
A multilevel model of information system success in the user department: integrating job performance theory and field theory

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Abstract: This study adapts from *job performance theory* and *field theory*, a multilevel model to identify and validate the antecedents and their effects on information system (IS) success in the user department. The model is validated by using hierarchical linear modelling (HLM) method with survey data of 283 user managers and 42 top managers collected from 42 manufacturing companies in China that were utilising ERP systems. The results reveal that top management support and user manager's knowledge and attitude all significantly affect the level of UDISP, and that top management support significantly moderates the relationship between user-manager attitude and UDISP, but not the relationship between user-manager knowledge and UDISP. To enhance job performance of user managers, top management should proactively support the company to provide them with training, psychotherapy, and positive developmental experiences in order to improve their knowledge and attitude about a specific job.

Keywords: information system success; top management support; TMS; user manager knowledge; user manager attitude; job performance theory; JPT; field theory; hierarchical linear model.

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1 Introduction

Information system (IS) applications have enabled many organisations to become more productive and competitive in the 21st century (Ashrafi and Mueller, 2015; Johnson and Lederer, 2013; Li et al., 2013b; Luftman, 2003; Szydlowski and Smith, 2009; Yeh and Teng, 2012), through IS resources and IS capabilities (Ashrafi and Mueller, 2015). However, while there are many IS success stories, many failures have also been reported (Akgün et al., 2014; Barker and Frolick, 2003; Dawson and Owens, 2008; Lech, 2013). In particular, new systems produced by ineffective planning are reported to waste scarce resources and fail to support organisational objectives (Mirchandani and Lederer, 2014). Therefore, the application of IS does not necessarily lead to favourable organisational outcomes (Soh and Markus, 1995). Scholars in past studies on IS success commonly has

taken a quality perspective (DeLone and McLean, 1992; Wixom and Todd, 2005). They argue that IS success comes from providing information, system, and service qualities to the users and results in net benefits for both individuals and organisation (DeLone and McLean, 2003). In fact, this perspective seems parochial; it is only appropriate for IS managers who implemented the systems. In an organisation, people play important roles in the success of IS applications (Barker and Frolick, 2003; Bingi et al., 1999; Nguyen, 2005), especially user managers who are responsible for applying IS functions in their departments. After a system is implemented, the success of IS hinges on how well user managers improved their departmental performance through IS applications.

Past research has identified user managers' resistance as a bottleneck for attaining organisational information system performance (ISP) (Gallivan, 2001). Most studies into people-related effects on ISP have focused on how top management support (TMS) affects organisational ISP (e.g., Bingi et al., 1999; Ragu-Nathan et al., 2004; Somers and Nelson, 2001). There is a paucity of theoretical development and empirical studies about how user managers' capability and attitude affect their department-level ISP. Examining these people-related factors of successful IS applications and their interaction effects on ISP are of paramount important to every company. The success of IS depends on how well the system improves the operational efficiency and effectiveness of both individual users and the company, which were identified as individual impact and organisational impact by DeLone and McLean (1992). The key to attain such improvement relies heavily on the achievement of department-level ISP. Most researchers have analysed the antecedents of ISP at either the individual level (Iivari, 2005; Ives and Olsen, 1984; Montazemi, 1988; Rai et al., 2002) or the company level (Chatzoglou and Diamantidis, 2009; Ragu-Nathan et al., 2004; Somers and Nelson, 2001; Tsai et al., 2012), instead of at the department level. As company-level ISP relies on different departments in the company to apply ISs at various levels of sophistication, it is important to analyse the antecedents of ISP at the user's department level. To fill this research gap, this study intends to explore the effects of people-related factors on user department information system performance (UDISP). The research question of this study is therefore: 'How do the salient people-related factors affect ISP in the user department?'

Prior studies on organisational behaviour have shown that job performance (JP) has multiple dimensions and that it is predicted by three components: capacity, willingness, and opportunity (Blumberg and Pringle, 1982; Campbell, 1990). User managers are responsible for the effectiveness and efficiency of IS usage in their own departments, and thus UDISP should be one of the JP dimensions of user managers. Job performance theory (JPT) in organisational behaviour research (e.g., Blumberg and Pringle, 1982; Campbell, 1990) focuses on the people-related antecedents of JP, and therefore can be applied to analyse the people-related factors affecting UDISP. The model development process in this study is similar to the information technology (IT) acceptance research and IS continuance research. The IT acceptance research adapts the theory of reasoned action of social psychology and proposes a model of IT acceptance (Davis, 1989); while the IS continuance research adapts the expectation-confirmation theory of consumer behaviour and proposes a model of IS continuance (Bhattacharjee, 2001). Likewise, this study adapts the JPT of organisational behaviour and proposes a model of UDISP. Based on the JPT, we develop a multilevel model illustrating the people-related factors affecting UDISP and argue that knowledge and attitude of user manager are the key people-related determinants of UDISP through the interaction with TMS.

