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Mobile ERP systems adoption: case studies in Brazil

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Abstract

The use of ERP systems via mobile/wireless devices is a subject rarely studied in academic research. The aim of this paper is to explore how ERP systems have been used with mobility and what are the main consequences of this use for organizations. It used as research method multiple case studies in three companies located in the South of Brazil. The research results show that, in the analyzed companies, the use of ERP with mobility generated "positive" consequences such as increases in productivity, efficiency and effectiveness, and improvements for users' quality of life. However, the use also generated "negative" consequences such as increased surveillance and control over employees.

Keyword:

Enterprise Mobility; ERP (Enterprise Resource Planning); Consequences of mobile ERP systems use

1. Introduction

The widespread adoption of mobile/wireless technology is providing a new platform for business through some benefits of mobility (Scornavacca & Barnes, 2008). With the increasing availability and use of mobile technologies, companies today are beginning to understand the consequences of enterprise mobility, which stands for the application of mobile and wireless information technologies in business processes (Kalakota & Robinson, 2002; Sorensen, 2011).

Instantaneous access to information anywhere can be beneficial in many businesses situations. Consequently, essential information systems such as ERP also need to be accessed via mobile devices, such as cell phones, smartphones or tablets (Kurbel et al., 2003).

Although the concept of enterprise mobility has been addressed in the literature, its consequences are not yet completely understood (Basole, 2008; Sorensen et al., 2008). Searching in some of the major academic databases (EBSCO, Science Direct, Scirus, Scielo e AIS - *Association for Information Systems*), one can see that there are few academic papers discussing the use of ERP systems through mobile technology. There seems to be a knowledge gap on this subject.

The objective of this paper is to explore how ERP systems have been used with mobility and what are the main consequences of this use for organizations. The questions related to this subject are: (1) what are the ERP modules that are more frequently accessed via mobile

devices? (2) Which organizational processes are addressed by them? (3) What are the consequences of such use for organizations?

The term "consequences" is used instead of the term "impact", because we want to consider both "positive" and "negative" or unanticipated consequences of technology use, considering the duality of technology when it is applied in a specific context (Orlikowski, 1992).

Next, sections 2 and 3 present the research theoretical basis, leading to the propositions of this study. Section 4 explains the research method adopted; section 5 shows the research results and, finally, section 6 shows final remarks and suggestions for future research.

2. The consequences of ERP use

ERP are information systems that integrate a company through a single database with transaction processing in real time (Davenport, 2002). In general, ERP are modular commercial software packages or software services, aiming to support the majority of business processes (procurement, manufacturing, financial, HR, etc.). For Davenport (1998), ERP systems impose its own logic to the strategy, culture and organization of a company. It is a generic solution that reflects a series of hypotheses about how firms operate, through the incorporation of "business best practices" used in the market.

Reviewing the literature, one can find that there are many studies about ERP systems in academia (see Esteves & Bohorquez, 2007), but most of them do not focus on the consequences of ERP use after the system adoption. The content of the few articles found with this focus is synthesized in Table 1.

Consequences of ERP use	Definition	References
Productivity gains	<ul style="list-style-type: none"> • ERP use allows the redesign, optimization and automation of activities, improving organizational processes. • ERP users have more information and thus can perform their tasks better and faster, with higher productivity. 	Turban et al. (2001); Saccol et al. (2004).
Increased Organizational Effectiveness	<ul style="list-style-type: none"> • The use of ERP improves decision making processes by providing access to real time information, this increases organizational effectiveness . • The information decentralization improves decision making and contributes to increased efficiency. 	Saccol et al. (2004); Velcu (2007); Ross (1999).
Increased Organizational Efficiency	<ul style="list-style-type: none"> • ERP provides more information about products and services, improving the organizational processes. • Greater flexibility and better information quality increase organizational efficiency. 	Saccol et al. (2004); Gattiker & Goodhue (2005); Hsu & Chen (2004); Spathis & Constantinides (2004), Zwicker & Souza (2003).
Improved communication	<ul style="list-style-type: none"> • Improved communication between different units of an organization. • Production can schedule manufacturing and sales can also see what are products inventories and delivery dates. 	Hsu & Chen (2004).
Better relationship with suppliers	<ul style="list-style-type: none"> • ERP use reduces lead time by improving interaction and information exchange with suppliers. 	Turban, Mclean, Wetherbe (2001); Saccol et al. (2004); Velcu (2007).

