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Incorporating System Portablity into Technology Acceptance Models

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INCORPORATING SYSTEM PORTABILITY INTO TECHNOLOGY ACCEPTANCE MODELS

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Abstract

The proliferation of mobile information systems are challenging IS researchers to re-examine some of the temporospatial assumptions embedded in established IS theories. While adoption and use of information systems has a substantial body of knowledge does not seem to have captured some of the temporospatial specificities of mobile technologies such as system portability. The purpose of this paper is to demonstrate how system portability could be incorporated into technology acceptance models. In order to achieve this goal, it proposes a conceptual model and sets the initial ground for the development of a System Portability scale.

Keywords: Mobile Information Systems, Portability, Technology Acceptance.

1 Introduction

The fast developments and proliferation of mobile information systems (IS) are fostering some interesting challenges to IS research, specially with regards to temporospatial assumptions embedded in IS theories (Lyytinen and Yoo, 2002, Scornavacca and Huff, 2008, Ladd et al., 2010). Perhaps, one of the important issues surrounding IS mobility, is to what extent theories that were created to study stationary systems that were operating in bounded environments are still applicable or may need to be adapted to mobile/ubiquitous paradigm (Gebauer et al., 2007, Yuan et al., 2010, Scornavacca et al., 2006).

The adoption and use of information systems has remained a central concern of information systems research and practice (Venkatesh et al., 2003, Venkatesh and Davis, 2000, Benbasat and Barki, 2007). Explaining the user acceptance of new technologies - focusing on individual acceptance of technology by using intention or usage as a dependent variable - is frequently described as one of the most mature areas of information systems research (Hu et al., 1999, Venkatesh et al., 2003, Straub and Burton-Jones, 2007). Research in this area has resulted in quite a few theoretical models, with roots in information systems, psychology, and sociology (Taylor and Todd, 1995, Davis, 1989, Venkatesh and Davis, 2000, Venkatesh et al., 2003, Benbasat and Barki, 2007).

While adoption and use of information systems has a substantial body of knowledge, little is still known about user acceptance of mobile technologies (Pagani, 2006, Junglas, 2007, Mallat et al., 2006, Yuan et al., 2010). Most of the literature regarding user acceptance of mobile IS relies heavily on well-known IS theories and models such as Rogers' (1995) Diffusion of Innovation (DoI) Theory and Davis' (1989) Technology Acceptance Model (TAM), and does not seem to have captured some of the temporospatial specificities of mobile technologies such as system portability (Scornavacca and Huff, 2008, Ngai and Gunasekaran, 2007, Ladd et al., 2010, Mallat et al., 2009).

The purpose of this paper is to demonstrate how system portability could be incorporated into a basic technology acceptance model and to set the initial steps for the development of a system portability scale.

The paper is structured as follows: the next section provides some insight of the role of system portability in the context of mobile IS. This is followed by presentation of a basic research model as well as the conceptualization of a System Portability construct. Finally, a System Portability scale is proposed. The papers wraps-up with conclusion and recommendations for future research.

2 Contextualizing System Portability in the Mobile IS domain

This section aims to portrait the importance of System Portability in the context of mobile IS. In order to do so, it looks into the key technological enablers of IS mobility as well as the temporospatial evolution of mobile IS.

2.1 Technological Enablers of IS Mobility

In the IS literature, the terms "wireless" and "mobile" are often used interchangeably – typically referring to applications derived from the convergence of wireless and mobile technologies (e.g. mobile phones, smartphones, tablets). However, there are some conceptual differences between these two technological enablers of mobile ecosystems (Balasubramanian et al., 2002, Kalakota and Robinson, 2002, Varshney, 2003).

The general understanding of wireless usually refers to some sort of data transmission using radio waves (Balasubramanian et al., 2002, Barnes, 2003a, Varshney, 2003). The data exchange can occur directly from one device to another or mediated by a wireless network (Varshney, 2002, Barnes, 2002). On the other hand, the term mobile usually implies portability of the device (Kalakota and Robinson, 2002, Kakihara and Sørensen, 2002, Jarvenpaa et al., 2004).

