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A STUDY ON MOBILE ERP APPLICATION USAGE OF SMARTPHONES: A CASE OF TRAVELING SALESMAN IN PHARMACEUTICAL COMPANY

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ABSTRACT

Today, many organizations have implemented the ERP system to enhance the efficiencies of their business processes regardless of the company size and industry sector. Moreover, lots of the organizations have already adopted the mobile version of the ERP system, which actually provide the interface to enable to get access to the back-end ERP system. In this sense, it is obvious that mobile applications that connects to the company's ERP systems is very useful tool for traveling sales forces since they can complete their tasks without having to open their laptop. In Korea, Pharmaceutical companies are one of the largest industry sectors who are quite dependent on the salesperson's competencies. However, not many studies regarding the mobile ERP application usage in pharmaceutical industry were found. Thus, this study examined what influences the salesperson's satisfaction level when they use a mobile ERP application. In addition, the relationships between the user satisfaction level in pharmaceutical industry and that of other industry sectors were investigated. To achieve this goal, this study examined variety of existing mobile application evaluation model, and constructed a conceptual model by adopting some factors from TAM and D&M's IS success model in order to satisfy the research objectives. This study found not only the significant factors that influenced the satisfaction level of the sales forces in pharmaceutical companies, but also the factors of user satisfactions that varied across industry sectors.

Keywords: *Mobile Applications, M-ERP, User Acceptance Model, User Behavior, TAM, D&M IS Success Model*

1. INTRODUCTION

The widespread use of mobile devices and the globalization of business enabled the company to sell their products and services to customers worldwide. These growth potentials lead to greater levels of complexity. The larger the company, the more complicated the issues of customer communication, inventory and supply chain management as well as employee management [1]. Among the employees, salesmen are forced to access the company's ERP system from the outside due to the nature of their profession. It is necessary for salespersons to check the company's ERP system in order to figure out the details of the products or those of the customers that they are responsible for [2]. From a big point of view, having an ERP system that can manage all of these elements will certainly benefit senior managers as well as salesmen who are responsible for selling the company's products [3]. Thus, the traditional ERP system has been shifting in response to the growing wave of mobile devices in the enterprise. Many organizations have been implementing mobile enterprise applications that connect to their backend enterprise applications such as ERP, SCM, and etc. in order to increase the enterprise mobility. But, most of the enterprise mobility is currently in the exploration stage. [4]. Mobile ERP applications have become extremely important in the last few years. However, little public information exists on mobile application usage behavior [5]. According to the International Data Corporation, the mobile workforce population would steadily increase over the next five years, and will reach 105.4 million in 2020 from 96.2 million in 2015. They also expected that mobile workers to account for about three-quarters (72.3%) of all US workers by the end of the forecast period [6]. The use of mobile technology is proposed due to the increased

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mobility of users to improve immediate transaction or database access for decision making to support ERP systems [7].

2. LITERATURE REVIEW

Currently, due to the widespread use of mobile devices in the workplace has led ERP vendors to realize that their existing functionality cannot meet the growing demands of mobile workers. As a consequence, the vendors began to recognize the need to build a new mobile application by creating a hybrid ERP system, which is a combination of cloud services and mobile applications. By obtaining operational budgets with independent support, organizations can quickly add mobile capabilities to third-party mobile vendors using reduced costs [8]. Enterprise mobility can be defined as a set of people, processes, and technologies that focus on mobile devices, mobile services, and wireless network management [9]. As more employees use smartphones and tablet devices for their work, the company have realized the need to link the ERP system, which is the back-end system of the company, with the mobile devices.

2.1 Traditional ERP System

According to Koch [10], Enterprise Resource Planning (ERP) is a concept that is widely understood. He pointed out that 'planning' in ERP can be ignored. However the 'enterprise' part has to be remembered. He continued to explaining that the ultimate goal of the ERP system is to integrate all departments and their functions into one computer system to meet the specific needs of different departments [10]. As a result, a successful ERP system implementation will lead to a high level of productivity, innovation and profitability [3].

Thus, over the past decade, ERP system has been implemented in millions of organizations around the world, and the company has invested billions of dollars, as well as huge amount of time [2-3]. A recent research found that the total ERP market revenue had reached $47.5 billion in 2011 and is expected to grow to an estimated $67.7 billion by 2017 [6].