Better relationship with customers	<ul style="list-style-type: none"> • ERP provides more information about customer demands and thus helps to improve the relationship with them. 	Ross (1999); Velcu (2007).
Cost reductions	<ul style="list-style-type: none"> • Reduction of administrative costs (ex: accountancy) • Lower costs with faults and errors in the products and processes information. 	Spathis & Constantinides (2004), Poston & Grabski (2001); Velcu (2007).
Higher market value	<ul style="list-style-type: none"> • Financial markets tend to reward ERP adopters with higher company market value. 	Hitt, Wu & Zhou (2002).
Maintenance costs	<ul style="list-style-type: none"> • Maintaining and updating ERP generates permanent costs 	Zwicker & Souza (2003).
Increased surveillance and control	<ul style="list-style-type: none"> • Company is integrated by a single system, it means that employees are under control and surveillance 	Wood Jr. et al. (2003).
Increased standardization / bureaucratization	<ul style="list-style-type: none"> • Companies using the same ERP systems become standardized and this may result in loss of competitive advantages. 	Wood Jr. et al. (2003).
Dependance on ERP vendor	<ul style="list-style-type: none"> • The adopter company can become dependent on the ERP vendor. 	Zwicker & Souza (2003).

Table 1: Main consequences of ERP use in organizations.

The literature review indicates that the consequences of ERP use are diverse. Efficiency, effectiveness and cost reduction are among the most cited "positive" consequences. Among the "negative" consequences (few articles address this issue) are: constant costs for maintenance and upgrading, constant surveillance/control over employees, increased standardization and bureaucratization, as well as dependency on an ERP vendor.

3 – Enterprise Mobility Consequences

Currently, digitalization reached a new level. This is due to the wide scale dissemination of mobile and wireless technologies, such as cell phones, personal digital assistants (PDAs), laptops, smartphones and tablets - whose physical and functional properties allow for interaction, information processing, collaboration and learning in mobile work (Wiredu, 2005; Sorensen, 2011). The literature shows many examples of the dialectic change caused by the use of mobile and wireless technologies, its implications for individuals, companies and societies - see Table 2.

Mobility consequences	Definition	References
Better relationships with customers	<ul style="list-style-type: none"> • Real time information to customers, regardless of their location, can improve their satisfaction. • Access to customers' information anywhere, anytime, helps companies to deliver better products/services. 	Basole (2009); Rodina, Zeimpekis & Fouskas, (2003); Picoto & Palmados-Reis (2010); Kadyte (2004); Kumar & Zahn (2003).
Increased efficiency	<ul style="list-style-type: none"> • Better communication between employees, even at distance, leads to improvements in organizational efficiency. • The increased visibility of work processes improves 	Basole & Rouse (2006); Kumar & Zahn (2003); Scornavacca & Barnes

	<p>efficiency.</p> <ul style="list-style-type: none"> • Real time data collection (in fieldwork) avoids rework and errors. • Automate internal processes in fieldwork, streamlines internal process of the entire company, improving efficiency. 	(2008); Barnes (2004); Kadyte (2004); Ali e Al-Qirim (2003); Picoto & Palma-dos-Reis (2010).
Cost reductions	<ul style="list-style-type: none"> • Physical spaces are no longer necessary for employees to perform their tasks. • Displacement/transportation costs are reduced. • Mobility leads to cost reductions in the sales cycle and thereby reduce costs. 	Basole & Rouse (2006); Rodina, Zeimpekis & Fouskas, (2003).
Increased organizational effectiveness	<ul style="list-style-type: none"> • The increased visibility of processes using mobility improves effectiveness. • Mobility improves organizational agility. • Staff becomes better informed even outside the company, which improves decision making and effectiveness. 	Gebauer e Shaw (2004); Scornavacca & Barnes (2005); Barnes (2008); Kadyte (2004); Streng & Beulen (2002).
Productivity gains	<ul style="list-style-type: none"> • Information can be received directly from customers, there is an improvement in production. • Real time data collection and sales orders receiving, it is no longer necessary to wait for orders to be inserted in the system at the end of the day. 	Gebauer & Shaw (2004); Rodina, Zeimpekis & Fouskas, (2003); Ali & Al-Qirim (2003); Davis (2002).
Increased revenues	<ul style="list-style-type: none"> • The company's improved efficiency and higher customer satisfaction leads to increased revenue. • Creation of new sales channels through mobile devices can generate revenue gains. 	Rodina, Zeimpekis & Fouskas; (2003); Picoto & Palma-dos-Reis (2010); Kalakota & Robinson (2002).
Interruptions at work	<ul style="list-style-type: none"> • Real time information and communication cause interruptions, since employees are always receiving data or calls. 	Cooper (2002); Ling, (2004).
Information overload	<ul style="list-style-type: none"> • Information, always available, can cause overload. 	Davis (2002).
Loss of quality of life	<ul style="list-style-type: none"> • People receive information and communications even beyond working hours (e.g. at leisure times, at home). 	Davis (2002); Gant (2001); Cipriano & Nicolaci-da-Costa (2009).
Loss of privacy	<ul style="list-style-type: none"> • The use of mobile devices everywhere, anytime causes loss of privacy for users. 	Davis (2002); Gant (2001).