Successful application of IS can help enhance the strategic positioning of a company and improve its operational efficiency and effectiveness (Byrd et al., 2006; DeGroot and Marx, 2013; Li et al., 2013b). As this study concentrates on IS's influence on companies' internal operations, we define UDISP as an improvement in the efficiency and effectiveness of a user department after using IS functions. The level of ISP can be judged from an economic, financial, behavioural, or perceptual perspective (DeLone and McLean, 1992; Molla and Licker, 2001). In this study, we adopt the perceptual view because economic, financial, and behavioural improvements are difficult to assess at an individual user department. Even though assessing improvements from IS applications is possible, direct comparisons of ISP among user departments may not be accurate because the ways of IS applications may differ among departments and between companies. Thus, we assess UDISP by the perceptions of user managers who are responsible for IS applications in different departments of a company.

In the remaining sections, we first introduce a conceptual model adapted from JPT and develop our research hypotheses based on this model. Next, we conduct an empirical study designed to test the hypotheses using a sample of Chinese companies and report the results and findings of the study. Finally, we discuss the theoretical and practical implications derived from this study.

2 Theoretical background

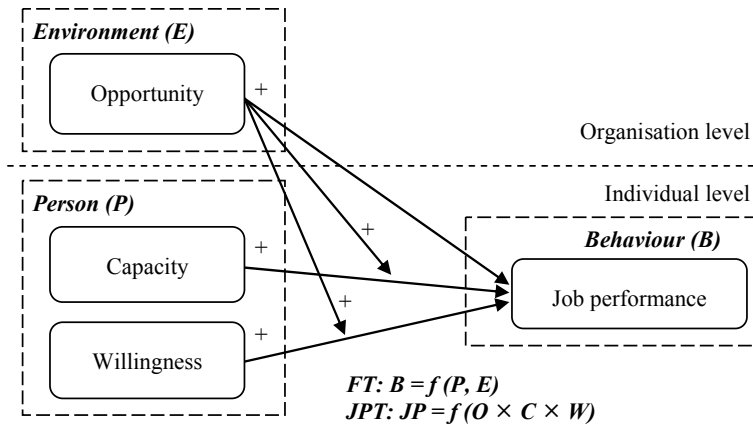
JPT is widely used to explain the people-related antecedents of JP (Law et al., 2008; Waldman and Spangler, 1989) in organisational behaviour research. A job usually contains multiple tasks. The theory explains that the *performance* of a particular task is a function of *capacity*, *willingness*, and *opportunity* (Vroom, 1964; Blumberg and Pringle, 1982). *Capacity* refers to the physiological and cognitive capabilities that enable an individual to complete a task effectively. *Willingness* refers to the psychological and emotional characteristics that influence the degree to which an individual is inclined to perform a task. *Opportunity* refers to the certain environmental factors beyond an individual's control that influence the individual's JP (Blumberg and Pringle, 1982; Campbell, 1990). Like willingness and capacity, opportunity alone cannot ensure JP; it interacts with capacity and willingness to make performance possible. The underlying theory can be expressed as $JP = f(O \times C \times W)$. Figure 1 illustrates the key constructs and their relationships in JPT. The relationships are explained as follows.

First, individual capacity is a key predictor of JP. For example, to develop a computer program, a programmer must possess the relevant knowledge of computer language, hardware and software. Likewise, a project manager must know what, how, and whom to best perform the needed tasks. Without such knowledge, it seems impossible for the individual to develop a high quality program. Therefore, individual capacity is a key determinant of JP, similar to self-efficacy (Compeau and Higgins, 1995; Martocchio and Dulebohn, 1994).

Second, individual willingness is also important for JP. For instance, if the programmer is not interested in the program nor satisfied with the rewards that he or she expects to receive in compensation, he or she may spend little effort on writing a program and assuring its quality, as long as the program works. The programmer in such a

situation might make excuses for why the program operates slowly. Therefore, both capacity and willingness affect the level of individuals' JP (Vroom, 1964).

Figure 1 A multilevel conceptual model of JP



Third, in addition to willingness and capacity, opportunity is a key contributor to the attainment of JP. As Blumberg and Pringle (1982) stated, employees need adequate opportunities to perform tasks effectively, and such opportunities may include tools, equipments, materials, leader behaviour, organisational rules, organisational policy, among others. Some other researchers also stated that the availability of adequate resources (e.g., instruments and materials) and leaders' guidance and support are significant determinants of JP (e.g., Gist, 1987; Komaki, 1986). For example, a programmer must have clear instructions and guidance from supervisors and adequate computer hardware and software support to develop the required program. Without these supporting opportunities, the programmer will not be able to perform properly.

Fourth, opportunity will interact with capacity and willingness in achieving JP. As Blumberg and Pringle (1982) stated, for JP to occur, all the three elements (capacity, opportunity, and willingness) must be present. This is consistent with that of Bandura (1974) who stated that human accomplishments result from the individuals' reciprocal interactions of external circumstances with a host of personal determinants. Moreover, the *field theory* (Lewin, 1951) in social psychology also prescribed the equation of $B = f(P, E)$ to explain that individual's behaviour (B) is a function of the person (P) interacting with the environment (E); both the person and the environment jointly affect the person's behaviour. For example, if the supervisor does not support and provide little resources, even though the employee possessing the capacity and willingness to write a high-quality program, he or she will not be able to perform. Conversely, if the supervisor supports the work and provide good work environment, the employee with high willingness and capacity can perform well. Conceptually, the JP model is a multilevel model in which opportunity is the organisational context essential to the performance of individuals' behaviours, because the contexts are stimuli and phenomena that surround and thus exist in the environment external to the individual, most often at a different level of analysis (Mowday and Sutton, 1993).