However, in spite of the benefits that a successful ERP system brings to the company, the timing of adopting an ERP system depends on the size of the company and the industry. Above all, the many cases of failures in ERP system implementation made companies hesitate to adopt ERP systems. And the cost and complexity of implementing the system is the most important issue. Implementing ERP system typically costs from $ 500,000 to $ 300 million, with an average cost of $ 15 million [11].

About 90 percent of ERP implementations are failed to get delivered within-time and within-budget [2-3]. Moreover, 70 percent of ERP implementations did not meet the benefits they expected before the implementation [3]. Another issue is the organizational culture change that comes with implementing ERP systems in some companies [12]. In fact, ERP projects not only tend to be complex to implement, but they also involve a wide range of organizational transformation processes during the entire implementation process [13-15]. The additional loss that typically arises in this situation is related to the loss of productivity due to outages and conflicts among individuals within the organization [16, 17]. To increase the probability of successful ERP implementation, organizations must obtain relevant and accurate information related to the best practices of an ERP implementation [18].

So far, several models have been proposed to increase the probability of success in the implementation of ERP systems. Each of these models was based on different research designs. The models of Gefen and Ragowsky provide flexibility in relation to the size of the company. However, their model focused only on manufacturing companies [19]. In addition, this model did not address failure factors and did not provide insights into other industry sectors. The model developed by Zwikael and Globerson [20] focused mainly on the critical success factors, and did not fully stress the reasons of failure in ERP systems implementation. Hsiao et al. [21] applied the Six Sigma method to identify "core failure factors" that frequently occur in the implementation of ERP systems. Their analysis centers on the organizational factors that impede the success of ERP implementations. These organizational factors include cost control, product management and planning, financial accounting, procurement and management of raw materials, and project management. According to 42 IT project studies, 35% of project failures are due to technical factors, while the remaining 65% are caused by management factors. The management factors mentioned here was related to individual behavior [22]. Chung has designed and developed a model that defined the elements of an ERP implementation process, and a research had shown that applying

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this model somewhat improved the probability of an organization's ERP implementation success [23]. The advantage of this model is that it focuses on the perspectives of the project success and the users' perspectives in terms of failure and success factors related to ERP system implementation. However, the disadvantage of this study is that the research domain is limited to engineering and construction companies. Critical work has been done and reported in the literature on developing models to improve the success of an organization in implementing an ERP system [2]. However, none of the models seem to be universally applicable to a wide range of organizations. Therefore, organizations continue to face dilemmas when considering the implementation of ERP systems. On one hand, there is a risk of not being able to take advantage of the ERP system. On the other hand, the risks are related to ERP system implementation failures, which can lead the organization at a competitive disadvantage.

There is also a counter-risk to organizations that promote ERP implementation programs resulting in failure or inefficiency. In contrast to putting the organization at a competitive advantage, the risk associated with inefficient ERP implementations is direct expense. Therefore, most organizations still need a model that is relevant and reliable to increase their chances of successful implementation of ERP system. It is clear that implementing a successful ERP system will bring significant benefits to the enterprise. In order to increase the probability of ERP system success and develop a robust system, appropriate and accurate information about what was effective in implementing an ERP system in an organization is necessary [24]. There have been many studies focused on successful ERP implementation related to identifying critical success factors.

2.2 Mobile ERP System

In the late 1990's, portable handheld were used initially as "stand alone" units rather than the integrated smartphone of the current day. Recently, with the rapid adoption of mobile devices in the workplace, the ERP vendors have found that the ever-growing mobile workforce cannot keep up with their existing capabilities [25]. As a result, the vendors have realized the need to build the new mobile apps, which is a hybrid ERP systems that combines cloud services and mobile apps. As a result, mobile functionality has been introduced into a broader market, and features have been released as part of the regular supplier software lifecycle, requiring major upgrades to implement mobile access [25]. By providing significant operational budgets through independent support, organizations can use the reduced costs to add mobile capabilities of third-party mobility providers more quickly and extend the life of their ERP systems by 10-15 years. In order to integrate the business successfully, it requires an adaptive foundation to be established in a way that ensures accurate, relevant, timely, and cost effective data is available in consistent, repeatable end-to-end processes. Integrating internal processes is important in the context of implementation of ERP systems, including basic information systems functions that connect "front and back office" functions.

