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# The Study of Intention to Apply Live Video Transmission System in Disaster Sites for Firefighters through UTAUT model

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**Abstract.** With the rapid development of network technology, the live video transmission system (LVTS) has improved the work efficiency because of the visual communication combining both images and data. In order to strengthen the effectiveness of disaster prevention through instant communication, the Fire Department in Taiwan has used the "VVLINK" videoconferencing system to provide multi-functional online conferences, and even grasp on-site dynamic situation of disasters in the first time, and then giving order to the disaster relief site online. Here, a research about the application of LVTS system in disaster sites was carried out to study the intention for firefighters in Fire Bureau of Changhua County, Taiwan. In this study "behavioural intension (BI)" and "usage behaviour (UB)" on LVTS system are explored through the Integrated Technology Acceptance Model (UTAUT). In addition, moderate variables such as gender, age, experience and voluntary are needed to be considered. "Performance expectation (PE)", "effort expectation (EE)" and "social influence (SI)" can affect BI to be very significant; BI and "facilitating conditions (FC)" can also affect UB. Questionnaire analysis was applied. The results show that PE, EE, and SI have a positive direct impact on BI, and BI also has a positive direct impact on UB. It was also found that the FC had a positive and direct impact on BI as well as SI impacting on UB. All the moderate variables have significant difference on each UTAUT categories.

## 1. Introduction

Nowadays, the rapid development of information technology has made rapid progress. The software and hardware in wireless communication development has gradually matured and improved in Taiwan. Mobile devices have become a common tool in life [1], and they have evolved from technical targets to social behaviours. Services such as transportation, logistics, finance, and medical services should improve their performance through wireless mobile technology [2]. With the popularity of smartphones and tablets, and the advent of 4G networks with the increase of bandwidth, and the amount of data that can be obtained and sent quickly. Among them, the most benefited are the audio and video related applications. We can use high-speed 4G network to perform high-definition real-time image return from disaster relief scene. Since 2000, the Fire Administration in Taiwan has planned a project "the establishment of a digital image transmission system for disaster prevention and relief" to expand the application of fire prevention and disaster relief information. The VVLINK [3] image transmission software" is combined with the Emergency Management Information System (EMIS) to integrate



relevant information in major disasters. A questionnaire survey was carried out in this research for users of the live image transmission system (LVTS) built by the Fire Bureau of Changhua County. It will analyse the key factors that affect the usage intention of the firefighters who have used this LVTS. It could be used as a reference for strategy formulation with LVTS in future.

## 2. UTAUT model

Here, a research about connecting users' intention and their behaviour by "Unified Theory of Acceptance and Use of Technology (UTAUT)" model was carried out through a survey by questionnaire on usage of LVTS at fire safety works.

### 2.1. Relationship of intention and behavior

A research by Davis and his colleague in 1985 addressed the intentions in terms of attitudes for peoples' computer acceptance. It proved that user acceptance of computer technology is influenced by peoples' intentions. Actually, theory of reasoned action (TRA) proposed by Fishbein and Ajzen in 1975 was derived from social psychology, which was developed by Fishbein and Ajzen in 1975 based on social psychology. People usually consider various behaviour intentionally as the result of the scheme, which will be jointly affected by the attitude and subjective norm. In 1985 Ajzen extended TRA to develop the theory of planned behaviour (TPB), in which we can expect the personnel behaviour be more proactive and explainable. Also, the technology acceptance model (TAM) developed by Davis in 1989 which could be the most influential in explaining the behaviour adopting information technology (IT). He believed that the external factors for users' acceptance of new IT are the key intermediary factors of perceived usefulness and perceived ease of use, which affect the user's intention. Afterward the UTAUT model, in which 32 constructs were synthesized from eight well-known models and theories, was developed and assumed being able to consolidate previous TAM and related studies. It could be the most suitable for studying users' acceptance [4].

### 2.2. Model developing

In the domain of the research on users' acceptance of technology, many of the theoretical models originated from information systems, psychology, and sociology are produced. Researchers are facing difficulties in selecting a proper research model, which also force them to choose several useful concepts to construct a new model. Therefore, Venkatesh *et al.* [5] developed the UTAUT model to consolidate TAM based on TRA and TPB. To help the future researched in this domain, we can use this integrated model as a basis to find out more concepts affecting users' intention, and moreover to improve the interpretation of the model to understand users' behaviour. According to the eight well-known models and theories about intention and behaviour [4], the UTAUT is summarized into four main categories: performance expectancy (PE), effort expectancy (EE), and social influence (SI), and facilitating conditions (FC). Among them, the so-called PE refers to that the users believe that the new technology system will bring work performance under improvement; EE refers to the ease for user's operation on new technology system; SI refers to the user's perception for his important stakeholders to approve the use of new technology system; and FC refers that the users believe that the existing relevant infrastructure in the organization is sufficient to support the use the new technology system. In the UTAUT model as shown in Figure 1 [5], performance expectancy (PE) and effort expectancy (EE) were used to incorporate the constructs of perceived usefulness and ease of use. Another two important categories were incorporated, such as social influence (SI) by approval of important stakeholders and facilitating conditions (FC) for relevant infrastructure. Also, those four categories can be moderated by age, gender, experience, and voluntaries of use. In UTAUT model the behavioural intention (BI) is confirmed by PE, EE, and SI. And the usage behaviour (UB) is confirmed by BI and FC.

