by substantial risk, time sensitivity, and intense pressure. When operating a dispatch system, firefighters are not only affected by its technical factors, such as information quality and service quality, but also by task demands, work environment, and the degree of task–technology fit. Moreover, individual and social factors—including personality traits, teamwork, and subjective norms—may shape firefighters' perceptions of time, financial, and physical risks, thereby influencing their usage attitudes and satisfaction. Therefore, this study integrates multiple theoretical

perspectives to examine the issue from system, task, and individual dimensions, and proposes the following research hypotheses as the foundation for empirical analysis.

2.2 The Relationship Between System Quality, Information Quality, Service Quality, and User Satisfaction

According to the Information System Success Model (DeLone & McLean, 2003), system quality refers to the overall performance of a system in terms of operational stability, response speed, and ease of use (Hamilton & Chervany, 1981). When a fire dispatch system operates stably and provides real-time responsiveness, it can significantly enhance firefighters' operational experience and overall satisfaction during duty execution (Idkhan & Idris, 2023). Based on this reasoning, H1 is proposed:

H1: System quality has a positive effect on satisfaction.

According to the Information System Success Model (DeLone & McLean, 2003), information quality refers to the accuracy, timeliness, and completeness of the information provided by the system, which is a crucial factor influencing users' overall satisfaction. When the fire dispatch system delivers clear, accurate, and comprehensive mission information in real time, firefighters can better understand on-site conditions and make correct judgments during emergency responses, thereby improving user satisfaction and operational efficiency (Rasheed & Rashid, 2024). Conversely, delayed or inaccurate information may result in misjudgments, communication errors, and slower response times, which can diminish users' trust and satisfaction. The stability and timeliness of information quality thus play a critical role in the successful operation of the fire dispatch system (Ayubi & Retnowardhani, 2025). Based on this reasoning, H2 is proposed:

H2: Information quality has a positive effect on satisfaction.

According to the Information System Success Model (DeLone & McLean, 2003), service quality is defined as the responsiveness, professional assistance, and problem-solving capability demonstrated by the system provider during system maintenance and operation. High-quality service enables users to receive timely support and responses when encountering operational difficulties or technical issues, thereby enhancing overall satisfaction (Almaiah et al., 2022). For firefighters, the availability of stable technical support and backend maintenance during duty operations facilitates the smooth execution of missions. Therefore, service quality is regarded as a key factor influencing firefighters' user experience and overall satisfaction. Based on this reasoning, H3 is proposed:

H3: Service quality has a positive effect on satisfaction.

2.3 The Relationship Between Work Environment, Subjective Norms, Teamwork, Personality Traits, and User Satisfaction

According to the Conservation of Resources (COR) Theory (Hobfoll, 1989), individuals under high-pressure conditions tend to preserve and utilize accessible resources to reduce stress and maintain performance. For firefighters, a favorable work environment signifies that essential mission resources—such as equipment, communication tools, and logistical support—are adequately supplied, readily available, and replaceable (Park et al., 2014). When fire departments provide sufficient equipment and operational support, firefighters can effectively reduce stress and uncertainty during duty, thereby improving their overall job satisfaction (Cahyani et al., 2025). Conversely, inadequate resources may increase operational risks and psychological burdens, leading to decreased satisfaction. Based on this reasoning, H4 is proposed:

H4: Work environment has a positive effect on satisfaction.

According to the Theory of Planned Behavior (TPB) (Ajzen, 1991), subjective norms refer to the perceived expectations or social pressure from important others or social groups when performing a specific behavior. When individuals perceive that their peers, superiors, or organizations support a particular behavior, they are more likely to develop positive behavioral intentions (Fishbein & Ajzen, 1975). In the firefighting context, if members within a brigade generally recognize the value of the fire dispatch system and receive active encouragement from superiors to use it, firefighters' trust in and identification with the system will be reinforced to enhance their satisfaction (Al-Oraini, 2025). Moreover, based on the Conservation of Resources (COR) Theory (Hobfoll, 1989), social support and team identification serve as psychological resources that help individuals reduce anxiety and stress in high-pressure environments while maintaining performance and emotional stability. Therefore, when firefighters feel supported and encouraged by colleagues and supervisors, they are more likely to adopt the system for operations and mission challenges with a positive attitude, leading to greater satisfaction. Based on this reasoning, H5 is proposed:

H5: Subjective norm have a positive effect on satisfaction.

According to the Conservation of Resources (COR) Theory (Hobfoll, 1989), teamwork serves as an essential

resource that enables firefighters to reduce stress and enhance task performance in high-pressure environments through mutual trust and collaboration. Firefighting operations are characterized by considerable risk, and immediacy, often requiring multiple individuals to work together. Effective teamwork facilitates communication, information sharing, and coordinated support (Carron et al., 2002). When firefighters build trust and rapport with their colleagues, task efficiency increases, and the likelihood of errors decreases, resulting in smoother collaboration experiences while using the fire dispatch system and consequently greater overall satisfaction (Salas et al., 2015). From the perspective of social support, teamwork functions as a psychological resource that helps alleviate anxiety and negative emotions caused by operational stress. Therefore, dedicated team cooperation not only improves firefighters' work performance but also significantly enhances their satisfaction with the dispatch system (Phulpoto et al., 2023). Based on this reasoning, H6 is proposed:

H6: Teamwork has a positive effect on satisfaction.