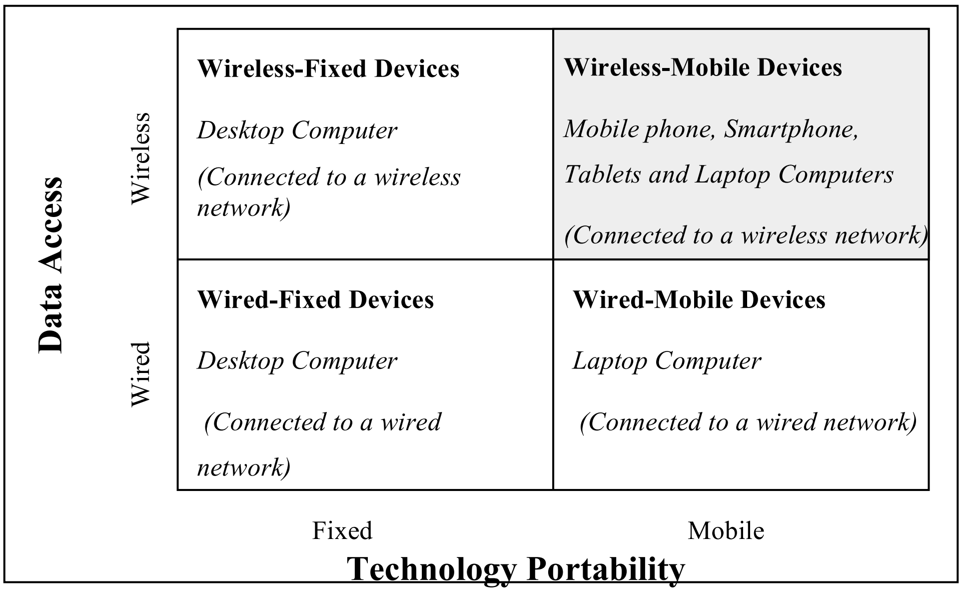

Figure 1. Technological enablers of IS mobility

As shown in Figure 1, wireless and mobile are key characteristics of the technologies underlying mobile IS (Kalakota and Robinson, 2002, Lehmann and Lehner, 2002, Hsu and Bruner II, 2002). One example of wireless but not mobile technology would be someone using a desktop computer connected to a WiFi network. Similarly, a person using a handheld device (such as a PDA) that does not support wireless connectivity (e.g. data synchronization occurs via a docking station) would qualify as mobile but not wireless. Alternatively, someone using a smartphone would qualify as mobile and wireless.

In the early stages of mobile IS, Kalakota and Robinson (2002) classified mobile devices into two categories: "offline" – without wireless connectivity; and "online" – capable of exchanging data through a wireless connection. This classification is based on the idea that "online" devices would be able to receive and transmit real-time data while "offline" mobile devices would have to use a data synchronization process in a docking station or wired network (e.g. dial-up, LAN and ADSL). What is important to keep in mind is that the distinction between "offline" and "online" mobile devices deeply affects how mobile IS is designed and used (Kalakota and Robinson, 2002, Scornavacca and Barnes, 2004). Nowadays, "offline" mobile devices have become increasingly rare due to the extensive convergence of mobile and wireless technologies.

Now that the conceptual differences of the two key technological enablers of IS mobility have been provided, the next section focuses on understanding the temporospatial expansion of mobile IS.

2.2 Temporospatial Expansion of Mobile IS

Almost as a direct consequence of wireless data access and technology portability, Figure 2 aims to represent the increasing temporospatial availability of IS in our lives. The two perpendicular axes represent time and space, while the sinuous line represents the movement of an individual in the temporospatial continuum. The light grey areas represent locations in time and space where IS support is not available, while the dark grey areas represent places where IS support is available. The area bounded by large dashed lines represents physical boundaries (in this example "home", "work" and "internet kiosk" are used) while the dotted line around the dark grey area represents the organizational virtual boundary – delimitating areas where the organization's information systems can be accessed and IS assisted tasks can be accomplished. Finally, the white elliptical areas represent individual work-related tasks that require the support of IS.