Table 2: Some consequences of enterprise mobility

The number of propositions is high due to the exploratory nature of this research and the novelty of the issue. These propositions have guided our study and can serve as a basis for future research:

P1 – The use of ERP with mobility leads to increases in organizational productivity.

P2 - The use of ERP with mobility leads to increases in organizational efficiency.

P3 - The use of ERP with mobility helps to reduce organizational costs.

P4 – The use of ERP with mobility leads to increases in organizational effectiveness.

P5 - The use of ERP with mobility improves relationships with customers.

P6 - The use of ERP with mobility improves organizational communication.

P7 - The use of ERP with mobility improves relationships with suppliers.

P8 - The use of ERP with mobility generates ongoing maintenance/upgrading costs.

- P9 - The use of ERP with mobility leads to company's higher market value.
- P10 - The use of ERP with mobility generates increased vigilance and control.
- P11 - The use of ERP with mobility increases organizational bureaucracy.
- P12 - The use of ERP with mobility generates increased revenues for the organization.
- P13 - The use of ERP with mobility generates more interruptions at work.
- P14 - The use of ERP with mobility leads to information overload.
- P15 - The use of ERP with mobility generates losses to the users' quality of life.
- P16 - The use of ERP with mobility generates loss of privacy.

4. Method

The research is qualitative and exploratory, because, according to Collis & Hussey (2005), this type of study should be conducted when there are few or no previous studies on the researched issue. The data collection happened during the first semester of 2011. We adopted the method of multiple case studies (Yin, 2010).

Considering the literature on ERP and enterprise mobility and the research propositions, we designed a case study protocol to guide the multiple case studies with companies that had adopted mobile ERP solutions. According to Yin (2010), the case study protocol increases the reliability of case study research and it is mandatory for multiple case studies. The protocol was validated by an academic expert, a professor from the area of Information Systems, and also by a senior consultant on ERP implementation. Both of them made the constructs validation (Collis & Hussey, 2005) that reveals the degree to which a phenomenon and the variables involved in it were properly defined and measured (operationalized). The interviews scripts designed in the case study protocol were also validated (face validity) by a manager of one of the companies studied, this manager uses a mobile ERP application.

For the multiple case studies, three companies were selected according to the criterion of accessibility; they needed to use a mobile ERP solution. Companies will be here called ONE, TWO and THREE, in order to preserve their identities. All of them are located in the South of Brazil, at the state of Rio Grande do Sul.

Data collection was conducted with on-site interviews and observations of the mobile ERP solution adopted. Twelve (12) interviews were done in total (at least 3 in each company), with people from different sectors in the surveyed companies, including: 03 general managers, two IT personnel, 2 financial managers, 1 HR manager and 4 salesmen.

Content analysis techniques (Bardin, 2009) were used for data analysis. The main categories of analysis were the possible consequences of mobile ERP use, defined in each one of the research propositions (see section 3).

5. Results

Initially, we present a brief profile of each one of the companies studied, the type of mobile ERP solution adopted and a summarized description of the adoption process.

