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An exploratory evaluation of three IS project performance measurement methods

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AN EXPLORATORY INVESTIGATION OF CRITICAL SUCCESS FACTORS IN WIRELESS FIELD FORCE AUTOMATION PROJECTS

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Abstract:

Wireless Field Force Automation (WFFA) is a wireless solution designed to support field staff such as service personnel, repair or installation employees, technical teams, or medical workers. Certain companies try to provide their field workers with this sort of solution to improve their productivity, their effectiveness and to reduce administrative costs, but more than 50% of these projects fail. This paper discusses the Critical Success Factors (CSF) contributing to the success of these projects. To do this, an exploratory qualitative study was conducted with ten experts in the field. The results of this study show that eight CSF are important in this kind project and that conversely to traditional, sedentary Information Systems, successful WFFA requires taking into consideration a new CSF called "management of mobility" that integrates device management, helpdesk support and mobile device fleet management.

1   Introduction

Advances in mobile technologies, particularly the development of data transmission bandwidths in wireless networks[1], mobile applications[2] (Alag, 2006) and mobile devices[3] have prompted the development of mobile technologies for business[4]. Despite their slow growth, when compared to consumer mobile technologies practitioners and researchers predict that business applications will have an enormous impact in the future (Lehmann et al., 2004). The consulting firm Strategy Analytics (2005) predicts that business use of wireless data will grow by 20 percent in North America, Western Europe and Asia/Pacific to surpass $22 billion in 2009.

Mobile business technologies target several diverse populations such as sales force, executive staff, and field workers. This last group represents those individuals that can most benefit from mobile technologies (Barnes, 2004; Rodina et al., 2003). Mobile technologies that support the field force are called Wireless Field Force Automation (WFFA). In 2004, Redman estimated that the number of WFFA users would reach 4 million by 2008 and that the market for wireless FFA would be worth roughly $400M in North America alone. The same 2005 Strategic Analytics study predicts a 16 percent WFFA growth in North America, Western Europe and Asia/Pacific with the market eclipsing $1 billion in 2009. The benefits claimed by WFFA systems are improved field force productivity, reduced costs, increased revenues and improved customer satisfaction (Evans, 2002; Rodina et al., 2003).

Despite the growing popularity of wireless FFA in organizations, the failure rate for these projects is high, above 50% (Bush et al. (2005) cited in Scholl et al., (2007)), and surprisingly few researchers have studied the Critical Success Factors (CSF) in WFFA project implementations. Existing studies concentrate on very specific or limited CSF factors such as lack of buy-in or user implication, inappropriate technological choices (Djemai et al., 2008), lack of training, or poor project management.

The goal of this research is to simultaneously and globally investigate the CSF of WFFA projects by using an exploratory study resulting in a description of the different factors contributing to success.

The contributions of this paper are both theoretical and practical. At the theoretical level, this paper extends classical critical factors (traditionally adapted to sedentary systems) to the mobile context, particularly to WFFA projects, and proposes a new critical factor called "management of mobility". At the practical level, the CSF, identified in this study, provide useful guidelines for project managers, IT managers, integrators and consultants in order to successfully implement WFFA.

This paper is organized as follows. The first section presents WFFA by defining it and presents those CSF found in the existing Literature. The second section presents our

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[1] *The bandwidth has evolved from 9,6Kbits/s in generation 2 to 171Kbits/s in generation 2.5 and to 2Mbits/s in the third generation.*

[2] *Mobile application is the software installed in the mobile device. This software has evolved from a disconnected mode to connected "always-on" mode.*

[3] *Mobile devices have evolved from mass-market devices to rugged-devices, adapted to the job conditions of field workers.*

[4] *Mobile technologies for business refer to the concept of mobile business or mobile e-business.*

research methodology, followed by results and discussion, and the final section presents our conclusions.