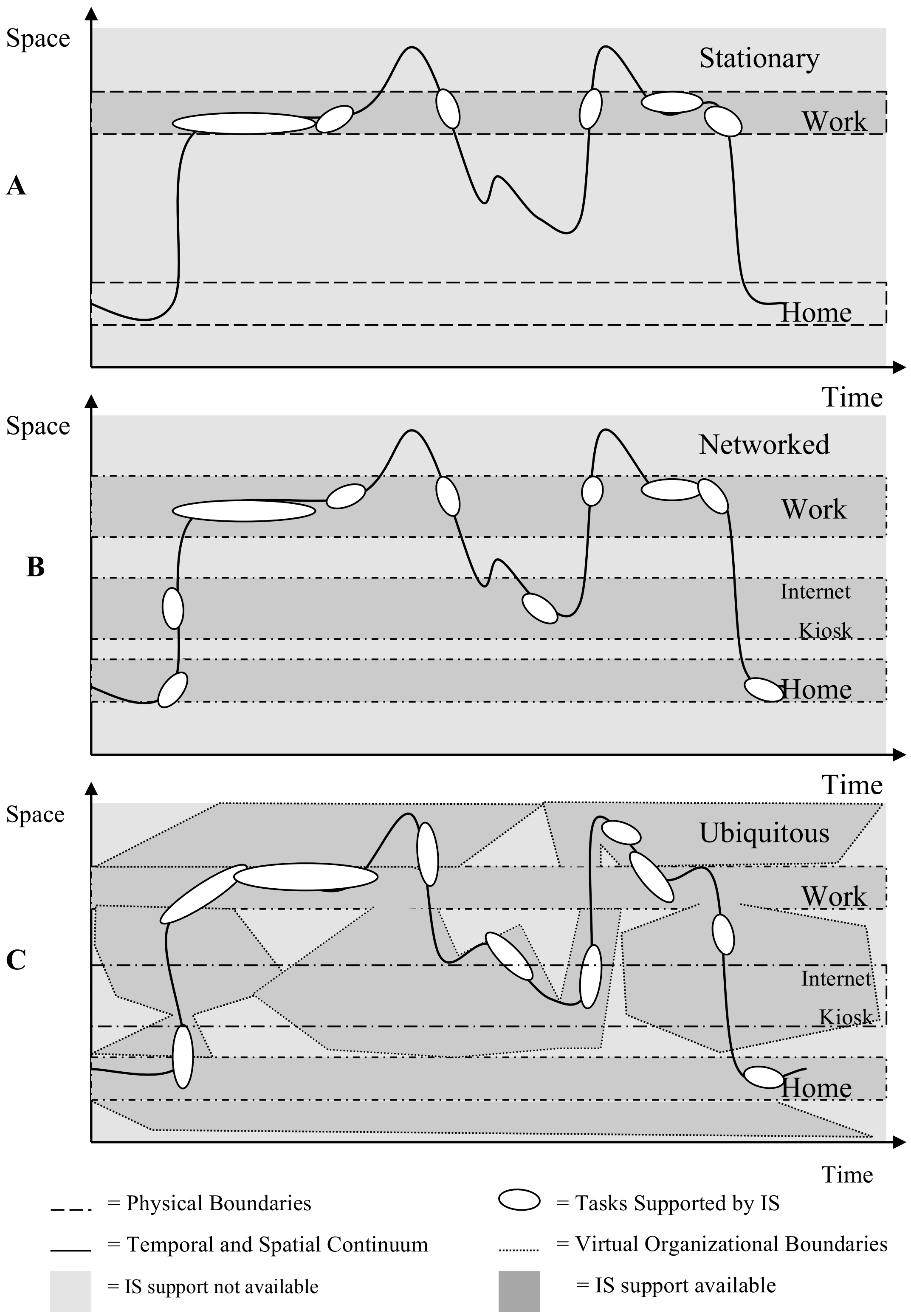

Figure 2. The evolution of temporal and spatial availability of IS

In order to illustrate the evolution of IS, Figure 2 also shows three distinct stages: Figure 2 (A) represents a "stationary stage" where individuals could only accomplish work-related tasks with assistance of IS within the boundaries of the workplace. Figure 2 (B) represents the introduction of wired "network" capabilities and the creation of a virtual boundary of the organization that merged with the existent physical boundaries – allowing the user to accomplish work-related tasks with the assistance of IS either from "work", "home" or an "Internet kiosk" (in this example). Finally, Figure 2 (C) represents the introduction of mobile technologies which substantially increases the reach of the virtual organizational boundaries.

In each evolutionary stage, there is an increment of temporospatial availability of IS support – notice the increment of the dark grey area (Figure 2). In the "stationary" stage, the ability to have the support of IS to undertake tasks was quite limited and confined to the boundaries of the workplace. On the other hand, in the "networked" stage, workers had to search for some physical location (in this example represented by the Internet kiosk) where IS support was available to assist them accomplishing tasks beyond the physical boundaries of the organization. While in the "ubiquitous" stage, workers are challenged to avoid areas (represented in light grey) where IS support is not available (e.g. by the lack of network coverage in a building basement). Perhaps the few light grey areas remaining in Figure 2 (C) should be colored in black and called as "black holes" to better illustrate the absence of the ability to undertake IS supported tasks.