Figure 1 summarises the discourse above into a multilevel research model in which an individual's JP is the consequence of the individual's capacity and willingness, and the

organisation's opportunity provided to the individual. Furthermore, the organisational opportunity interacts with the individual capacity and willingness, and affects (fosters or hinders) their effects on the individual's JP. The corresponding elements of Lewin's (1951) equation are indicated in the model to represent the field theory. The next section examines how JPT can serve as a theoretical foundation for explaining the relationships among people-related factors and UDISP.

3 Research model and hypotheses

Like any other employee, a company's user managers are required to perform multiple tasks. In the companies with IS applications, one of the tasks performed by user managers is overseeing the application of IS in their own departments and making sure it performs satisfactorily. Thus, UDISP is a significant JP dimension for user managers, and the JP model reviewed in the previous section can serve as the conceptual framework for explaining the causal relationships of UDISP and its determinants.

First, according to the JP model, user managers need to have capacity to carry out the IS-related tasks within their departments. Previous studies have shown that the most critical capacity which determines JP is job knowledge (Hunter, 1983; Schmidt et al., 1986). In the knowledge management field, research has shown the important role of knowledge for firm to obtain competitive advantage (Cao and Xiang, 2013). For ISP, users must have enough information system knowledge (ISK) (Rozell and Gardner, 2000). Without adequate ISK, it is impossible for a user manager to clearly describe the business data and information needs of his or her department, make the correct decisions in selecting the right software package, and effectively manage the usage of IS within his or her department to fully exploit IS benefits. For example, an IS vendor may claim that their system has certain functionalities when it does not, and some packages are better suited to larger organisations than others (Akkermans and Helden, 2002). To choose the most suitable package, it is necessary to decide which version or modules will best fit the organisation (Piturro, 1999). If the wrong package is selected, the organisation will face either a misfit between the IS package and their business processes and strategy, or the need for modifications that can be costly and risky (Janson and Subramanian, 1996). Furthermore, clearly defining business data and information needs is an important first step for a successful application of IS (Davenport and Prusak, 2000). In this vein, the ISK of user manager is critical to achieve UDISP. Thus, the following hypothesis is proposed.

H1 The ISK of user manager has a positive effect on the UDISP.

Second, according to the JP model, user managers need to have willingness to carry out the IS-related tasks within their departments. Therefore, we believe that user managers who are more willing to utilise ISs will perform better in this task. According to Blumberg and Pringle (1982), willingness is a positive attitude. The more positive a user manager's attitude towards IS usage, the more effort they will spend on the IS projects assigned by top management or even may initiate new IS projects within their own departments, which in turn, improve UDISP. In a study concerning social network, Zhong et al. (2011) confirm that a person with persistent willingness to search for ICT information and adopt media technological devices (e.g., smartphones, iPad, and Kindle) tends to achieve high performance in social network usage. In the mobile marketing field,

research also shows that people's attitude toward the marketing communications influences their performance in the use of smart-phone related technology (Watson et al., 2013). Thus, we hypothesise:

H2 The attitude of user manager towards IS has a positive effect on the UDISP.

Third, according to the JP model, a user manager needs resource opportunities to achieve expected UDISP. In the IS context, usually the opportunities are provided by top management. In general, IT systems are open systems comprising two subsystems, one being the users and their organisation, and the other the computer hardware and software (Diehl, 2005). These opportunities require investment, such that if top management does not actively support application of IS by allocating the appropriate resources, there is little hope to achieve UDISP. Prior studies have identified TMS as one of the key success factors of ERP implementation (Bingi et al., 1999; Buckhout et al., 1999; Nah et al., 2003). Taking from IT innovation literature, the important role of top management in the diffusion of innovation has been well documented (Bantel and Jackson, 1989; Daellenbach et al., 1999; Elenkov and Manev, 2005; Guo et al., 2013; Hoffman and Hegarty, 1993; Li et al., 2013a; Lyon and Ferrier, 2002; Yoon and George, 2013). With respect to the implementation of IS projects, Grover and Walker (2003) stated that the implementation of new technology must be orchestrated with a commitment from top management, while Ginzberg (1981) argued that top management is instrumental to the successful application of IS. Top management must understand the capabilities and limitations of IS, establish reasonable goals for the IT systems, exhibit strong commitment to the success of the project, and communicate the corporate IS strategy to all employees (McKersie and Walton, 1991). Therefore, the opportunities for application of IS provided by the top management is critical for user managers to achieve UDISP. Based on the above discussion, the following hypothesis is proposed.

H3 TMS has a positive effect on UDISP.