2 Wireless Field Force Automation

Terms such as "Fully Mobile Wirelessly Connected" (FMWC) or "Mobile Workforce Management" are used to identify Wireless Field Force Automation (WFFA) and these terms are inter-changeable. There are also several definitions of wireless FFA that vary from author to author (for more details please refer to the appendix). A review of these definitions highlights the different angles from which the subject is approached. Some focus on technological aspects (Gorlenko and Merrick, 2003; Rodina et al., 2003), others on their characteristics (Barnes, 2004; Olofsson and Emborg, 2004) others on their target users (Barnes et al., 2006; Rangone and Renga, 2006; Rodina et al., 2003), and still others on their objectives (Olofsson and Emborg, 2004). We propose the following definition that synthesizes all of these perspectives:
Wireless FFA is a class of information systems functioning in real time applied in order to support and manage (scheduling, supervising and reporting by) a field force, remote from their base of operations and who do not carry out any sales activities.

2.1 Critical Success Factors for WFFA implementations

(Rockart, 1979) defines CSF as "*the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for an organization*". Unlike the crowded Information Systems research field where much ink has been devoted to investigating CSF (Plant and Willcocks, 2007), little research has concentrated on CSF for WFFA. In order to address this lack we have chosen to analyse the existing literature using Nah and Delgado's (2006) classification of CSF for ERP systems[5] as a framework for identifying the critical success factors for WFFA projects. Change management, technological factors and communication emerge as being particularly important, change management having been widely studied as compared to the other factors.

Change management: Front and back office staff reductions and changing roles are the principle areas of potential WFFA impact on the employee and they may incite people to resist change (Vas and Vande Verle, 2000; Westelius and Valiente, 2006). According to Vas and Vande Verle (2000), resistance may occur at different levels (managers, technicians, dispatchers, team managers and regional directors) and may be expressed either tacitly (by inertia, covert acceptance) or explicitly (sabotage, argumentation). These results make change management an important factor for success and thus have been studied from both static and dynamic perspectives. Static perspective research tries to identify factors that can facilitate transition. These factors include:

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[5] *The synthesis of the body of existing literature relating to CSF in WFFA projects is based on (Nah & Delgado, 2006)'s classification of CSF for ERP systems. They proposed an interesting classification that groups CSF for ERP projects into seven categories: (1) business plan and vision, (2) change management, (3) communication, (4) ERP team composition, skills and compensation, (5) project management, (6) top management support and championship, (7) system analysis, selection and technical implementation.*

- Training both field and back office employees is an important factor for managing change (Westelius and Valiente, 2006; Scholl et al., 2007).
- Business Process Reengineering (BPR)[6]: Scholl et al. (2007) identified several factors that may inhibit BPR efforts such as: extant process design inadequacy for work in the field (i.e. manager and/or team exclusion in the conception of new work processes), inappropriate compensation schemes and levels in fieldwork, lack of standard operating procedures, and managerial concerns and issues with regard to field operations.
- Getting people's Buy-in: according to Bush et al. (2005), success or failure depends mostly on the "Buy-in" of field workers. Two factors may lead to this; first, the degree of process change and workers understanding the associated evolution of work processes due to WFFA implementation, and second, the perception of technology enablement as a means to satisfy worker's individual needs and the resulting advantages for their work.

In contrast to the static perspective, the dynamic perspective responds to questions related to conducting change in WFFA projects. (Vas, 2005) adopted a longitudinal study for evaluating preponderance factors and their evolution before and after the adoption of wireless FFA. He found that organizational context facilitates the implementation of WFFA in the pre-adoption stage, but inhibits its acceptance in the post-adoption stage.

Technological Factors: technology can contribute to the success of WFFA projects and neglecting these factors may cause problems such as lack of flexibility, synchronization, and local decision-making authority, and may lead to cumbersome work order management reporting, or ineffective information organization and poor ergonomics. Effective technological choice can explain the failure or success of WFFA projects. Technological choices are studied according to strategic and functional perspectives. From the strategic perspective, choices are made according to their degree of process transformation and modification of existing procedures within the company (Chen et Kamara, 2008; Scholl, 2005). However, from a functional perspective, choices are made according to technical criteria (Djemai et Favier, 2008). Technical choice includes the choice of architecture (data-based or voice-based), software and its package, wireless network and mobile devices.

Communication: Scholl et al. (2007) underline the importance of alliances between managers and field workers who are the stakeholders in wireless FFA projects. They point out how their separation leads to frustration and conflicts for both groups.

Synthesizing this body of literature, we conclude that it underlines three factors: change management, technological factors and communication. Among these, change management has been widely studied as compared to other factors.