According to the Conservation of Resources (COR) Theory (Hobfoll, 1989), personality traits can be regarded as an important internal resource that enables individuals to maintain psychological stability and task performance in high-pressure environments. Individuals utilize intrinsic characteristics—such as self-confidence, responsibility, sense of control, and self-esteem—to alleviate stress, sustain motivation, and enhance performance (Rosenbaum & Ben-Ari Smira, 1986). For firefighters, who often face high-risk and uncertain operational conditions, possessing stable personality traits helps them remain calm during emergencies. At the same time, those with proactive and responsible dispositions are more likely to stay engaged and committed when using the fire dispatch system. These internal characteristics not only influence firefighters' work performance but also exert a positive impact on their satisfaction with the dispatch system (Li et al., 2025). Based on this reasoning, H7 is proposed:

H7: Personality traits have a positive effect on satisfaction.

2.4 The Relationship Between Time Risk, Financial Risk, Physical Risk, and User Attitude

According to the Perceived Risk Theory (Bauer, 1960), time risk is conceptualized as the uncertainty and anxiety individuals experience during decision-making when efficiency is hindered or time is wasted due to delays. For firefighters, time risk primarily manifests during emergency response operations. If the fire dispatch system fails to update information promptly or lacks accurate traffic data, it may delay arrival at the scene and increase psychological pressure. When the system response time is excessively long or mission instructions are not synchronized in real time, firefighters may perceive wasted time and reduced efficiency, leading to a negative attitude toward system use (Ariffin et al., 2018). Based on this reasoning, H8 is proposed:

H8: Time risk has a negative effect on attitude.

According to the Perceived Risk Theory (Bauer, 1960), financial risk is defined as the uncertainty and concern individuals experience about potential economic losses or additional costs when adopting a particular technology or service. For firefighters, financial risk may arise during operations through situations such as vehicle damage, equipment loss, or accidental incidents, all of which can evoke psychological perceptions of risk. When users perceive potential monetary loss or increased costs, they are more likely to develop doubts and negative attitudes toward system usage (Tarabieh, 2021). Based on this reasoning, H9 is proposed:

H9: Financial risk has a negative effect on attitude.

According to the Perceived Risk Theory (Bauer, 1960), physical risk refers to the uncertainty individuals experience due to potential bodily harm or health threats when performing a specific behavior. For firefighters, physical risk is the most direct and prominent form of risk encountered during duty. Firefighting operations often involve hazardous environments such as extreme heat, dense smoke, explosions, or structural collapses (Yuvendra et al., 2022). When users perceive potential physical danger, their trust in the system and their attitude toward its use tend to decline (Rudyanto et al., 2021). Based on this reasoning, H10 is proposed:

H10: Physical risk has a negative effect on attitude.

2.5 The Relationship Between Task Characteristics, Technological Characteristics, Task–Technology Fit, User Satisfaction, and Usage Intention

According to the Task–Technology Fit (TTF) Theory (Goodhue & Thompson, 1995), task characteristics refer to the attributes of a job task, such as its complexity, urgency, and non-routineness, which determine the extent to which technological tools can effectively support task execution. When the functions of a technological system adequately meet the requirements of a given task, it indicates a high degree of task–technology fit (Sharma et al., 2025). Firefighting duties are diverse and require rapid response, encompassing operations such as fire suppression and emergency medical rescue. If the fire dispatch system can provide real-time mission information, geographic

positioning, dispatch instructions, and disaster feedback, it can effectively support firefighters in completing their tasks and enhance the degree of task–technology fit. Based on this reasoning, H11 is proposed:

H11: Task characteristics have a positive effect on task–technology fit.

According to the Task–Technology Fit (TTF) Theory (Goodhue & Thompson, 1995), technological characteristics is conceptualized as the attributes of an information system or technological tool—such as functionality, reliability, ease of use, and response speed—that determine its ability to effectively support task performance. When a technological tool successfully meets user needs and facilitates task execution, the degree of task–technology fit increases (Chavarnakul et al., 2024). In the context of fire dispatch systems, technological characteristics encompass real-time information processing capability, system stability, user-friendly interface design, and data transmission speed. A dispatch system that provides real-time disaster information, optimal route planning, and mission reporting functions can assist firefighters in making quick and accurate decisions, thereby enhancing the system’s support for task execution. Based on this reasoning, H12 is proposed:

H12: Technological characteristics have a positive effect on task–technology fit.

According to the Task–Technology Fit (TTF) Theory (Goodhue & Thompson, 1995), task–technology fit refers to the extent to which a technological tool supports users in fulfilling the requirements and objectives of a specific task. When the functions of a technological system align closely with task demands, users can perform their work more efficiently and experience greater overall satisfaction. In the context of firefighting operations, if the fire dispatch system provides functions that effectively assist firefighters in rapid response and task execution, it can enhance their satisfaction with the system (Baldemor et al., 2025). Task–technology fit is also regarded as a critical determinant of behavioral intention. When firefighters perceive that the dispatch system effectively supports task goals and improves decision-making efficiency, they are more likely to develop a positive intention to continue using it (Kinanti et al., 2025). Based on this reasoning, H13 and H14 are proposed:

H13: Task–technology fit has a positive effect on satisfaction.