As shown in the example, the development of mobile technologies made possible the availability of IS support to individuals at locations and during periods of time which they would normally not be able to be assisted by any IS – due to the boundaries of traditional stationary information systems (Basole, 2005, Zheng and Yuan, 2007, Yuan et al., 2010). It becomes quite evident that the system portability should play a pivotal role when analyzing aspects of the usage of mobile information systems.

3 Towards a Conceptual Model - Integrating System Portability with Technology Acceptance Theories in IS

In the attempt to integrate System Portability and technology acceptance theories, it would be appropriate to use a simplified model of key constructs derived from the Unified Theory of Acceptance and Use of Technology (UTAUT) – as the UTAUT synthesizes well the body of knowledge on user acceptance of IS (Venkatesh et al., 2003, Venkatesh et al., 2007, Zmijewska and Lawrence, 2006). Figure 3 presents a basic research model.

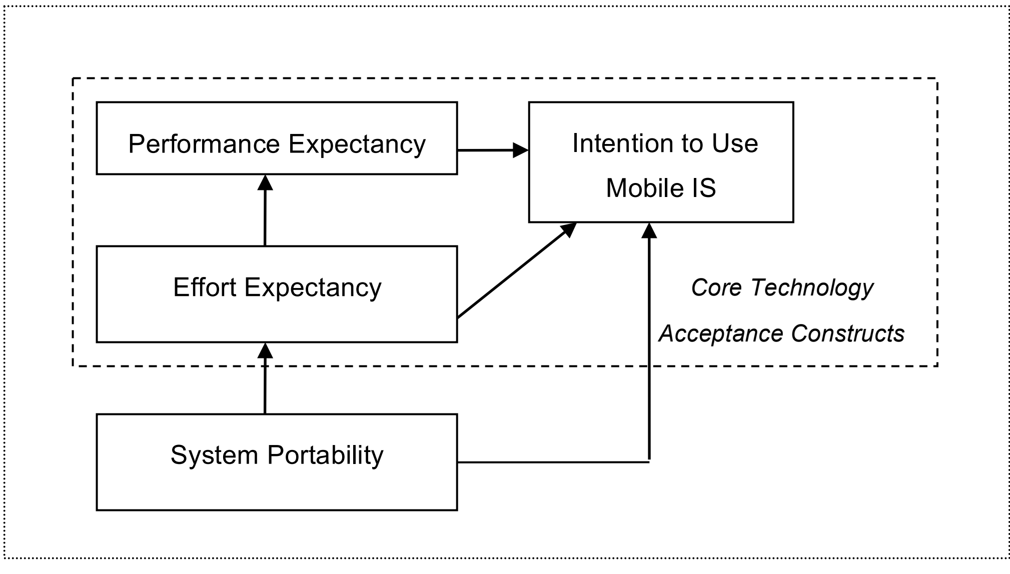

Figure 3. Basic Research Model

Intention to Use IS (IU) is defined as a measure of the strength of one's intention to use IS (Fishbein and Ajzen, 1975). Despite some concerns about intention models not predicting actual behavior (Straub and Burton-Jones, 2007), a significant body of research has found support for the predictive validity of behavioral intention including intention to use IS (Dishaw and Strong, 1999, Ajzen, 1991, Van der Heijden, 2004, Venkatesh et al., 2007, Venkatesh et al., 2003, Fishbein and Ajzen, 1975, Davis, 1989).

Performance Expectancy (PE) is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance (Venkatesh et al., 2003). The construct combines items from well-established technology acceptance constructs such as Perceived Usefulness (Davis, 1989, Davis et al., 1989) Relative Advantage (Moore and Benbasat, 1991) and Outcome Expectations (Compeau and Higgins, 1995, Compeau et al., 1999). Of the five models used to develop the UTAUT, the performance expectancy construct within each individual model was the strongest predictor of intention and remained significant at all points of measurement in both voluntary and mandatory settings, consistent with previous model tests (Venkatesh et al., 2003).

In addition, it is well documented in the general IS and mobile IS literatures that performance expectancy has a positive influence on intention to use (IU) (Mallat et al., 2009, Scornavacca and Huff, 2008, Venkatesh et al., 2007, Venkatesh et al., 2003, Gebauer and Tang, 2008, Jarvenpaa et al., 2003, Scornavacca et al., 2006, Hoehle and Scornavacca, 2008, Mylonopoulos and Doukidis, 2003).