Considerations for ERP systems and the associated benefits of wireless technology when using mobile devices are inherently different from those described for supply chain management. The main difference between these two is the wide range of data collected and analyzed along with the extensive processes involved in ERP systems. In addition, depending on where the sensitive data, such as human resources and financial data, is stored within the system, more controls on both the server and client sides of mobile apps to support organization's security requirements [3].

ERP mobility can be defined as a set of people, processes, and technologies that manage mobile devices, wireless networks, and related services to help businesses make widespread use of mobile computing. As more people use smartphones and tablet devices in the workplace, they have become increasingly important in the enterprise. But a truly useful new mobile device needs access to business information from an ERP system. Determining the best ERP / CRM enterprise strategy for integrating mobile devices with business processes is a challenge for Information Technology to build a robust mobility platform [25].

The mobile devices for ERP are becoming an important extension of ERP. The goal is to unlock workforce productivity with two distinct benefits of mobility devices. The first benefit is the mobile devices' enhanced user interface which features portability, high screen resolution and finger-swipe functionality that promote productivity. The second benefit is extending the reach of ERP systems to employees and customers when/where they need it. Combining mobile devices and ERP business systems can empower workers. In addition, it even can allow them to communicate more fully with their colleagues and customers.

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Lee [2] developed a model by extending TAM to examine the applicability of TAM onto the mobile ERP user behavior. However, the study did not focus on the sales person's mobile ERP usage. In addition, the industry sector of healthcare that includes the pharmaceutical companies was not investigated either. However, the research proposed critical success factors that significantly influence the usage behavior of mobile ERP applications. Thus, this study will examine the applicability of the model developed by Lee with the data from pharmaceutical companies in Korea to figure out the salesperson's mobile ERP usage behavior. Since the model was derived from TAM, it is critical to understand the details about the TAM.

2.3 Technology Acceptance Model (TAM)

In 1986, the Technology Acceptance Model (TAM) was introduced by Davis, and it describes various computing factors of user acceptance as they are related to the behavior of a specific user. The goal of TAM is "to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behavior across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified".

In addition, in case of measuring outside variables' impact in terms of internal beliefs, TAM also provides a good framework. It was created through identification of key variables as proposed by previous studies dealing with emotional and cognitive determinants which was associated with IS acceptance. Then, it adopted the TRA methodology as the theoretical basis for modeling this type of relationship between the variables [26-27].

'Perceived Usefulness' and 'Perceived Ease of Use' for IS (Information Systems) acceptance behavior are of primarily related to this model. The definition of Perceived Usefulness is described by the user's subjective view of the probability of improving business performance when using a specific information system that exists within an organization. Perceived ease of use is measured to the extent that all users are not expected to require additional effort on the target system. The TAM assumes that variables outside the system can indirectly affect the attitudes toward use. This can lead to actual system usage due to the Perceived Usefulness as well as the Perceived Ease of Use. The relationships between various TAM elements have been verified by numerous empirical studies of quality [28-32].

The concept of the Subjective Norm is defined as the perception of individuals who believe that other important people should or should not perform certain behaviors. Davis excluded this particular variable from the TAM because of uncertainty in theoretical and psychometric status, the small impact on usability, and expected usefulness. Although the original TAM was useful, many studies have found the advantages in extending the TAM elements. Moon and Kim argued to extend the model to include expansion factors related to the problem being investigated. These extended elements included general situations, target technology elements, and considered the main users of the new system [33]. Extension of TAM model in this way has proven useful in other studies [34]. Thus, TAM2 extended the initial measurement of TAM by incorporating the concept of Subjective Norm as intent predictor when using a mandatory system. TAM2 also used additional theoretical constructs that include social influence and instrumentally cognitive processes.

Determining the quality of an implemented IT project is clearly depends on the users. The purpose of this study is to investigate factors that affect user satisfaction after the implementation of Mobile ERP application, whether or not they completed within the time and budget range. Therefore, this study focuses on investigating the academic gap by examining the end user's use behavior view after implementing the Mobile ERP application program.