H14: Task–technology fit has a positive effect on intention to use.

2.6 The Relationship Between Attitude, Satisfaction, Usage Intention, and Task Performance

According to the Information System Success Model (DeLone & McLean, 2003) and the Theory of Planned Behavior (TPB) (Ajzen, 1991), user attitude is regarded as a key psychological factor influencing both satisfaction and behavior. When users develop a positive attitude toward a system, they tend to experience greater satisfaction during actual use (Nuryakin et al., 2023). Satisfaction, in turn, serves as a crucial antecedent of usage intention. When firefighters feel highly satisfied with the fire dispatch system, they are more likely to continue using and relying on it, as behavioral intention is considered an important predictor of performance outcomes (Kiatsangsilp & Pankham, 2025). When firefighters demonstrate a strong intention to use the dispatch system continuously, they can more actively apply it for real-time decision-making and task coordination, thereby improving overall response speed and operational performance (Wongwatkit et al., 2020). Based on this reasoning, H15, H16, and H17 are proposed:

H15: Attitude has a positive effect on satisfaction.

H16: Satisfaction has a positive effect on intention to use.

H17: Intention to use has a positive effect on task performance.

3. Research Methods

3.1 Research Framework

In the field of information technology applications, theoretical models that examine user behavior are primarily grounded in the Technology Acceptance Model (TAM) (Davis et al., 1989) and the Theory of Planned Behavior (TPB) (Fishbein & Ajzen, 1975). TAM explains how technological characteristics influence user acceptance and performance (Camilleri, 2024), but it only pays limited attention to psychological factors at the individual or environmental level. Although TPB effectively explains how users’ attitudes, subjective norms, and perceived behavioral control influence behavioral intentions (Rhodes & Courneya, 2005), it provides only a partial understanding of technology-related attributes. To gain a more holistic understanding of firefighters’ behavior and reactions when operating the fire dispatch system in real work environments, this study integrates four theoretical perspectives: the Information System Success Model, the Task–Technology Fit (henceforth, TTF) Theory, the Conservation of Resources (henceforth, COR) Theory, and the Perceived Risk Theory. From the system perspective, the Information System Success Model (DeLone & McLean, 2003) has been used to examine how information quality, system quality, and service quality affect user satisfaction. The TTF Theory (Goodhue &

Thompson, 1995) further explores how task characteristics, technology characteristics, and the degree of task–technology fit influence firefighters’ operational effectiveness across different emergency scenarios.

Meanwhile, the COR Theory (Hobfoll, 1989) focuses on how individuals use available resources to reduce stress and maintain performance in high-pressure environments. Derived from this theory, the study investigates how firefighters manage their psychological and physical resources under various work environments, team dynamics, personality traits, and subjective norms (Antonovsky, 1979). Additionally, this study also incorporates the Perceived Risk Theory to examine other dimensions such as time, financial, and physical risk to determine whether potential risks faced during duty influence firefighters’ attitudes, satisfaction, and overall task performance (Kim et al., 2022). The integrated model thus not only deepens the understanding of firefighters’ behavior in adopting and using fire dispatch systems but also provides a more comprehensive theoretical foundation for future system optimization and practical implementation in public safety management.

This study develops an integrated research model (Figure 1 below) based on the Information System Success Model (DeLone & McLean, E. R. (2003), Task–Technology Fit (TTF) Theory (Goodhue & Thompson, 1995), Conservation of Resources (COR) Theory (Hobfoll, 1989), and Perceived Risk Theory (Bauer, 1960). The research framework encompasses seventeen key variables, collectively reflecting the influences from the system, task, and individual psychological dimensions. Figure 1 below summarizes the proposed relationships among our study variables (H1- H17):