In the UTAUT, Effort Expectancy (EE) is defined as the degree of ease associated with the use the system (Venkatesh et al., 2003). This construct is a result of an amalgamation of Perceived Ease of Use (Davis, 1989, Davis et al., 1989) and Ease of Use (Moore and Benbasat, 1991). One interesting observation noticed from the literature is that effort-oriented constructs have been found to be more salient in the early stages of adoption (Venkatesh et al., 2003, Davis et al., 1989, Venkatesh and Davis, 2000). Benbasat and Barki (2007) point out that there is extensive evidence in the literature that Performance Expectancy is a very influential belief and that Effort Expectancy is an antecedent of Performance Expectancy and an important determinant of use in its own right. The positive effect of Effort Expectancy on Intention to Use technology has also been described in a number of studies (Mallat et al., 2009, Scornavacca and Huff, 2008, Venkatesh et al., 2007, Venkatesh et al., 2003).

It is interesting to observe that in the UTAUT model the scales of IU, PE and EE are commonly applicable to 'stationary' as well as 'mobile' IS. However, while EE captures known usability issues of mobile IS such as small screens and cumbersome input methods, it does not account for effort expectancy related to technology portability. As a result, it is necessary to develop a construct that captures individuals' perceptions of System Portability. This construct should help us understand users' Effort Expectancy "under mobile conditions".

The term 'mobile IS' usually implies portability of the device (Kalakota and Robinson, 2002, Kakihara and Sørensen, 2002, Jarvenpaa et al., 2004, Hoehle and Scornavacca, 2008, Lee and Benbasat, 2003, Lee and Benbasat, 2004, Lee and Benbasat, 2005, Basole, 2004). Junglas and Watson (2003; 2006) suggest that portability comprises the physical aspects of mobile devices, while Gebauer and Ginsburg (2009) found that form factors associated to portability (size, weight and sturdiness) were perceived relevant to individuals' perceptions of ease of use of mobile devices. Participants in a study by Hoehle and Scornavacca (2008) felt that mobile IS must be small and lightweight to remain "portable" and that portability was the only characteristic unique to mobile IS. In addition to hardware portability, it is also important to consider software portability, for example, to what extent the Microsoft Outlook has been well adapted to use on your mobile device (Junglas and Watson, 2003, Basole, 2004, Barnes, 2003b, Hoehle and Scornavacca, 2008). Therefore, *System Portability (SP) is defined as the degree of ease associated with transporting the mobile information system.*

Notice that 'transporting the mobile information system' incorporates two aspects of portability abovementioned: 1) hardware portability (carrying hardware from place to place) and 2) software portability (adapting software to mobile device).

As mentioned early in this section, device portability has been perceived to influence users' perceptions of effort involved using a mobile IS (Hoehle and Scornavacca, 2008, Mallat et al., 2009). As a result, System Portability is expected to have a positive effect on Effort Expectancy (Lucas et al., 2007, Benbasat and Barki, 2007, Chatterjee et al., 2009, Urbaczewski and Koivisto, 2008, Prasopoulou et al., 2006, Scornavacca and Huff, 2008, Venkatesh et al., 2007, Venkatesh et al., 2003).

An important concern of this paper is to understand the degree to which existing theories that explain information system use are applicable to mobile information systems. This is particularly important in regards to system portability because it may shed light on the contingency of the IT artefact and how it relates to users' intention to use (Straub and Burton-Jones, 2007, Benbasat and Barki, 2007). Similarly to Effort Expectancy, System Portability is expected to influence users' intention to use mobile IS. It is believed that if the mobile device is 'easy to carry', users are more likely to have the intention use it (Mallat et al., 2009, Gebauer and Ginsburg, 2009, Hoehle and Scornavacca, 2008, Chatterjee et al., 2009).

4 Developing a Scale for System Portability

A key objective of the item development procedure is to ensure content validity (Moore and Benbasat, 1991). According to Hinkin (1998), the researcher should aim to develop items that will result in measures that sample the theoretical domain of interest to demonstrate content validity. Statements should be simple and as short as possible, and the language used should be familiar to the target population. Also, each item should address a single issue (Hinkin, 1998).

One way of achieving a low measurement error when generating a sample of items is to draw items from existing, already validated scales (Churchill, 1979). In the specific case of this study, the items drawn from the three technology acceptance theory constructs in the model (Performance Expectancy, Effort Expectancy and Intention to Use) did not require any further development. However, this is not the case for System Portability, which still requires further development.