Marchewka and Kostiwa [6] studied the understanding of student perceptions by using course management software through UTAUT model and accounted for 70% of the variance in usage intention, better than any of TAM studies alone. Curtis *et al.* [7] studied 409 non-profit organizations in the United States by UTAUT model and found that organizations with a clear public relations department are more

likely to adopt social media technology and use them to achieve their organizational goals. A study by Verhoeven et al. [8] for freshmen from 714 universities in Belgium discovered that UTAUT can explain the difference of IT abilities from their computer usage frequencies. Chen & Lin [9] investigated the intention to apply mobile device in emergency medical service sites for firefighters and results showed that most users approved good satisfaction about that the usage of mobile device incorporated with ambulance service.

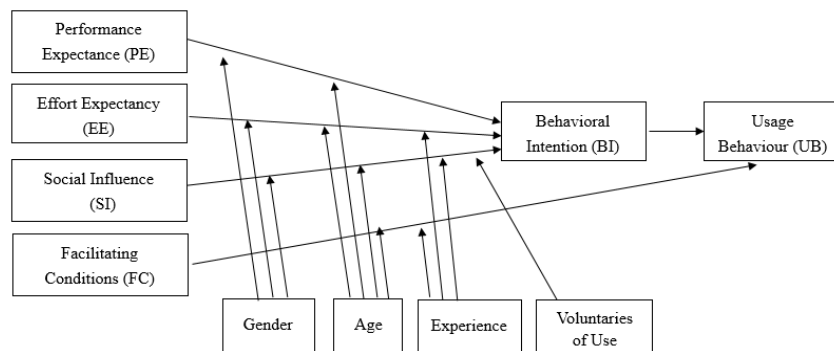


Figure 1. The UTAUT model [9].

### 3. Methodology

#### 3.1. Research framework

To study the usage behaviour for firefighters about application of LVTS in disaster sites the UTAUT model was proposed to apply for effect by categories of performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC), behavioural intention (BI) and usage behaviour (UB). Also the moderate factors, such as age, gender, experience, and voluntaries of use, will affect behavioural intention. Here, the experience includes usual experience with video transmission, experience of using LVTS at disaster site, and working unit.

The defined operation for those categories in UTAUT model are described below:

- PE: Firefighters subjectively believe that the use of LVTS at the disaster site will help improve efficiency on duty.
- EE: Firefighters subjectively believe that ease and convenience of applying LVTS in disaster sites to adapt their mission.
- SI: Firefighters can be approved by the public, their chief executive and colleagues for their application of LVTS in disaster sites.
- FC: Firefighters believe that the existing organization or technological infrastructure (network, hardware, etc.) can support the use of LVTS in disaster sites.
- BI: The degree of willingness for firefighters' personal inclination to apply LVTS in disaster sites.
- UB: Behavioural intentions can actually affect individual behaviour through previous research on TAM as well as TRA and TPB. Therefore, the higher the firefighters' intention to recognize the advantages of LVTS, the higher his willingness to apply it.

#### 3.2. Questionnaire design and analyses for validity and confidence

After the questionnaire was reviewed by the experts and revised, a formal questionnaire with expert validity was prepared. According the operational definition for those five categories in UTAUT model there are 19 questions designed as shown in Table 1. The questionnaire is scored by Likter's 5 point scale with range from 1 point (very disagree) to 5 points (very agree).

Table 1. Questionnaire designing.

Category and No. of Q	Questions
PE 4	Applying the LVTs : Helpful for disaster relief work; to complete disaster relief work quickly; improve disaster relief effectiveness; really helpful to win reward.
EE 4	Applying the LVTs : Familiar with the use of system; familiar with the operation without much time; easy to use (friendly interface); easy to learn how to use.
SI 4	Applying the LVTs : Someone can influence on me (supervisor, colleagues) will ask me to use it; someone important (friends, colleagues) around me will ask me to use it; supervisor or colleague will assist me; the service unit will encourage me.
FC 4	Applying the LVTs : Available immediately and connected; with the necessary knowledge; the information I want can be really reached; should be a specific person or team who can assist me.
BI 3	Applying the LVTs : Will continue to use; will use it when having a chance no matter be used before or not; should recommend others to use.

For confidence level, Cronbach's  $\alpha$  was always measured to assess the reliability, or internal consistency. There were 45 pre-test questionnaires issued to evaluate the Cronbach's  $\alpha$  through SPSS which is higher than 0.7 of "good" confidence in Table 2.

Table 2. Cronbach's  $\alpha$  for each category.