The remainder of this paper is organized as follows: The existing conceptual framework for a successful ERP model will be reviewed in Chapter 2. Chapter 3 describes the research model and hypotheses for this study. Chapter 4 details the research methodology, including the data collection process. It also reports data analysis results. Chapter 5 presents conclusions and recommendations for future work.

3. RESEARCH METHOD

To verify the hypotheses, this study combined collection of data through a survey instrument, and the structural equation modeling (SEM) technique. The SEM is a set of statistical techniques that contains statistical methods for various mathematical models, computer algorithms and data structures. It includes confirmatory factor analysis, factor analysis, and path modeling, etc. SEM can

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answer a series of interrelated research questions in the analysis by simultaneously showing the relationship between several independent and dependent constructs [10]. Sometimes, due to the complexity of the model, the multiple regression process is painful. However, the factor analysis and goodness-of-fit indices in multiple regression models can be substituted by SEM.

3.1 Research Framework

The main goal of this study was to obtain new insights into how Korean pharmaceutical companies plan and implement successful mobile ERP applications that meet the user's intention to use. The user in this study was limited to salespersons in pharmaceutical companies in Korea. To this end, this study first examined the applicability of the TAM2, which Lee had adopted to investigate the usage behavior of the mobile ERP applications. The five key dependent variables that were adopted from TAM2 are (a) Output, (b) Image, (c) Job Relevance, (d) Result Demonstrability, and (e) System Reliability. Another dependent variable added by industry experts is 'compatibility'. Compatibility between mobile devices and backend systems is important because mobile applications are very sensitive to its operating system such as Android OS and Apple's iOS. The median variables used in this study are (1) Perceived Usefulness, (2) Perceived Ease of Use, and (3) Intention to Use. The dependent variable indicating the users' intention to use is 'Usage Behavior' [3]. Therefore, the research framework can be constructed as shown in Fig. 1.

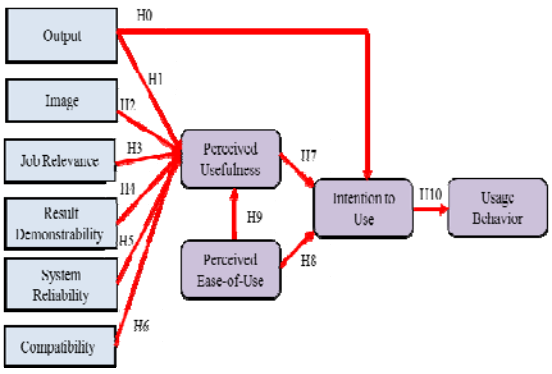

Figure 1: Research Framework

3.2 Structure Equation Modeling (SEM)

In order to test the hypotheses, a structural equation modeling (SEM) analysis was performed. The SEM is a statistical techniques that contains statistical methods for various mathematical models, computer algorithms and data structures. It includes confirmatory factor analysis, factor analysis, and path modeling, etc. SEM can answer a series of interrelated research questions in the analysis by simultaneously showing the relationship between several independent and dependent constructs [10]. Typical SEMs include 'measurement models' and 'structural models'. The former explores the relationship between observed variables and latent variables, while the latter examines the relationship between latent variables [35].

A model that is trimmed with SEM, also known as a modified model, was derived by modifying the path of the full model. A full model can be referred to as a fixed model as well. Then the goodness-of-fit indices of both models were measured in order to choose the best-fit model as a competing model over another model. The path diagram was obtained through a path analysis to see causal dependencies within a model. The arrows in the path diagram represent causal relationships within the model.

The goodness-of-fit indices that were used for SEM analysis in this study are: (1) $\chi 2$: Chi Square, (2) $\chi 2$ /df: Chi Square to Degree of Freedom Ratio, (3) TLI: Tucker Lewis Index, (4) CFI: Comparative Fit Index, (5) SRMR: Standardized Root Mean Square Residual, and (6) AIC: Akaike Information Criterion.

As previously mentioned, SEM is a proven technology that specifies two models: the full model and the trim model. In this study, the fit indices of both models were created first. Then, the optimal model that is the best-fit model between these two models was selected. Using the obtained optimal model, path analysis was performed using M-plus, a statistical software package which was optimized for SEM. Finally, an R2 value indicating how well the data points fit into the model is shown to measure the rate at which the model describes the variation of the data set. The R2 value is obtained by subtracting the residual variance shown in the circle on the path diagram.