According to Hinkin (1998) there is no fixed rule guiding how many items a construct should have. However he suggests that half of the items created are expected to be retained for use in the final scale. Irrespectively to the actual number of items in each construct, is it vital to assure in this stage that the domain of each construct is adequately sampled (Straub et al., 2004, Chin et al., 1997).

Incorporating an indicator of portability (e.g. 'easy to carry') into the effort expectancy would result in the construct becoming a formative composite variable instead of a reflective latent variable (Freeze and Raschke, 2007, Petter et al., 2007). As a result, system portability was modeled as an independent reflective variable and is expected to have a positive effect on effort expectancy(Chatterjee et al., 2009).

While portability has been widely discussed in the literature as a key characteristic unique to mobile IS, to the best of the researcher's knowledge, no actual measurement of individuals' perception of system portability has been developed yet (Junglas et al., 2009, Hoehle and Scornavacca, 2008, Chatterjee et al., 2009).

Three possible aspects for the construct emerged from the literature: physical properties of the device – such things as size, weight and sturdiness (Gebauer and Ginsburg, 2009, Junglas and Watson, 2006); 'easy to carry', which relates to the perceptions of effort associated in carrying the device around most of the time (Chatterjee et al., 2009, Junglas et al., 2009, Hoehle and Scornavacca, 2008); and software adaptation, which concerns how well applications have been adapted for use on mobile devices (Basole, 2004, Barnes, 2003b).

Based on Moore and Benbasat's (1991) item creation procedure, the following steps were followed:

Step 1 – Examine the literature for existant scales

Step 2 – Analyse reliability of measurements

Step 3 – Analyse and categorize all items – verifying applicability to research

Step 4 – Add items for constructs where all dimensions were not covered

Step 5 – Revise items - uniform and clarity of wording, adapt to agreement scale

Step 6 - Re-evaluate items, revise wording, and eliminate ambiguous and redundant items

All SP items were developed to be measured using a seven-point Likert scale ranging from "strongly disagree" to "strongly agree". Table 1present the items for the proposed System Portability scale.

Code	Item	Origin
SP 01	I find the Mobile Information System device easy to carry.	(Chatterjee et al., 2009, Junglas et al., 2009, Hoehle and Scornavacca, 2008)
SP 02	I find the Mobile Information System device easy to take with me while 'on the go'.	(Chatterjee et al., 2009, Junglas et al., 2009, Hoehle and Scornavacca, 2008)
SP 03	The Mobile Information System device is very heavy.	(Gebauer and Ginsburg, 2009, Junglas and Watson, 2006)
SP 04	The Mobile Information System device is very fragile.	(Gebauer and Ginsburg, 2009, Junglas and Watson, 2006)
SP 05	The Mobile Information System device is very big.	(Gebauer and Ginsburg, 2009, Junglas and Watson, 2006)
SP 06	The Mobile Information System is very portable.	(Chatterjee et al., 2009, Junglas et al., 2009, Hoehle and Scornavacca, 2008)
SP 07	The mobile versions of applications I normally use on my PC provide very limited functionalities.	(Basole, 2004, Barnes, 2003b)
SP 08	The mobile versions of applications I normally use on my PC have been well adapted for use on the mobile device.	(Basole, 2004, Barnes, 2003b)
SP 09	I find the Mobile Information System is portable without being limited.	(Basole, 2004, Barnes, 2003b)

Table 1 System Portability Items

The next section provides some conclusions and recommendations to future research.

5 Conclusions and Recommendations for Future Research

The emergence and rapid proliferation of mobile information systems are challenging IS researchers to re-evaluate some of the temporospatial assumptions embedded in established IS theories. The substantial body of knowledge adoption and use of information systems does not seem yet to have captured some of the temporospatial specificities of mobile technologies such as system portability. This paper aimed to propose a possible way to incorporated System Portability into technology acceptance models. In order to achieve this goal, it proposed a conceptual model and set the initial ground for the development of a System Portability scale. This paper hopes to have laid the initial pathway for integrating System Portability into Technology Acceptance models and, therefore, capturing a key idiosyncrasy of mobile IS,

Further research should focus on empirically evaluating content validity, construct validity, and reliability of the System Portability construct as well as testing the proposed research model (Hinkin, 1998, Moore and Benbasat, 1991, Straub, 1989, Churchill, 1979).

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