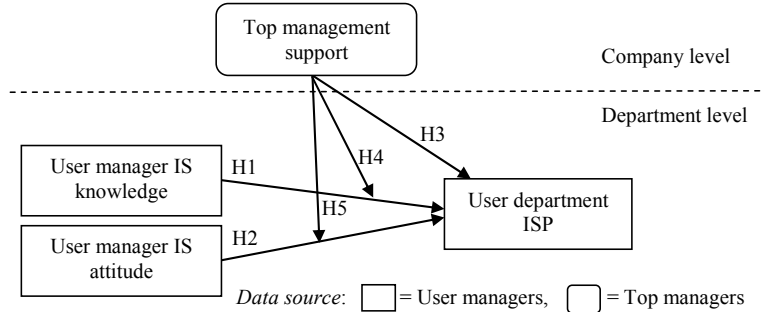
Fourth, according to the JP model, opportunities will interact with individual capacity and willingness in achieving JP. In the IS context, the degree of department ISP is hinged on the degree of TMS. If top management doesn't support the IS application, then user managers will have no needed resources to operate an IS in their department. In this case, even though their attitude towards IS usage is positive and they have the relative ISK to apply IS effectively, they still cannot attain high department ISP. Therefore, TMS has a moderating effect on the relationships between the knowledge and the attitude of user managers with the ISP of the department. Similarly in the context of human resource management, research has shown that supervisors' leadership interacts with subordinates' work attitude in predicting subordinates' JP (Yao et al., 2014). Based on the above discussion, we propose the following two hypotheses.

H4 TMS moderates the relationship between user manager attitude towards IS and UDISP.

H5 TMS moderates the relationship between user manager ISK and UDISP.

To summarise, we have applied JPT in organisational behaviour research to developing a multilevel model that describes the association between the people-related factors and UDISP. The proposed model for this study is shown in Figure 2, in which individual level in Figure 1 corresponds to the department level and organisational level refers to the company level.

Figure 2 A multilevel model of UDISP



4 Method

4.1 Procedures and samples

Our empirical investigation of the multilevel model consists of two stages. In the first stage, we conducted a focus group meeting consisting of the authors and two university professors with extensive IS consultant experience. Together we examined one-by-one the initial measurement items adapted from the existing literature for their practicality and clarity, and repeatedly modifying the existing items and generating new items until no further improvement was necessary. Then, we used the modified questionnaire to interview 16 practitioners in southern China. Five of them were Chief Information Officers (CIOs) in their companies, seven were user managers in companies with application of IS, and four were IS implementation consultants working for software suppliers. During the interviews, we presented our measurement items to these practitioners and solicited their suggestions for modifying the existing items and generating new items. Subsequently, the original focus group examined the results of the interviews and finalised the measurement items. The purpose of this stage was to develop a questionnaire to be used in our survey and assure its face validity. The final questionnaire contains two parts as shown in Table 1; one for three department-level constructs [ISK, information system attitude (ISA), and UDISP] and the other for one company-level construct (TMS).

In the second stage, we surveyed 42 manufacturing companies that were running the applications of enterprise resources planning (ERP) systems such as SCM (supply chain management) systems, CRM (customer relationship management) systems, and MRP (manufacturing resource planning) systems. Guangdong province was chosen as the research location because it is one of the most developed provinces in China where a large number of the companies situated have applied ISs with varying degrees of performance. The context of ERP system was selected because it is relatively complex for integrating business and IS, which contributes to the variance of UDISP. Additionally, many failure stories about the application of ERP systems were reported (Dawson and Owens, 2008) making UDISP an important issue to be studied. We personally contacted the top managers of the 42 companies to solicit their support for this study. After gaining their support, we asked each top manager to distribute questionnaires to at least five of his/her user departments' managers and personally fill out the

questionnaire as well. The questionnaire for the user managers consisted of department-level items (i.e., user managers' ISK and attitude, and UDISP) and the questionnaire for the top managers consisted of three items measuring TMS for IS, which are at the organisational level. We received a total of 283 valid questionnaires from user managers, and 42 valid questionnaires from top managers. This multilevel sample allows us to test the multilevel relationships shown in Figure 2. The key advantage of this sampling process is to ensure that the questionnaires are completed by the appropriate top- and user-managers. Of the 283 user managers responded, 70.3% are male. Of the 42 top managers responded, 81.0% are male.

Table 1 Description of questionnaire items for user managers and top managers

<i>Item code</i>	<i>Description</i>	<i>Sources</i>
<i>Department level</i>		
User department ISP		
UDISP 1	1 The productivity of my department has improved because of the application of information system.	DeLone and McLean (1992), Ragu-Nathan et al. (2004), Byrd et al. (2006)
UDISP 2	2 The performance of my department has improved because of the application of information system.	
UDISP 3	3 Information system has facilitated my department decision-making quality.	
UDISP 4	4 The processes of my department have improved because of the application of information system.	
UDISP 5	5 Using information system has led to better management of my departmental activities.	
UDISP 6	6 The efficiency of our departmental operations has improved because of the application of information system.	
IS knowledge		
ISK 1	1 I know which type of information systems is helpful to improve the operational efficiency of my department.	Boyatzis (1982), Spencer and Spencer (1993)
ISK 2	2 I know the functions of the information systems that are appropriate for my department.	
ISK 3	3 I know the relationships between the information systems applied in my department and those applied in other departments within the company.	
ISK 4	4 I know the application status of similar information systems in other companies within the same industry.	
ISK 5	5 I know the effects of similar information systems applied in other companies within the same industry.	