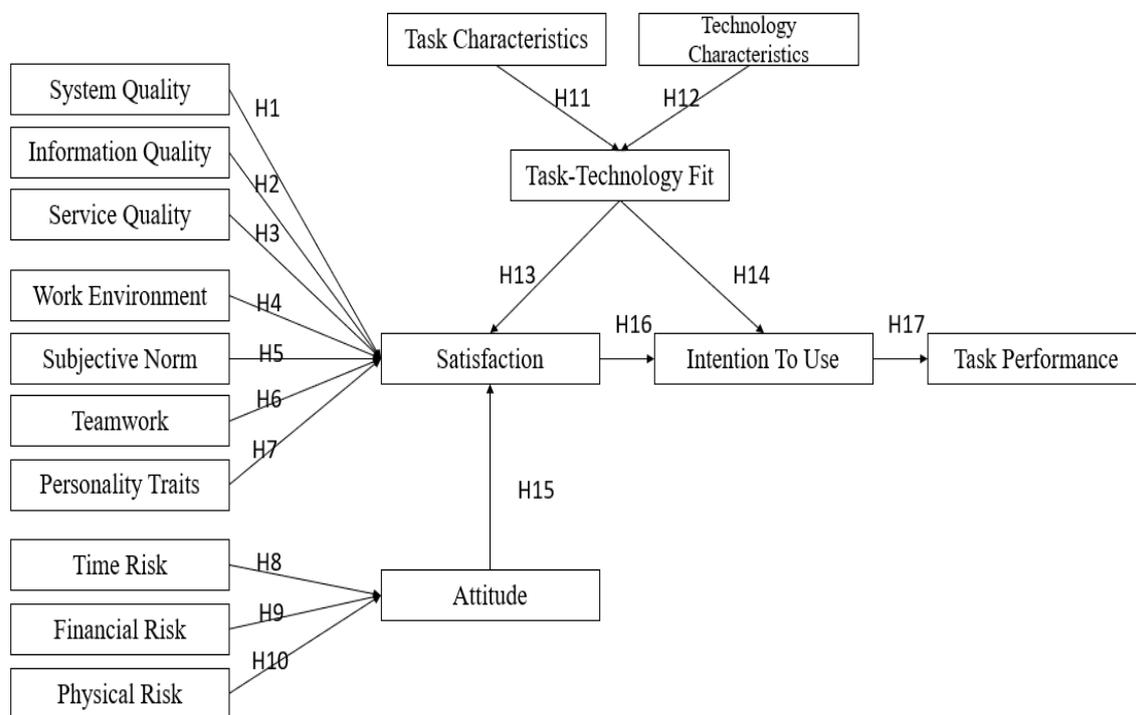


Figure 1. Research framework

3.2 Research Variables and Operational Definitions

This study takes the fire dispatch system as its main research focus, examining the behaviors and responses of frontline firefighters when using the system in operational contexts. To ensure that the questionnaire design accurately reflects firefighters’ daily experiences and perceptions of system usage, interviews and discussions were first conducted with firefighters who had prior experience using the fire dispatch system. These sessions helped identify the system’s main functions, operational procedures, and daily work conditions of firefighters. Based on the discussion outcomes, the questionnaire items were jointly reviewed and revised with the academic advisor to ensure that the design aligned with real-world scenarios. A pilot test was then administered, inviting a group of firefighters to complete the questionnaire and provide feedback to confirm the clarity, feasibility, and practicality of the items. Before full deployment of the survey, the instrument was reviewed by one of the authors’ IRB Board for approval. Through this research design, the study ensures that respondents share a consistent understanding of the research topic, thereby improving the accuracy and reliability of questionnaire responses.

Table 1. Operational Definitions of Variables

Constructs	Operational Definitions	Reference Scholars
System Quality	The FDS provides stable operation, fast response speed, and ease of use.	Maulana, et al.(2025); Tan and Lim(2023)
Information Quality	The FDS provides information that is accurate and timely.	Sanusi et al.(2025); Ayubi and Retnowardhani(2025)
Service Quality	The FDS provides technical support and maintenance services with high quality and efficiency.	Khan(2025); Lutfi(2023)
Task Characteristics	The complexity and urgency during task execution reflect the level of support required from the FDS.	Li and Liang(2025); Armanda et al. (2025)
Technology Characteristics	The overall performance of the FDS affects task execution efficiency.	Sasmi et al. (2024); Al-Mamary et al. (2024)
Task-Technology Fit	The degree to which the functions of the FDS align with operational task requirements.	Shahzad et al. (2025); Nagadeepa et al. (2024)
Work Environment	The adequacy of resources, equipment, and support is available when using the FDS during duty operations.	Basalamah and Asad(2021); Aeni et al. (2025)
Subjective Norm	The influence of superiors or peers on the use of the FDS.	Zhang et al. (2025); Baghirov et al. (2025)
Teamwork	The level of communication, coordination, and collaboration among colleagues when using the FDS during duty operations.	Siriphatcharachot et al. (2025); Lebrata et al. (2024)
Personality Traits	The stability and sense of responsibility demonstrated by firefighters when facing stress while using the FDS during duty operations.	Duan and Deng (2025); Fernando et al. (2023)
Time Risk	The risk of time loss that may occur during duty operations when using the FDS.	Andrian and Selamat(2021); Zhao and Khaliq(2024)
Financial Risk	The risk of monetary loss that may occur during duty operations when using the FDS.	Li et al. (2023); Koay et al. (2023)
Physical Risk	The risk of safety threats that may arise during duty operations when using the FDS.	Jiang and Lau(2021); Nazir et al. (2021)
Attitude	The overall perception and evaluation of using the FDS.	Zhong et al. (2022); Timur et al. (2023)
Satisfaction	The degree of satisfaction with the functions and services of the FDS.	Hasan et al. (2024); Hussain and Khan(2025)
Intention To Use	The willingness to continue using the FDS.	Wang et al. (2025); Kumar et al. (2023)
Task Performance	The operational efficiency and performance achieved after using the FDS.	Eliyana et al. (2025); Hasani et al. (2023)

*Note: The Fire Dispatch System is hereafter abbreviated as FDS.