3.3 Hypotheses

In previous section, the reason that the ''Experience' and 'Voluntariness' were excluded

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from the research model was discussed. Based on the research framework that was developed above, the following 11 hypotheses were proposed:

- H0: The 'Subjective Norm' has effect on users' 'Intention to Use' of mobile ERP.

- H1: The 'Subjective Norm' has effect on users' 'Perceived Usefulness' of mobile ERP.

- H2: The 'Image' has impact on users' 'Perceived Usefulness' of mobile ERP.

- H3: The 'Job Relevance' has effect on users' 'Perceived Usefulness' of mobile ERP.

- H4: The 'Output Quality' has effect on users' 'Perceived Usefulness' of mobile ERP.

- H5: The 'Result Demonstrability' has effect on users' 'Perceived Usefulness' of mobile ERP.

- H6: The 'Subjective Norm' has effect on users' 'Intention to Use' of mobile ERP.

- H7: The 'Perceived Usefulness' has effect on users' 'Intention to Use' of mobile ERP.

- H8: The 'Perceived Ease of Use' has effect on users' 'Intention to Use' of mobile ERP.

- H9: The 'Perceived Ease of Use' has effect on users' 'Perceived Usefulness' of mobile ERP.

- H10: The 'Intention to Use' has effect on users' 'Usage Behavior' of mobile ERP.

4. DATA ANALYSIS

4.1 Survey Instrument

The survey questionnaire developed by Lee (2016) was used to examine that the data gathered from pharmaceutical companies contain similar characteristics with the data obtained from various industry sectors.

4.2 Target Population and Sampling Method

For the target population, organizations participating in this study had to experience existing ERP systems implementation and mobile-ERP application development within the last five years, regardless of company size. Several ERP vendors were contacted to get a list of companies in the pharmaceutical industry that implemented mobile ERP applications having the traditional ERP systems on their back-end. Therefore, the following criteria were applied to the sampling process. Thus, the following criteria were applied to the sampling process.

1) Participating organizations had to have an experience of implementing a traditional ERP system and developing the mobile ERP application within the last five years.
2) The individuals chosen to represent the organization to respond to the data collection survey tool for this study had to be salespersons of the organization during / after implementing the mobile ERP system.

As a result, a list of ten Korean pharmaceutical companies was obtained from ERP vendors. Each of the ten companies was asked to participate in this study via email. A total of 156 people participated in the main survey. The most important job function data to identify whether a salesperson was missing was 14 out of 156 cases. The main surveys were conducted online for 30 days (September 15, 2016 through October 14, 2016).

4.3 Descriptive Statistics

The collected sample comprises 52% male and 48% female subjects. This indicates that the sample was collected from almost an even proportion in gender. In terms of work experience, 72 respondents had 1-5 years of work experience (48%). The second largest set of respondents, comprising 25.8% of the group, had 6-10 years of work experience. This indicates that the less work experienced people had higher response rate.

After the questionnaire was completed, the responses for each item were grouped together to add up scores. Then, these scores were averaged by the number of items per variable and the number of respondents to calculate the average for each variable. The values along with the mean, mode, standard deviation, and variance were also calculated and represented in Table 1.

With the exception of the variable 'Output quality', the values of all other variables related to the Kurtosis and Skewness was between -1 and 1 indicating that the sample was normally distributed. The rule of thumb for evaluating normality for the

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purpose of assumption testing is that if the Kurtosis and Skewness are between -1 and +1 and there is an appropriate sample size is at least 20 per cell, then the normality of the sample should not be doubted.

Therefore, also the trimmed model had to be investigated to find a better fit out of these two SEM models.