Company ONE - This Company was founded in 1978. Its business is the distribution and sale of soft drinks, beers, juices, mineral waters and the like. The major clients served are restaurants, grocery stores, snack bars, convenience stores and shops, bakeries and drugstores.

The company is located close to the beach, and therefore it has seasonal sales. In months of low season it has 52 employees, and in high season it has 80 employees.

The mobile application was added to the ERP package already owned by the company as a new feature, in 2006, and it is used only to support the sales process. The functionalities of this mobile ERP application are: orders fulfillment, queries and update of the customer database, sales reports, financial reports and control of actions taken by salespeople. The device used to access this solution was the Palm Treo®.

Company TWO - This company works with sales and distribution of sweets and chocolates, since the year of 2008. Its main clients are supermarkets, restaurants, snack bars and bakeries and it has 18 employees.

The ERP system has been adopted since the company's foundation in 2008. The mobile application adopted (in January 2011) was a module of the ERP system, provided by the same company that supplies the ERP. The ERP mobile application is used only in sales, and has functionalities such as: sales request, queries and update of customer database, sales reports, financial reports, route planning, control of actions taken by the salesmen and registration of new customers. The device used was a Samsung smartphone.

Company THREE - This Company was founded in 2008 and it has 20 employees. It is a factory that sells bottled water to wholesale and retail. Its main customers are beverages wholesalers.

The company's mobile ERP access was adopted along with the full ERP system in 2008. They do not have a specific mobile module of the ERP, they have a mobile application that accesses the database of their ERP. This solution has been used since the foundation of the company, therefore they do not have perceptions about “before and after” the use of mobility with ERP, as occurred in the other two cases studies. The mobile application has always been used in the sales process, and it has features such as: access to financial information and customer registration, sales reports and register of sales orders. The device used by this company to access the ERP was the smartphone Qtek.

Table 3 shows a summary of which research propositions were evaluated with similar results in all of the three cases studied. For the remaining propositions, there were no conclusive results to be reported.

	Confirmed	Not confirmed
Productivity gains	Confirmed	Not confirmed
Increased organizational efficiency	Confirmed	Not confirmed
Lower costs (*)	Confirmed	Not confirmed
Increases in organizational effectiveness	Confirmed	Not confirmed
Better relationships with customers	Not confirmed	Not confirmed
Improved organizational communication	Not confirmed	Not confirmed
Better relationships with suppliers	Not confirmed	Not confirmed
Increased surveillance and control	Confirmed	Not confirmed
Information overload	Not confirmed	Not confirmed
Loss of quality of life of users	Not confirmed	Not confirmed

Table 3: Main results of the research propositions

(*) Note that some costs were reduced (e.g. administrative costs, but others (telecommunications costs) increased

Based on Table 5, it can be stated that, in the studied companies, the research propositions that could be confirmed were the following.

Proposition 1: The use of ERP with mobility leads to increases in organizational productivity – Confirmed. For instance, in the studied companies, the use of ERP with mobility allowed more customers served per employee and the agility of employees increased.

Proposition 2: The use of ERP with mobility leads to increases in organizational efficiency - The use of ERP with mobility in the studied companies allowed the decrease in the number of employees needed to perform the sales processes, the number of hours worked were reduced and the number of overtime hours decreased. The range of time between taking the customer orders and delivering the products has decreased.

Moreover, sales orders are taken and sent to the company’s headquarters in real time, from the field, whereas before it was necessary to wait for the return of salespeople to the office in order to enter the orders into the ERP. The logistic/delivery processes occur sooner, which reduced the company’s lead-times. Customers receive the goods faster, the error rate is lower; for example, errors in sales orders (that before the mobile ERP solution were made by handwriting) were reduced.

Proposition 3: The use of ERP with mobility helps to reduce organizational costs - In the companies studied, the use of ERP with mobility helped to reduce costs of displacement, transportation and administrative costs (paper, pens and printed material). Two managers, from company ONE and company TWO, respectively, indicated a reduction in staff members. According to the respondents, less employees would be required to carry out bureaucratic processes, such as order entering, reporting on customers' purchases, etc.

However, the adoption of this technology has generated increased telecommunication costs, involving the purchase of a larger number of devices, contracting data services, among others. In company THREE the telecommunication costs for using the ERP with mobility were even greater because this company is located in a rural area with less communication services available. Due to that, they had to install an antenna on a private property to get access to internet connection that until then was not accessed.