4. Data Analysis and Empirical Results

4.1 Descriptive statistical analysis

This study employed paper-based questionnaires, personally distributed by the researcher to various fire brigades, inviting firefighters with experience using the Fire Dispatch System (FDS) to participate. The survey was conducted over three months (March 1 to May 31, 2025). A total of 850 questionnaires were distributed, and after excluding invalid responses, 760 valid questionnaires were obtained, resulting in an effective response rate of 89.4%. Descriptive statistical analysis of respondents showed that 95.3% were male and 4.7% were female, with the majority aged between 26–35 years (41.7%), followed by 36 and 45 years (30.0%) and 18–25 years (15.1%). In terms of education, most held junior college degrees (45.7%), followed by university degrees (36.4%). Regarding FDS usage frequency, 49.3% used the system more than thirteen times per week, and 15.7% used it 3–4 times per week. For years of FDS experience, 38.4% had five years or less, and 30.8% had between six and ten years. The main purpose of FDS use was work-related (83.2%), and the most preferred function was the rescue route navigation (48.0%). Among primary duties, emergency medical services accounted for the highest proportion (81.8%). In terms of devices used to access the FDS, tablets were the most common (56.8%), followed by computers (35.1%).

4.2 Reliability and Validity Analysis

4.2.1 Reliability

The purpose of the reliability analysis is to examine whether each variable measured in the questionnaire effectively reflects the constructs within the theoretical framework and whether the endogenous variables demonstrate internal consistency. By assessing the reliability of each latent variable, the quality and consistency of the questionnaire items can be determined. Reliability refers to the degree of stability and consistency of the measurement instrument used to evaluate the constructs. This study adopted a seven-point Likert scale and used Cronbach's α coefficient to assess the internal consistency of the items. A higher Cronbach's α value indicates greater consistency among questionnaire data. According to conventional standards, a Cronbach's α value above 0.7 suggests acceptable reliability, while values exceeding 0.8 indicate excellent reliability (Hair et al., 2009). In this study, the Cronbach's α values for all constructs ranged from 0.747 to 0.981, demonstrating high internal consistency and stability of the measurement items, as shown in Table 2.

The standard threshold for Composite Reliability (CR) is 0.7 or higher, indicating that the questionnaire items within each construct demonstrate a high degree of internal consistency and measurement reliability (Hair, 2014). In this study, the CR values ranged from 0.854 to 0.988, all exceeding the recommended standard, suggesting that the measurement constructs possess excellent reliability. The detailed results are presented in Table 2.

4.2.2 Validity

Convergent validity refers to the degree to which items measuring the same construct produce consistent results across different measurement methods. When the Average Variance Extracted (AVE) exceeds 0.5, it indicates good convergent validity (Hair et al., 2009). In this study, the AVE values for all constructs were above 0.5, demonstrating strong convergent validity. Furthermore, factor loadings greater than 0.7 signify that the items of each variable cluster effectively within the same construct (Hair et al., 2009), as shown in Table 2.

As shown in Table 2, the factor loadings of all measurement items for each variable were above 0.6, indicating that each item effectively represents its corresponding construct. This demonstrates that the questionnaire possesses good convergent validity and measurement consistency overall.

Table 2. Reliability and convergent validity tests.

Construct	Cronbach's alpha	Composite reliability	AVE	Factor loadings
System Quality	0.781	0.873	0.696	0.878, 0.841, 0.780
Information Quality	0.825	0.895	0.741	0.809, 0.854, 0.916
Service Quality	0.963	0.976	0.931	0.964, 0.968, 0.962
Work Environment	0.923	0.951	0.867	0.924, 0.948, 0.920
Subjective Norm	0.937	0.959	0.887	0.961, 0.943, 0.921
Teamwork	0.933	0.957	0.882	0.918, 0.954, 0.945
Personality Traits	0.981	0.988	0.964	0.979, 0.985, 0.982
Time Risk	0.853	0.911	0.773	0.875, 0.889, 0.873
Financial Risk	0.849	0.908	0.768	0.877, 0.895, 0.856
Physical Risk	0.747	0.854	0.665	0.673, 0.891, 0.865
Task Characteristics	0.882	0.927	0.808	0.899, 0.899, 0.899
Technology Characteristics	0.893	0.933	0.823	0.881, 0.916, 0.925
Task-Technology Fit	0.926	0.953	0.871	0.921, 0.940, 0.939
Attitude	0.943	0.963	0.898	0.958, 0.959, 0.926
Satisfaction	0.972	0.981	0.946	0.969, 0.977, 0.972
Intention To Use	0.923	0.951	0.867	0.939, 0.923, 0.931
Task Performance	0.958	0.973	0.923	0.953, 0.970, 0.960

Discriminant validity is used to assess the degree of distinction between variables, ensuring that different constructs can be clearly differentiated from one another. According to the criterion, the square root of the Average Variance Extracted (AVE) for each construct should be greater than the correlation coefficients between that construct and others (Hair et al., 2009). As shown in Table 3, the square roots of the AVE values for all constructs in this study were higher than their respective inter-construct correlation coefficients, indicating good discriminant validity. Taken together, the results of both convergent validity and discriminant validity demonstrate that the questionnaire possesses strong construct validity and high measurement quality.