Table 1 Description of questionnaire items for user managers and top managers (continued)

<i>Item code</i>	<i>Description</i>	<i>Sources</i>
<i>Department level</i>		
IS attitude		
ISA 1	1 It is good for my department to apply information systems.	Ajzen (1991)
ISA 2	2 It is wise for my department to apply information systems.	
ISA 3	3 It is positive for my department to apply information systems.	
ISA 4	4 It is foolish for my department to apply information systems (reversed).	
<i>Company level</i>		
Top management support		
TMS 1	1 The top management understands the importance of information systems application.	Ragu-Nathan et al. (2004)
TMS 2	2 The top management supports the application of information systems	
TMS 3	3 The top management is interested in the application of information systems	

4.2 Measures

The measurement items for the four constructs in this study were all adapted from the existing literature. The scale for TMS was adapted from Ragu-Nathan et al. (2004), with modifications based on our interviews. It consists of three items, e.g., one item states “The TMSs the application of information systems”. This scale was completed by the top managers of the 42 companies in our sample. The internal-consistency reliability (Cronbach’s α) of this measurement with the multilevel sample of 42 top managers was 0.884.

The items for measuring UDISP are drawn from three previous studies of IS success (DeLone and McLean, 1992; Byrd et al., 2006) and ISP (Ragu-Nathan et al., 2004), with needed modifications based on our interviews. The final version of the scale consists of six items. An example item reads like: “Using information system has led to better management of my departmental activities”. This six-item scale was completed by the user managers in the sample. The Cronbach’s α reliability of this measurement with the multilevel sample was 0.871.

The scale of attitude towards IS are adapted from Ajzen (1991), with proper modifications to suit our research context. The scale consists of four items; an example is: “It is wise for my department to apply information systems”. This scale was completed by the user managers in the sample. The Cronbach’s α reliability of this measurement with the multilevel sample was 0.895.

Based on the knowledge requirements for given tasks reported in previous studies (e.g., Boyatzis, 1982; Spencer and Spencer, 1993) and our interviews, we developed five items to measure the ISK of user managers. One item states: “I know which type of

information systems is helpful to improve the operational efficiency of my department". This scale was completed by the user managers in the sample. The Cronbach's α reliability of this measurement with the multilevel sample was 0.894.

All of the measurement items used a five-point Likert-type scale format, ranging from strongly disagree ('1') to strongly agree ('5'). Factor analysis and correlation analysis were used to analyse the validity of the measurements. Hierarchical linear modelling (HLM) (Raudenbush et al., 2000) was used to analyse the data from the multilevel sample to test the hypotheses.

5 Analysis and results

5.1 Validity of measures

We first conducted the Kaiser-Mayer-Olkin (KMO) and Bartlett's test of sphericity before performing the exploratory factor analysis (EFA) on the three department-level constructs (i.e., UDISP, user manager ISK, and user manager ISA). Using IBM SPSS 22.0 with the sample of 283 user managers, we found KMO value to be 0.881 (greater than the recommended level of 0.70) and the significance of Bartlett's test to be $p < 0.001$. This finding confirms that the department-level sample exhibits a multi-variant normal distribution and is adequate for EFA. Next, we conducted EFA through principle axis factoring method to extract the important component items for each construct and see if any measurement items should be deleted. By using the varimax with Kaiser normalisation rotation (Kaiser, 1970, 1974), a three-factor solution emerges, which explains 68.993% of total variance. The similar process was applied to the company-level sample of 42 top managers for the construct of TMS. The KMO value and the significance of Bartlett's test are 0.711 and $p < 0.001$, respectively. Using principal component analysis without any rotation, a one-factor solution emerges, which accounts for 72.874% of total variance. The results of the EFA of the multilevel sample data are shown in Table 2. All of the items loaded heavily on their respective factors and the cross-loadings were relatively small. We also calculated the values of composite reliability of all four scales. As Table 1 shows the composite reliability values of all four scales were well above 0.80. Thus, we conclude that the four multilevel construct measures derived from the existing scales and modified after completing the pilot reviews possess reliability and construct validity.

The descriptive statistics and correlations among the variables in the multilevel sample are shown in Table 3. All variables have reasonable and small dispersions in the distributions across the ranges, as the standard deviations show. Convergent validity is adequate since all values of average variance extracted (AVE) surpass the threshold of 0.5 (Fornell and Larcker, 1981) as shown in Table 2. Specifically, the formula of AVE for construct X with indicators x_1, x_2, \dots, x_n is

$$AVE = \frac{\sum [\lambda_i^2] Var(X)}{\sum [\lambda_i^2] Var(X) + \sum [Var(\varepsilon_i)]}$$

where λ_i is the loading of x_i on X, Var denotes variance, ε_i is the measurement error of x_i , and Σ denotes a sum (Fornell and Larcker, 1981).

Table 2 Results of the EFA

<i>Items</i>	<i>Factor 1</i>	<i>Factor 2</i>	<i>Factor 3</i>	<i>Composite reliability</i>	<i>AVE</i>
<i>Department level</i> (<i>N = 283</i>)					
User department ISP				0.881	0.555
UDISP 1	0.674	0.191	0.171		
UDISP 2	0.799	0.209	0.003		
UDISP 3	0.836	0.138	0.143		
UDISP 4	0.806	0.201	0.118		
UDISP 5	0.700	0.270	0.169		
UDISP 6	0.631	0.267	0.027		
IS knowledge				0.894	0.628
ISK 1	0.246	0.757	0.110		
ISK 2	0.237	0.749	0.239		
ISK 3	0.226	0.833	0.093		
ISK 4	0.233	0.826	0.141		
ISK 5	0.245	0.793	0.081		
IS attitude				0.914	0.758
ISA 1	0.147	0.171	0.895		
ISA 2	0.172	0.224	0.882		
ISA 3	0.158	0.182	0.918		
ISA 4	0.023	0.003	0.701		
Eigenvalue	6.369	2.347	1.633		
Cumulative % of variance explained	42.460	58.108	68.993		
<i>Company level</i> (<i>N = 42</i>)					
Top management support				0.889	0.729
TMS 1	0.944				
TMS 2	0.746				
TMS 3	0.860				
Eigenvalue	2.440				
Cumulative % of variance explained	72.874				

Note: AVE = average variance extracted.