Proposition 4: The use of ERP with mobility leads to increases in organizational effectiveness - This proposition was confirmed due to several evidences. As an example, in company TWO, according to the manager and one of the interviewed salesmen, the use of ERP with mobility changed the goals established. The management of the company can drill down data on sales goals achievement, knowing even if one employee really visited a customer. Everyone can access the sales goals and performance anytime, anywhere, and then pursue them more intensively. The quality of delivery of products to customers improved.

Proposition 10: The use of ERP with mobility generates increased vigilance and control - The use of mobile ERP in the companies brought an increase in surveillance and control over employees because managers have records on what time the salespeople visited customers, for how long they have been with them and how many customers were visited every day.

In the three studied companies, some research propositions were not confirmed, as described below.

Proposition 5: The use of ERP with mobility improves relationships with customers - According to the respondents, the use of ERP with mobility did not bring better relationships with customers, because communications with them were still the same. Thus, this proposition, based on the literature previously studied, was not confirmed in our study.

Proposition 6: The use of ERP with mobility improves organizational communication - In the companies, the use of ERP with mobility brought no consequences for organizational communication, since, according to the respondents, they are still communicating mostly via e-mail and telephone, it means that, although the mobile ERP increases the volume of data and information available to the sales force, the interaction between people in the companies still relies on phone calls and e-mail.

Proposition 7: The use of ERP with mobility improves the company's relationship with suppliers – According to the interviewees, nothing has changed in the relationship with suppliers. The communication between the companies and their suppliers remains based mainly through the use of e-mail or phone calls. There is no integration between the ERP systems of the companies and the ERP systems of their suppliers. In company ONE, for example, suppliers do not have access to the company's ERP system. The purchase orders are registered and sent in paper.

Proposition 14: The use of ERP with mobility leads to information overload - According to the respondents, the use of ERP with mobility brought no information overload for users, but instead, it brought more information quality to support the contact with customers, helping to qualify the sales force.

Proposition 15: The use of ERP with mobility generates losses to the users' quality of life - According to the respondents, the use of ERP with mobility brought them *higher* quality of life, because it facilitates the fieldwork and reduces the number of working hours, as well as the time spent on displacements, which, especially according to the salesmen, collaborate with their quality of life.

6 . Final Remarks

The main objective of this study was to explore the ways by which ERP systems have been

used in a perspective of enterprise mobility and what are the consequences for organizations.

Among the main results, it was found that the mobile ERP applications have been used only for sales force automation in the studied cases. There are no other modules of the ERP been accessed on the move.

Regarding the consequences of adopting mobile ERP solutions in the studied companies, it helped them to get productivity gains, higher efficiency and organizational effectiveness. The use of ERP with mobility also generated reductions of some types of organizational costs (e.g., printed material, administrative costs and extinction of some job positions), but telecommunications costs increased. There was also an increase in surveillance and control over employees, since now companies have detailed records on their daily fieldwork. All these propositions were supported by the literature considered in this study.

However, some research propositions were not confirmed in all of the three studied cases, for example, no improvements occurred in the relationships with customers or suppliers, and in organizational communication.

Finally, two research propositions were different from the expected (according to the previous literature). First, it was found that the use of the mobile ERP did not bring information overload for users, on the contrary, respondents claimed that this technology helped to qualify the sales force. Likewise, according to the respondents themselves, there was improvement (not decrease) in the users' quality of life, because they can avoid dislocations and operational work (e.g. data entry of handwritten orders in the ERP system).

Since there are few studies that address the question of the use of ERP systems in a mobility perspective, this work can serve as a reference for future studies on the topic. The research results may also be relevant to other organizations that want to adopt mobile ERP solutions. The results can also generate relevant insights to suppliers of ERP and mobility solutions.

As research limitations, a small amount of cases were studied, and all the studied companies are small or medium sized, using only ERP applications with mobility for sales force automation.

Future research needs to investigate companies of all sizes, sectors, and with other mobile ERP solutions (e.g. for business intelligence). Our case study protocol can be used as a basis for other cases of even for designing a survey instrument. It can be accessed at: https://www.dropbox.com/s/uw8311utzmm39xv/%28AP%C3%8ANDICE_protocolo%20casos%29.pdf

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