Table 3. Discriminant validity result

Construct	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]
1.System Quality	0.834																
2.Information Quality	0.733	0.861															
3.Service Quality	0.589	0.644	0.965														
4.Work Environment	0.626	0.656	0.581	0.931													
5.Subjective Norm	0.574	0.551	0.480	0.570	0.942												
6.Teamwork	0.606	0.637	0.563	0.704	0.677	0.939											
7.Personality Traits	-0.520	-0.534	-0.463	-0.559	-0.718	-0.712	0.982										
8.Time Risk	-0.392	-0.331	-0.307	-0.331	-0.406	-0.387	0.453	0.879									
9.Financial Risk	-0.327	-0.274	-0.292	-0.307	-0.368	-0.319	0.383	0.583	0.876								
10.Physical Risk	-0.351	-0.335	-0.272	-0.313	-0.475	-0.338	0.435	0.475	0.613	0.816							
11.Task Characteristics	0.686	0.725	0.561	0.660	0.675	0.741	-0.671	-0.412	-0.428	-0.498	0.899						
12.Technology Characteristics	0.701	0.686	0.546	0.649	0.552	0.697	-0.537	-0.388	-0.362	-0.395	0.746	0.907					
13.Task-Technology Fit	0.691	0.712	0.579	0.677	0.678	0.749	-0.658	-0.392	-0.346	-0.436	0.816	0.789	0.934				
14.Attitude	0.709	0.698	0.575	0.688	0.645	0.725	-0.625	-0.376	-0.352	-0.414	0.778	0.803	0.871	0.947			
15.Satisfaction	0.714	0.718	0.623	0.683	0.587	0.702	-0.553	-0.359	-0.344	-0.358	0.732	0.758	0.801	0.832	0.973		
16.Intention To Use	0.643	0.633	0.500	0.638	0.640	0.732	-0.624	-0.416	-0.365	-0.403	0.751	0.718	0.816	0.817	0.779	0.931	
17.Task Performance	0.672	0.657	0.546	0.656	0.623	0.736	-0.600	-0.401	-0.373	-0.417	0.771	0.761	0.817	0.845	0.804	0.871	0.961

4.3 Structural Model Analysis

This section examines the structural relationships among the constructs and assesses the significance of the proposed hypotheses. The analysis was conducted using SmartPLS4 and SPSS software to explore the causal relationships within the structural model.

The structural model analysis revealed that in the Information System Success Model, system quality, information quality, and service quality all had significant positive effects on user satisfaction, supporting H1, H2, and H3 ($t = 3.089, 2.619, 3.306$; $\beta = 0.117, 0.099, 0.101$; $t > 1.96$). Within the Conservation of Resources (COR) Theory, the positive effects of work environment, teamwork, and personality traits on satisfaction were significant, confirming H4, H6, and H7 ($t = 2.003, 2.033, 2.205$; $\beta = 0.068, 0.104, 0.075$), while subjective norms (H5) were not significant ($t = 0.612, t < 1.96$). In the Perceived Risk Theory, time risk and physical risk had significant negative effects on attitude, supporting H8 and H10 ($t = 4.144, 5.752$; $\beta = -0.209, -0.278$), whereas financial risk (H9) was not significant ($t = 0.986, t < 1.96$). According to the Task–Technology Fit (TTF) Theory, task characteristics and technological characteristics significantly and positively influenced task–technology fit, validating H11 and H12 ($t = 12.040, 8.864$; $\beta = 0.513, 0.406$). Moreover, task–technology fit showed a significant positive relationship with satisfaction (H13, $t = 3.257$; $\beta = 0.178$) and usage intention (H14, $t = 11.893$; $\beta = 0.536$). Additionally, attitude positively affected satisfaction (H15, $t = 7.348$; $\beta = 0.405$), satisfaction positively influenced usage intention (H16, $t = 7.489$; $\beta = 0.349$), and usage intention strongly and positively affected task performance (H17, $t = 58.612$; $\beta = 0.871$). Overall, most of the proposed hypotheses were supported, indicating that the relationships among constructs in the model were statistically significant, as summarized in Table 4.

The results of the model fit analysis indicate that the saturated model SRMR value was 0.04, which is below the acceptable threshold of 0.08, and the NFI value was 0.87, exceeding the recommended minimum of 0.80.

These results demonstrate that the proposed model meets the standard criteria and exhibits good model fit and validity. Furthermore, the R² values of the endogenous variables show strong explanatory power: The R² for satisfaction was 0.763, for usage intention 0.710, and for task performance 0.759, indicating that the model explains 76.3%, 71.0%, and 75.9% of the variance, respectively. Overall, these results confirm that the research model possesses excellent explanatory capability and robustness, as illustrated in Figure 2.