3   Research Methodology

The purpose of this study is to investigate the critical factors effecting WFFA system implementation. To address this objective, we adopt a qualitative exploratory approach. Two factors motivate this choice. First, mobile technology is a young technology in its initial phase of development (Lyytinen and Yoo, 2002). Second, there is little empirical research on WFFA (Barnes et al., 2006; Scornavacca et al., 2005).

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[6] *(Hammer & Champy, 1993) define BPR as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvement in critical, contemporary measures of performance, such as cost, quality, service, and speed".*

When these two conditions are fulfilled (new area and little empirical research), interviewing experts is desirable (Evrard et al. 2003). For our study ten WFFA experts were interviewed: one Business Development Manager, one Mobile Solutions Leader, one CEO of an editing company, 4 CEOs of WFFA integrators, and 3 stakeholders in WFFA projects (2 Directors of Operating Methods and one Telecommunications Manager). The interviewees were asked about WFFA technology, evolution, WFFA impact and barriers. The interviews lasted between 40 and 60 minutes. Audio recordings of the interviews were made and the data was later transcribed. Data analysis was carried out using thematic analysis following the suggestions of Miles et al. (2003). We use Nah and Delgado (2006) classification of CSF to codify data.

4   Results and discussion

The Critical Success Factors found in this study are classified into eight themes: action plan and vision, change management, project team composition, project management, top management support and sponsors, communication, technological factors, and management of mobility.

4.1   Action plan and vision

In this factor group it is important to determine the objective and ROI project before launching the WFFA project.

4.1.1   Objective setting

Clearly established objectives are considered as a key to success in WFFA projects. The objectives may be quantitative or qualitative and may vary from one firm to another. For one of the companies studied, the objectives are improved productivity and increased technician responsibility. As stated by one Director of Operating Methods "*It's important for us to provide our technicians with mobility tools to avoid returning to the central station and eventually making a round-trip and for the workload.*" At another company, the objective is to improve customer satisfaction.

4.1.2 Justification of ROI

It is important to set operational indicators that facilitate ROI calculations. The most popular indicator is an increase in the number of interventions done per day. In the case of Elyo the number of intervention is increased from 8 to 12 per day and the ROI is attained in 6 months. In some cases ROI is difficult to determine, particularly when objectives are qualitative, for example when the objective is to increase customer satisfaction. "*As we prepare the specifications for a project, we analyse each operational process to identify the potential gains. In parallel to the technical solution, we build an administrative tool that allows us to access a maximum of information so that we can track ROI indicators. We only finished deploying the system in February of this year, so the feedback is relatively recent, but we already have very interesting data. These are rough indications, but at the same time they serve as benchmarks, dare I say, for comparison amongst our different operations units. They allow us to*

measure where we are in relation to our initial desired target. The trend is very good." Director of Operating Methods.

4.2   Change management

The majority of respondents argue that managing change in WFFA projects is relevant because of potential impact on field workers and state that training, business process reengineering, and involving users in the project enhances successful change management.

4.2.1 User training

The majority of respondents agree on the importance of training in managing change, for example one Telecommunications Manager states that: *"Everything is accompanied by training, for instance, when we deploy an application, it's always proceeded by a day of training."* In WFFA projects, there are two kinds of training, familiarisation with a specific mobile device and software application training. The first is necessary when a field force has paper process experience but has never used mobile equipment. The later is always necessary. *"What kind of training should be pursued? If you know that you have field workers coming from a paper culture, you need to not only provide applications training, but also hands on instruction for using the (mobile) terminal…Typically, with portable telephones there are occasional breakdowns.   How can I correct the problem? This sort of event isn't a pure applications issue, so it needs to be dealt with in the training."* Mobile Solution Leader.

Training quality can be measured by the number of post-training hotline calls coming from field workers; the better the training, the fewer the calls. *"A poorly trained... person…will call us everyday and will slow us down, (because) they will require extra help. That's proof that the training was ineffective, or that there is a problem in transferring the information… If the training is successful, there won't be calls to the hotline…however, (there is always the possibility that) despite the training, the number of calls increases (and this is a problem)"* CEO of WFFA integrator.