Furthermore, for discriminant validity, the AVE value from a construct should be greater than the variance shared between the construct and the other constructs in the model (Chin, 1998). According to the results in Table 3, each square root value of AVE exceeds correlations between the construct and any other construct, hence, the discriminant validity is confirmed. Given the validity of the measurement model, we can proceed to further analysis with the multilevel research model.

Table 3 Descriptive statistics and correlations

Variable	<i>N</i>	Mean	Std. dev.	α	1	2	3
<i>Department level</i> (<i>N</i> = 283)							
1 User department ISP	283	3.37	0.75	0.87	(0.745)	283	
2 IS knowledge	283	3.37	0.81	0.89	0.552**	(0.792)	
3 IS attitude	283	4.26	0.70	0.90	0.318**	0.351**	(0.870)
<i>Company level</i> (<i>N</i> = 42)							
1 Top management support	42	3.68	0.87	0.88	0(.854)		

Note: Parenthesised number is the square root of AVE; ** $p < 0.01$.

5.2 Hierarchical linear model of UDISP

As our model involves cross-level predictors (i.e., two department-level predictors and one company-level predictor), and the dependent variable is at the lower department level, we use HLM (Raudenbush et al., 2000) software, HLM 6.02, to test the hypotheses. Besides verifying the reliability of the respondents, a prerequisite for testing the cross-level predictors is that the intraclass correlation coefficients, ICC_1 and ICC_2 , of the respondents must be sufficiently large. While ICC_1 compares the between-organisations variance to the within-organisation variance to indicate the portion of variance in individual responses accounted for by the between-organisations difference, ICC_2 reveals the reliability of the mean of an organisation-level variable (Bliese, 2000). The absolute value of ICC_1 and ICC_2 should exceed 0.12 and 0.60, respectively (James, 1982; Bliese, 2000). The formulae of ICC_1 and ICC_2 are illustrated as follows:

$$ICC_1 = \frac{MSB - MSW}{MSB + (K - 1) * MSW}$$

$$ICC_2 = \frac{MSB - MSW}{MSB}$$

where K represents the average firm size. For example, if we have 42 firms and the average sample is 6 to 7 people for a firm, K would be 6. Furthermore, MSB and MSW are the mean square between groups and the mean square within group obtained from ANOVA output. As our organisation-level variable, TMS, was collected from only one top manager from each company and cannot be used to compute ICC_1 and ICC_2 , we must examine these two coefficients with the dependent variable, UDISP. To do so, we conducted the ANOVA analysis for UDISP using the user manager scores. The results showed that the variances between groups were larger than within groups ($F = 3.030$, $p < 0.001$) as shown in Table 4.

Using the values of MSB and MSW from Table 4, $ICC_1 = (1.306 - 0.431) / [1.306 + (6 - 1) \times 0.431] = 0.253$ and $ICC_2 = (1.306 - 0.431) / 1.306 = 0.670$. Both absolute values exceed the acceptable thresholds of 0.12 and 0.60, respectively, allowing us to proceed to the HLM analysis.

Table 4 ANOVA results for UDISP

	<i>Sum of square</i>	<i>df</i>	<i>Mean square</i>	<i>F</i>	<i>p</i>
Between groups	53.566	41	1.306	3.030	0.000
Within group	103.914	241	0.431		
Total	157.481	282			

Table 5 HLM results for UDISP

<i>Variable</i>	<i>Null model</i>	<i>Model 1: Department-level predictors only</i>	<i>Model 2: Department and company-level predictors</i>	<i>Model 3: With cross-level interactions</i>
Department level (<i>N</i> = 283)				
Intercept (γ_{00})	0.06 (0.26**)	0.06 (0.09**)	0.06 (0.06**)	0.05* (0.05**)
IS knowledge (γ_{10})		0.41** (0.12**)	0.40** (0.11**)	0.38** (0.12**)
IS attitude (γ_{20})		0.19** (0.04*)	0.19** (0.03*)	0.20** (0.04*)
Company level (<i>N</i> = 42)				
Top management support (γ_{01})			0.15**	0.16**
Cross-level				
IS knowledge \times TMS (γ_{11})				-0.01
IS attitude \times TMS (γ_{21})				0.11 ⁺
Within-group residual variance	0.77	0.50	0.50	0.51
R ² _{within-group} ^a		0.35		
R ² _{between-group} ^b			0.33	0.44
Model deviance	776.99	670.71	667.31	670.72

Notes: User managers *N* = 283, companies *N* = 42; ⁺*p* < 0.10; **p* < 0.05; ***p* < 0.01.

Entries are estimations of the fixed effects (γ 's) with robust standard errors.