Variable	Mean	Standard Deviation	Sample Variance	Kurtosis	Skewness
1) Output Quality	4.72	1.20	1.51	0.24	-0.36
2) Job Relevance	4.58	1.12	1.15	0.06	-0.21
3) Image	4.91	1.06	1.12	0.40	-0.25
4) Result Demonstrability	4.52	1.13	1.21	0.53	-0.30
5) Compatibility	4.79	1.07	1.12	0.46	-0.39
6) Subjective Norm	4.69	1.08	1.18	0.31	-0.14
7) Perceived Usefulness	4.80	1.29	1.41	0.28	-0.23
8) Perceived Ease of Use	4.61	1.10	1.46	0.22	-0.21
9) Intention to Use / Use	4.78	1.08	1.11	0.36	-0.14
10) Usage Behavior	4.69	1.17	1.26	0.58	-0.23

Table 1. Descriptive Statistics

4.4 Reliability Analysis

The Cronbach 's alpha coefficients, which is also called internal consistency estimate, was measured to evaluate the reliability of item scores for the variables. The general rule of thumb for Cronbach's alpha is excellent if $\alpha > 0.9$, and good for $0.7 < \alpha < 0.9$. Table 2 shows that all of the items that alpha is greater than 0.7, indicates that all items are internally and strongly consistent. This implies that the survey questionnaire was well developed.

4.5 Structured Equation Modeling (SEM) Analysis

Table 2 shows the fit indices for both the full and the trimmed models in the sample. Both models had to be evaluated with the goodness-of-fit indices to determine if they fit well with the sample. In the full model, the $\chi 2/df$ ratio (2.55) and the SRMR (0.09) met the desired level of goodness-of-fit indices ($\chi 2/df < 3$, SRMR < 0.08). However, the other fit indices of CFI (0.77) and TLI (0.65) did not satisfy the desired level of values (CFI > 0.9, TLI > 0.9).

SEM	$\chi 2$/DF	CFI	TLI	SRMR	AIC
Full	2.55	0.77	0.65	0.09	822.7
Trimmed	2.44	0.90	0.93	0.06	696.5

Table 2. Fit Indices of Models

To get the trimmed model, the value was set to zero to adjust the path between the independent variables, 'Output' and 'Perceived Usefulness'. In order to investigate whether or not other adjustments in the path fit the sample better, the above adjustment process was repeated until the best-path was found. In the trimmed model, the all the fit indices of $\chi 2/df$ ratio (2.44), CFI (0.90), TLI (0.93), and SRMR (0.06) satisfied the desired level ($\chi 2/df < 3$, CFI > 0.9, TLI > 0.9, SRMR < 0.08).

The model that has a lower AIC is preferred for the best-fit model [36]. As seen in Table 2, the trimmed model had a lower AIC (696.5) than that of the full model (822.7). Therefore, the trimmed model was chosen as the best-fit model that finds the relationship of the variables in the sample.

4.6 Path Analysis

As previously mentioned, the SEM is a combined technique including features of confirmatory factor analysis, regression analysis, and path analysis. As a result of path analysis using the best-fit model which was obtained from above steps, only three out of six factors have a positive impact on 'Perceived Usefulness' ($p < 0.05$). These three factors are - (1) Subjective Norm, (2) Output, and (3) Job Relevance.

'Subjective Norm' is the factor that has the most significant effect on 'Perceived Usefulness'. TAM2 indicates that subjective norm influence the

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intention to use through perceived usefulness and calls it as an internalization process. TAM2 defined 'Job Relevance' as an individual's perception of the degree to which the target system can apply to his job'. 'Output' is defined as 'the degree to which an individual judges the effectiveness of a new system'. In other words, it is considered that the new system is capable of performing the required tasks [34].

5. CONCLUSION

The study extended the research by Lee [3] to investigate the applicability of the Lee model onto the mobile-ERP user behavior for salespersons in pharmaceutical companies in Korea. After the analysis, the study found that five important success factors, which were identified by Davis in TAM2 had a significant impact on 'Perceived Usefulness' did not work for 'Image' and 'Result Demonstrative'. In addition, 'Compatibility' that was adopted by industry experts but not adopted in TAM2, turned out not to have a significant impact on 'Perceived Usefulness'. Therefore, these did not help understanding or predicting the adoption of mobile-ERP applications of the users. Therefore, the following conclusions were proposed. Using the various data sets, three of the five factors in the proposed model are: (1) Subjective Norm, (2) Job Relevance, and (3) Output are key elements in understanding salespeople's behavior in mobile ERP applications in Korean pharmaceutical industry.

The result discovered that the 'Job relevance', it is found that a potential user judges the effects of using a mobile-ERP application if it enhances his/her performance. This study also found that the quality of 'Output', the degree to which a new system can perform the tasks it needs, is also a key determinant for users' behavior to use the system.

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