4.2.2 Business process reengineering

WFFA significantly impacts existing business processes. Firms must examine and adapt their processes in relation to this technology, otherwise the project will fail. "*Repeating existing procedures doesn't work, changes must be accepted.*" clarifies one Business Development Manager. Rewriting or creating processes can also facilitate the development of specifications lists, as mentioned by one Director of Operating Methods *"When we rewrote our processes we also wrote the specifications list… 100% of our processes were revisited"*.

4.2.3 Implication of users

As proved by previous research, user implication is highly relevant to WFFA project success. *"In the appropriation of tools, if we don't listen (to workers) they reject the tool, and if they reject it the system falls apart."* explain one Director of Operating

Methods. In addition, these users must be integrated at all stages of a WFFA project, as mentioned by another Director of Operating Methods *"The users were integrated in absolutely all stages of the project, even before the specifications list was developed. The technicians were involved in the choice of the final solution after they tested two operational prototypes. These (prototypes) had been field tested for three weeks under real work conditions. The choice was made based on feedback from these experiences. The impact of this test period was huge and gave the project enormous visibility. It really excited the workers who ended up using the system."*

4.3   Communication

The majority of participants emphasize the importance of communication in the success of WFFA. Several classical tools such as internal supports or internal newspapers, meetings…may be used to implement an effective communication but the creation of a network of representative (persons designated in each operational entity) who build a good internal communication appear to be the most efficient tools.

4.4   Team composition

The roles, processes and responsibilities of field workers are determined by Operating Methods Direction. Thus when a WFFA project is undertaken (a project that will strongly impact field work), the project team needs to include representatives from both Information Systems and the Operating Methods Division. Levels of responsibility and involvement vary depending on the phase of the project. At the beginning of a project the two teams interact, but once deployment is finished, the Operations team is left in charge of follow-up and the evolution of the applications.

4.5   Project management

Deployment methodology and financial guarantees are the two project management factors stressed by the participants.

4.5.1 Methodology of deployment

All participants emphasize the importance of deployment methodology in the success of a WFFA project. Globally, they stress five phases:

1. Buy or develop: in this phase the enterprise must choose between an off-the-shelf or a tailor-made solution. With off-the-shelf solutions, the company buys a pre-existing mass marketed application. A tailor-made solution allows the company to develop a specific application that fits their field worker's tasks. According to Chen et Kamara (2008) these alternatives fall under the category of mobility strategy.
2. Integration or specification: This selection is driven by the "buy" or "develop" choice. In the first case (buying off-the-shelf software) the company opts for gap analysis software to integrate a non-custom-made solution into their existing Information Systems. In the second custom software case, they opt for functional specification software.
3. Pilot phase: This generally takes from two to four weeks. The objective is to provide the solution to a selected group of users who test it and verify its usability.
4. Pre-deployment phase: This generally lasts anywhere from several weeks to a year. At this stage, it is important to select the appropriate population that will test the solution. The goal is to validate all of the WFFA solution components before deployment to the global population.

5. Final deployment: This phase entails global deployment of the solution. A progressive approach is important in order to identify errors or defects and to correct them. As suggested by one participant, *"progressive deployment will detect a problem with ten terminals, will redetect new things when we go to fifty terminals, will redetect new hazards at 500 terminals and at a thousand. This is an approach that increases the volume progressively ... while mastering (the system) and reclassifying the process."* CEO of WFFA integrator.

4.5.2 Financial guaranties

Like Information Systems, mobility projects run the risk that estimated budgets may be exceeded and projects will be abandoned. Guaranteeing that the budget estimated in the early stages of the project will not be exceeded is critical to the success of WFFA projects. *"(It is vital in order to) assure the operational life of the project because that's where there's a major rejection risk. In addition, there are market zones that allow us to be sure that things won't change economically. We are committed to ... maintaining a fixed price."* CEO of WFFA integrator.

4.6 Top management support and sponsors

Top management implication is also necessary in WFFA projects. *"(This aspect) is fundamental because it is truly a project of managing change"* explains one Director Operating Methods. The importance of this implication is proportional to the size of the future user group, especially when there are more than 50 users, and when the WFFA project affects the firm's core business.

Technological sponsors also play a crucial role in the success of WFFA projects especially when there is a large population of field workers that need to be federated. *"For example, team leaders help motivate the others (concerning the project) and can be helpful (in passing on messages from top management)"* explains a Mobile Solution Leader.