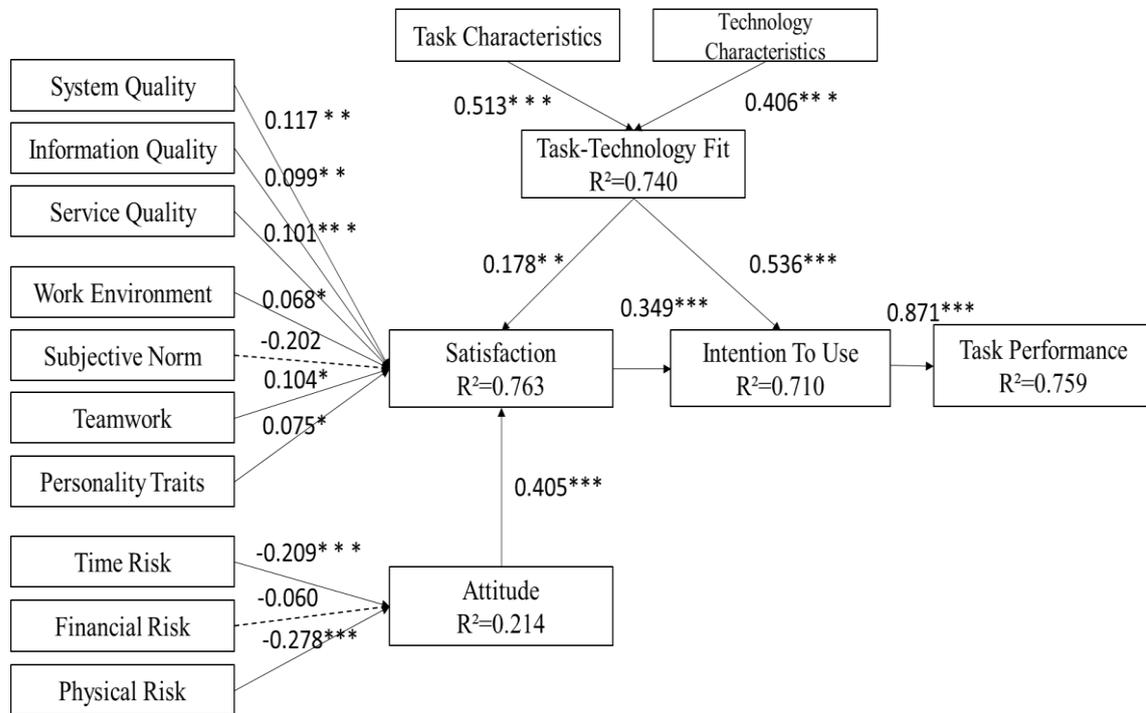


Figure 2. Structural model results.

Table 4. The results of SEM testing.

Hypothesis	Relationship of potential variables	t Value	Results
H1	System Quality→Satisfaction	3.089	Supported
H2	Information Quality→Satisfaction	2.619	Supported
H3	Service Quality→Satisfaction	3.306	Supported
H4	Work Environment→Satisfaction	2.003	Supported
H5	Subjective Norm→Satisfaction	0.612	Not supported
H6	Teamwork→Satisfaction	2.003	Supported
H7	Personality Traits→Satisfaction	2.205	Supported
H8	Time Risk→Attitude	4.144	Supported
H9	Financial Risk→Attitude	0.986	Not supported
H10	Physical Risk→Attitude	5.752	Supported
H11	Task Characteristics→Task-Technology Fit	12.040	Supported
H12	Technology Characteristics→Task-Technology Fit	8.864	Supported
H13	Task-Technology Fit→Satisfaction	3.257	Supported
H14	Task-Technology Fit→Intention To Use	11.893	Supported
H15	Attitude→Satisfaction	7.348	Supported
H16	Satisfaction→Intention To Use	7.489	Supported
H17	Intention To Use→Task Performance	58.612	Supported

5. Conclusion and Recommendations

5.1 Research Conclusion

The research findings indicate that, within the system dimension, information quality, system quality, and service quality all have a significant positive impact on firefighters’ user satisfaction. The hypothesis regarding information quality was supported (Rasheed & Rashid, 2024), suggesting that the Fire Dispatch System (FDS) can provide accurate, complete, and comprehensible mission information in real time, helping firefighters quickly grasp on-site

conditions and dispatch instructions, thereby reducing information gaps and misjudgment risks while enhancing overall satisfaction. The hypothesis concerning system quality was also supported (Ayubi & Retnowardhani, 2025), demonstrating that the system performs well in terms of operational stability, response speed, and interface design, effectively assisting firefighters in executing commands swiftly under high-pressure conditions, minimizing errors, and strengthening operational trust. Furthermore, the hypothesis for service quality was validated (Almaiah et al., 2022), indicating that the system's maintenance units provide timely technical support, problem reporting assistance, and software updates, enabling firefighters to receive continuous operational support and assurance during use. These findings collectively confirm that the Information System Success Model effectively explains the usage outcomes of the Fire Dispatch System.

The hypothesis for the work environment was supported (Cahyani et al., 2025), indicating that when fire departments provide adequate operational equipment, communication facilities, and logistical support, firefighters can perform their duties in a stable and safe environment. This finding aligns with the Conservation of Resources (COR) Theory (Hobfoll, 1989), suggesting that sufficient external resources help individuals maintain psychological stability and task performance. Similarly, the teamwork hypothesis was confirmed (Phulpoto et al., 2023), showing that effective communication, mutual trust, and coordination among colleagues enhance task efficiency and operational smoothness, thereby increasing overall satisfaction. Users' personality traits hypothesis was also supported (Li et al., 2025), implying that firefighters with stable, confident, and responsible dispositions are better able to handle high-pressure situations and system operation challenges, leading to higher self-efficacy, a stronger sense of accomplishment, and greater satisfaction. In contrast, the subjective norms hypothesis was not supported (Song et al., 2023), likely because firefighters operate under a command-based system where system use is mandatory rather than voluntary. Consequently, external social influences such as superior directives or peer opinions have a limited impact on satisfaction. Overall, firefighters' satisfaction primarily stems from the system's effectiveness and operational support, rather than from social or organizational factors.