Estimations of the random variance components (τ 's) are in parentheses. The τ for the intercept also represents the between-group variance in UDISP.

^aProportion of within-group variance explained by department-level predictors.

^bProportion of between-group variance explained by company-level predictors.

According to our research hypotheses, we examined three competing models (see Table 5). First, we tested the null model without any predictor at any level as the baseline model. The results show that the effect is not significant ($\gamma_{10} = 0.41$, *p* > 0.1) but the between-group variance in UDISP is significant ($\tau = 0.26$, *p* < 0.01). Next, we estimated a department-level model including ISK and ISA of user managers as the predictors (see Model 1 in Table 5). The results show that the two department-level variables explained 35% of the within-group variance of UDISP. Both predictors exhibit significant effects on the dependent variable ($\gamma_{10} = 0.41$, *p* < 0.01 for ISK; $\gamma_{20} = 0.19$, *p* < 0.01 for ISA). Thus, H1 and H2 are supported.

To test H3, we estimated a HLM model in which the ISK and ISA of user managers are the department-level predictors and TMS is the company-level predictor. We then regressed the department-level intercept coefficients on the variables of TMS at the company level. To decrease collinearity of the intercept and slope estimation at the organisational level and provide a higher accuracy of estimation for HLM analysis (Hofmann and Gavin, 1998; Kreft et al., 1995; Raudenbush, 1989), we regarded the group averages as the centre to adjust prediction at the department-level (cf. Hofmann and Gavin, 1998). The results show that TMS accounts for 33% of the between-group variance of UDISP, and the effect ($\gamma_{01} = 0.15$) is statistically significant ($p < 0.01$), as shown in Model 2 of Table 5. Thus, H3 is supported.

H4 and H5 concern with cross-level interactions and predict that the company-level variable, TMS, will moderate the relationships between ISK and ISA of user manager with UDISP. A prerequisite for testing the cross-level interactions is that the random variance for the ISK and ISA in the slopes-as-outcomes models estimated in the previous step is significant. As Model 2 in Table 5 shows, both ISK and ISA have significant random variance ($\tau = 0.11, p < 0.01$ and $\tau = 0.03, p < 0.05$ for ISK and ISA, respectively), which suggests that there is significant variability in department-level ISK-ISP and ISA-ISP relationships. We then examine whether these variances can be explained by company-level factor (i.e., TMS). The results show that TMS is related to the ISA slope ($\gamma_{21} = 0.11, p < 0.1$) but not related to the ISK slope ($\gamma_{11} = -0.01, p > 0.1$). Therefore, H5 is supported, while H4 is not. The multilevel model whose individual-level predictor scores are centred by their corresponding group means is formulated as follows:

- Department-level model:

$$UDISP_{ij} = \beta_{0j} + \beta_{1j} (ISK_{ij} - \overline{ISK}_j) + \beta_{2j} (ISA_{ij} - \overline{ISA}_j) + r_{ij}$$

- Company-level model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} (TMS_j) + U_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} (TMS_j) + U_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21} (TMS_j) + U_{2j}$$

The final formula for Model 3 is as follows:

$$\begin{aligned} UDISP_{ij} = & \gamma_{00} + \gamma_{01} \times TMS_j + \gamma_{10} \times (ISK_{ij} - \overline{ISK}_j) + \gamma_{11} \times TMS_j \times (ISK_{ij} - \overline{ISK}_j) \\ & + \gamma_{20} \times (ISA_{ij} - \overline{ISA}_j) + \gamma_{21} \times TMS_j \times (ISA_{ij} - \overline{ISA}_j) \\ & + U_{0j} + U_{1j} \times (ISK_{ij} - \overline{ISK}_j) + U_{2j} \times (ISA_{ij} - \overline{ISA}_j) + r_{ij} \end{aligned}$$

ISP_{ij} represents the i^{th} individual score of ISP in j^{th} organisation.

TMS_j represents the aggregate score of TMS in j^{th} organisation.

ISK_{ij} represents the i^{th} individual score of ISK in j^{th} organisation.

ISA_{ij} represents the i^{th} individual score of ISA in j^{th} organisation.

γ_{kl} represents the slope of the k^{th} level-1 predictor interacting with the l^{th} level-2 predictor.

- U_{kj} is a normal distribution and represents the residual of slope of k^{th} level-1 predictor in the j^{th} organisation.
- r_{ij} is a normal distribution and represents the residual of regression model in individual level.

6 Conclusions and implications

With the ongoing advancement in information technologies, an increasing number of companies are able to benefit from the application of IS. However, there are both success and failure in this application (Dawson and Owens, 2008), thus it is necessary to analyse the antecedents of ISP in an organisation. People may play important role in successful application of IS (Nguyen, 2005). However, the majority of the research on people-related antecedents of organisations' ISP has focused on the effects of TMS on company-level ISP (e.g., Ragu-Nathan et al., 2004; Somers and Nelson, 2001). Few studies have probed into the influences of user managers on UDISP and the antecedents of UDISP. This study thus attempts to examine the people-related antecedents of UDISP based on JPT in organisational behaviour research. Specifically, we adapted the theory into a JP model and argue that user managers who regard UDISP as one of the important performance dimensions of their jobs play a significant role in achieving UDISP. Based on the sample data collected in China, we find evidence that user managers' knowledge and attitudes towards IS are crucial predictors to UDISP. Most importantly, TMS does matter to user manager's ISA and UDISP, but not to user manager's ISK. It enhances UDISP and moderates the relationship between user manager's ISA and UDISP, but not the relationship between user manager's ISK and UDISP.