Category	No. of questions	Cronbach's $\alpha$
PE	4	0.791
EE	4	0.755
SI	4	0.822
FC	4	0.751
BI	3	0.893
total	19	0.899

## 4. Results and Discussions

### 4.1. Sample statistics

There were 525 returned from 600 questionnaires issued within the county fire bureau, and. 493 collected questionnaires were valid with a rate of 82%. Most surveyed objects are male (90.5%), the age is mostly in the range of 31 to 40 years old (57.2%) and more firefighters are basic staffs at local fire squad (57.1%). The usual experience of firefighter is mostly above 2 years (71.4%), however. 40% of firefighters never use it in disaster sites before. And 39% of firefighters are voluntary to use at each disaster sites.

### 4.2. Correlations

Correlation is measured with the Pearson Product-Moment Correlation with correlation coefficient  $r$  which quantifies the strength of such relationship. The strength of correlation is measured, where  $r > 0.7$  indicates highly correlation and  $0.7 > r > 0.4$  for medium correlation. According to the assumption of UTAUT model results showed high correlation with high significance on BI from categories of PE, EE, and SI in Table 3.

Table 3. Correlation coefficient  $r$  between each category according UTAUT model.

	PE	EE	SI	FC	BI	UB
BI	0.617**	0.415**	0.502**	-	-	-
UB	-	-	-	0.515**	0.492**	-

\*significant  $p < 0.05$  \*\*highly significant  $p < 0.01$

#### 4.3. Multiple Regression Analysis

The multiple linear regression is applied for a predictive analysis to explain the relationship between one continuous dependent variable and more independent variables. In this study only PE and FC are assumed to present good relationship with BI with high to very high significance. Also, BI can present a good relationship with UB with very high significance. The results of regression  $\beta$  coefficients and significance are shown in Table 4 and Table 5.

Table 4. Multiple regression analysis for BI corresponding to PE, EE, and SI

Category	Standardization coefficient $\beta$	T	Collinearity	
			Tolerance	VIF
PE	0.412	5.106***	0.750	1.333
EE	0.102	1.221	0.699	1.431
SI	0.219	2.706**	0.744	1.344

Table 5. Multiple regression analysis for UB corresponding to BI and FC

Category	Standardization coefficient $\beta$	T	Collinearity	
			Tolerance	VIF
BI	0.492	5.738***	1.000	1.000
FC	0.142	1.220	1.000	1.000

\*significant  $p < 0.05$  \*\*highly significant  $p < 0.01$  \*\*\*very highly significant  $p < 0.001$

#### 4.4. Analyses of Moderated Variables

As previous assumption behavioural intention is moderated by those variables, such as gender, age, voluntaries of use and experience (usual experience with systems, experience of using system at disaster site, and working unit). In this study the significance of difference was evaluated through independent-sample T-test and ANOVA.

- No significant difference for gender on each categories.
- No significance of differences for age has on each categories, too.
- Also, there is significance of difference on voluntaries of use for SI where unwillingness is more favourable than others.
- About usual experience with applying LVTS, there is significance of difference only for EE where firefighters with 1~2 years of experience are more favourable than others.
- About experience of using LVTS at disaster site, also there is significance of difference only for EE where firefighters with 0.5~1 year of experience are more favourable than others.
- No significant difference for working unit on each categories.

### 5. Results and Discussions

According the assumed UTAUT model (Figure 1) and examination of regression analysis as well as moderated variables, a new UTAUT model (Figure 2) was accomplished about the applying LVTS by firefighters. Except EE, PE and SI can affect the behavioural intention (BI), and BI, except FC, can affect usage behaviour (UB). Gender and age have no significant difference on each categories. Recently, many city/county fire departments in of Taiwan are gradually promoting the applying LVTS in disaster relief.

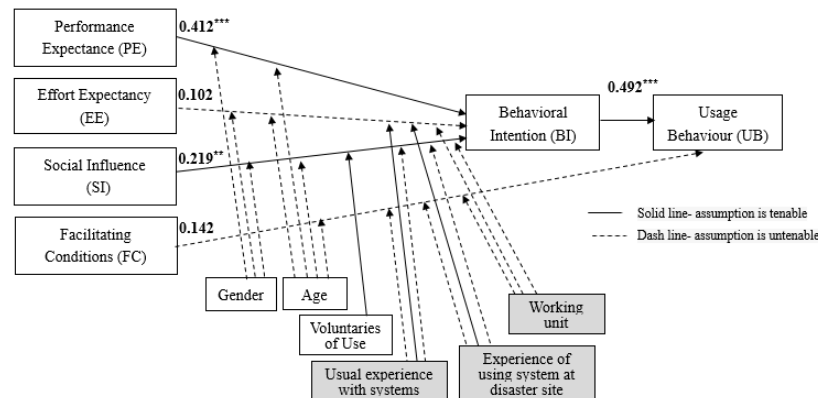


Figure 2. The final UTAUT model about applying LVTS by firefighters.

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