In the task and technology dimensions, the results indicate that both task characteristics (Sharma et al., 2025) and technological characteristics (Chavarnakul et al., 2024) have significant positive effects on task–technology fit, suggesting that when the functions and interface of the Fire Dispatch System (FDS) align with firefighters' operational needs, the system effectively enhances operational smoothness and task efficiency. This finding aligns with Goodhue and Thompson's (1995) (Goodhue & Thompson, 1995) Task–Technology Fit Theory, which emphasizes that the degree of alignment between technology and task demands directly influences performance outcomes. Moreover, task–technology fit demonstrated significant positive effects on both satisfaction and usage intention, indicating that when the system supports firefighters in making rapid and accurate decisions during high-pressure missions, it strengthens their trust, reliance, and willingness to continue using the system. In the perceived risk dimension (Bauer, 1960), both time risk (Ariffi et al., 2018) and physical risk (Rudyanto et al., 2021) showed significant negative effects on attitude, as delays in information updates, inaccurate navigation, or incomplete communication may increase firefighters' workload, stress, and distrust in the system. In contrast, potential physical threats such as structural collapses, toxic gases, or explosions amplify uncertainty and safety concerns. Conversely, financial risk (Namahoot & Rattanawiboonsom, 2022) did not have a significant effect, likely because fire departments provide sufficient equipment maintenance and government funding, absorbing most related losses and minimizing firefighters' personal financial concerns. Overall, these findings highlight that system–task alignment and real-time reliability are critical determinants of firefighters' satisfaction and attitude toward continued system use.

In the behavioral and outcome dimensions, the results show that attitude has a significant positive effect on satisfaction (Nuryakin et al., 2023), satisfaction has a significant positive effect on intention to use (Kiatsangsilp & Pankham, 2025), and usage intention has a significant positive effect on task performance (Wongwatkit et al., 2020). These findings indicate that when firefighters have a positive perception of the fire dispatch system and believe that the system effectively supports their operational tasks, they are more likely to continue using it. This demonstrates that positive user experience and perceived task efficiency are key drivers influencing both satisfaction and sustained system usage behavior.

5.2 Managerial and Practical Implications

1. System Design and Operational Optimization

In terms of system design and operational processes, firefighters generally regard the Fire Dispatch System (FDS) as highly practical; however, there remains room for improvement in its user interface and workflow. Future system development should focus on enhancing interface intuitiveness, minimizing system latency and operational errors, and incorporating voice-assist features to help firefighters operate more efficiently and respond rapidly under high-pressure conditions. Because system failures can directly delay mission progress and reduce user

satisfaction, preventive maintenance and regular updates should be reinforced to ensure stable system performance. Furthermore, establishing real-time technical support and incident reporting channels would enable firefighters to receive immediate assistance during unexpected situations, thereby strengthening their sense of trust and reliance on the FDS.

2. Duty Dispatch and Manpower Allocation

Firefighting is a high-pressure occupation that often involves long working hours, where delayed or unclear dispatch information can result in insufficient preparation and slower response times, ultimately affecting rescue efficiency and public safety. In addition to issues related to the dispatch system operations, it is essential to implement rational scheduling and workforce planning to reduce physical and mental fatigue as well as minimize potential operational errors caused by overwork. Establishing dynamic dispatching and workload distribution mechanisms can ensure that personnel perform missions in their optimal condition, thereby enhancing safety and overall response efficiency. Additionally, improving duty support processes to maintain smooth information flow and effective mission coordination is critical to preventing confusion and increased risk at the scene due to delayed or miscommunicated instructions.

3. Organizational Management and Psychological Support

In terms of organizational management and psychological support, inadequate facilities—such as aging buildings or insufficient rest spaces—can negatively affect firefighters' physical and mental health as well as their work performance. It is recommended that the government gradually improve duty facilities and rest environments, creating safer and more comfortable workplaces to enhance morale and satisfaction. To address coordination gaps often seen during large-scale disasters, regular simulation exercises and interdepartmental training should be implemented to strengthen collaboration and on-site adaptability. Given the long-term exposure of firefighters to high-risk and high-pressure situations, psychological counseling, peer support programs, and stress management mechanisms should be introduced to help maintain emotional stability and mental well-being. Furthermore, to enhance firefighters' trust in the Fire Dispatch System (FDS), an effective feedback and issue-handling mechanism should be established, allowing users to report problems and receive timely responses, thereby improving system usability, reliability, and overall operational performance.

5.3 Research Limitations and Future Research Directions

This study focused on key antecedent variables influencing the task performance of the Fire Dispatch System (FDS). While the proposed model effectively analyzed the relationships among major constructs, it did not encompass all potential influencing factors to improve the well-beings of firefighters in Taiwan. Future research could adopt additional theoretical frameworks to expand variable design and analytical perspectives, thereby deepening the understanding of firefighters' attitudes, behaviors, and psychological factors toward system usage. Furthermore, as this study utilized a quantitative questionnaire approach, it provided insights into statistical relationships but offered limited reflection of firefighters' real-life experiences and operational contexts. To address this limitation, future studies are encouraged to incorporate qualitative methods, such as expert interviews or focus group discussions, to capture more authentic user experiences and perceptions. Through the integration of diverse research methods and theoretical perspectives, future research can achieve a more holistic understanding of the FDS's practical effectiveness and improvement directions, thereby providing valuable implications for policy formulation and managerial decision-making.

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