To summarise, this study contributes to the IS literature in several ways. First, it is a pioneer study that develops the model of people-related antecedents of UDISP. Second, it provides empirical evidence for the effect of user managers on UDISP. Third, it examines UDISP from cross-level and organisational-behaviour perspectives, which is novel to the ISP research. Fourth, it reveals direct and moderation effects of TMS on UDISP and provides important insights for companies to train their user managers. Fifth, it provides direction for Chinese organisations to enhance their UDISP through balancing TMS and user managers' ISK and ISA.

6.1 Theoretical implications

This study has several important theoretical implications. First, it theorises and examines one of the earliest models of people-related antecedents of UDISP. The JP model adapted from organisational behaviour research provides an integrated picture of the people-related factors and their relationships to UDISP. Future research may attempt to integrate the constructs developed in this paper with those from other theories to develop and test more comprehensive models of UDISP.

Second, it is one of the earliest studies about the influences of user manager on UDISP. Although user managers' resistance has been acknowledged as a bottleneck for attaining ISP (Gallivan, 2001), there is a paucity of theoretical development and empirical studies about the effect of user managers' characteristics on UDISP. This

research provides empirical evidence that user managers' attitude and knowledge will affect their corresponding department's ISP.

Third, it examines UDISP from cross-level perspectives, which is novel to IS research, as most of the related extant IS studies have focused on the same level analysis. Previous research has shown that TMS is a key contributing factor to company-level ISP (e.g., Ragu-Nathan et al., 2004). However, research about the effect of TMS on UDISP remains limited. Based on the JPT, we propose a multilevel model showing that TMS to the application of IS is the critical opportunity for achieving high UDISP. Our results show that TMS for the application of IS accounts for 44% of between-group variance of UDISP.

Fourth, this study conducts a pilot research on the cross-interaction effects of TMS and user manager characteristics on UDISP. JPT shows that *opportunity* will moderate the *capacity-performance* relationship and the *willingness-performance* relationship. However, our research shows that in the IS context, TMS only moderate the relationship between user manager ISA and UDISP, it does not moderate the relationship between user manager ISK and UDISP. This means that in the IS context, UDISP is mainly decided by user manager characteristics and the necessary IS resource provided by top management. If TMSs the application of IS, user manager attitude towards IS will contribute more to UDISP. However, the extent of TMS will not affect the contribution of user manager ISK to UDISP. This implies that regardless of TMSs, user manager ISK is the key to achieving high UDISP. Additionally, as this study is based on a cross-level perspective, it provides a theoretical explanation of how upper-level management can affect the performance of lower-level employees in the IS context.

6.2 Practical implications

There are several practical implications worth noting. First, TMS has been touted as a critical success factor of organisational ISP, yet the influence of user managers has received relatively little attention. Our finding that user managers significantly influence UDISP, beyond the impact of TMS, indicates that the success of applying IS functions within an organisation depends not only on TMS but also user manager's knowledge and attitude toward IS applications. To improve user manager's knowledge and attitude, a company could provide training, psychotherapy, and positive developmental experiences (Spencer and Spencer, 1993). Second, based on the knowledge requirements for given tasks reported in previous studies and our interviews with 17 IS experts, we developed items to measure ISK of user managers. These items show the details of ISK that user manager needs to achieve UDISP, which may provide guidance for companies to train and develop their user managers ready for the application of IS. Third, our results show that TMS does not matter to the effect of user manager ISK on UDISP; this further implies the important role of user manager in exploiting his/her ISK for attaining UDISP. Finally, this study points out that user managers' knowledge about IS applications is the most important key to departmental IS success, followed by their attitude and TMS. This implies that if user managers know more about the IS applications, they could evangelise IS benefits better and convince their subordinates to use the systems. Therefore, to ensure IS success, corporate management should allocate to department managers the duty of IS success and IS providers should deliver hand-on training and detailed operating manual to these managers. When these managers lead in using IS, their subordinates tend to follow; this helps decrease the chance of IS failure.

7 Limitations and future research

As with any other study, this study has several limitations. First, the research model of this study is parsimonious and contains only three antecedent factors, one for each dimension of opportunity, capacity, and willingness. Although it is carefully validated, more factors may be included in these dimensions in the future. Second, the data in this study were collected from the richest province in China, Guangdong province, which may hinder the generalisation of the research results to other regions. However, there is no evidence that Guangdong has any particular characteristic that would make our results unique to this province. Future research should collect more data from other provinces in China. Third, the department-level variables were self-reported by the user managers, which could introduce a common method bias. However, the survey responses were anonymous and we gave the respondents assurance that there were no right or wrong answers, and that they should answer the questions as honestly as possible; this reduces the possibility of a common method bias (Podsakoff et al., 2003). We also conducted confirmatory factor analyses and found that the single-factor structure fitted the data poorly. Therefore, common method variances do not appear to significantly influence the findings. Nonetheless, future research should strive to obtain UDISP evaluation from other informant sources and cross validate the results of this study using the data collected from multiple provinces in China.

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