4.7 Technological factors

Effective choice of technological components is considered as the most important aspect in a WFFA project. These choices concern system architecture, software, middleware, mobile devices and telecommunications network (for detailed discussion about these choices and decision criteria please refer to Djemai et Favier (2008) study). *"When we put together a project like this, we decide to use a certain number of different components and even if we think that everything is moving in the right direction, it's important, when choosing middleware and applications, to choose, for example, the right terminal and not make a mistake. After that we have to choose the appropriate telecommunications operator, the correct transmission speed and why, etc…"* Mobile Solutions Leader. This aspect can, however, be problematic, as one participant states, *"The problems we most often encounter are technical…otherwise stated, the rejections (on the part of the field workers) that we experience are linked to the computing process"* Mobile Solutions Leader. This may be explained by the fact that the technology is still maturing.

Owing to the heterogeneity of technology in WFFA solutions and differing development standards, successful communication between purchased components is

vital. Integration management is an alternative that facilitates and optimises the choice and integration of technological components. "*We define each offer in regard to the (existing/available components), they are totally interdependent*" CEO of WFFA integrators. In addition, integration management assigns responsibility for and guarantees the correct functioning of the chosen solution(s). If this role is not fulfilled, it is difficult, if not impossible, to identify the origin of function errors and the responsible party.

4.8 Management of mobility

This emergent and increasingly important factor is the result of the growing mobility of field workers who spend the majority of their time outside of their organization. They work alone and remotely from their base of operations, making receiving support difficult if a problem should emerge in the field. This problem does not arise for sedentary workers or workers operating in a local mobility context as they can get support at any time from their colleagues or from their Information System Department. As explained by one CEO of WFFA integrators: "*We are working with people who… are all alone (in the field). With a traditional IS, when a problem arises the head of IS is available (to help). (In a remote context) the technician is alone and faced with a malfunctioning machine. He doesn't have the time to determine what works and what doesn't, he must respond quickly and make it work…he's got to figure out the solution by himself.*" Several services exist to remotely support field workers and to manage problems. Helpdesk support, device management and applications support are critical factors that are proper to the mobility context and deserve further examination, as follows.

4.8.1 Mobile device management

When mobile devices break down, field workers cannot receive information related to their work and as a result are unable to do their jobs. Quickly providing the fieldworker with functional replacement mobile devices is critical in this kind of project. This activity is called "mobile device management" and integrates several other services like "*managing breakdowns, returns, transport and forwarding, (and) management of stock security*" according to the CEO of an editing company. These activities can be accomplished by creating an internal maintenance and repair service for mobile devices, or by externalizing the function to integrators who take charge of device management. "*We get calls until 16h (four o'clock.) in the afternoon. The next morning, before 9 am, the on-site user should have a terminal that is in the final phase of configuration and is being synchronized to pick up from the moment the system broke down. We try to limit this kind of correction, preferring rather to make an "anticipated exchange" containing advanced specialized software that allows the user to avoid breakdown in the event that there is a technical problem…(and this reduces the down time to) virtually zero*" CEO of WFFA integrators.

4.8.2 Helpdesk support

Corporations must provide helpdesk support for their field force users on those occasions when they encounter use, login or start-up problems. As one respondent stated, "*if the (field worker) can't enter data into an application, he can call the hotline*". The participants agree that 70 to 80 % of the problems encountered in the field consist of workers who have pushed the wrong keys, mishandled their equipment, or who encounter login or start up difficulties. These problems can generally be resolved remotely in a few minutes by a specialist in the back office.

Two kinds of helpdesk exist, a start-up helpdesk and a recurrent helpdesk. The first supports users for six months following system deployment. The later provides ongoing support for users and is particularly helpful during the release and installation of new software. In addition, the helpdesk can anticipate and react to lingering problems in the field and warn mobile device service management about their existence.

4.8.3 Mobile device fleet management support

When a company wants to install a new application or release a new software version, historically, they needed to physically recover all the devices concerned and install the upgrades. This was very difficult and costly with field force workers in far-flung regions or in several countries. In addition, bringing mobile devices to a central location implied that field force work halted for the several days required to collect the devices from their field locations.

This problem is addressed by device fleet management support or tele-distribution7. "*It's imperative to create new applications for deployment that are capable of verifying what's happening on a terminal (and to enable the installation or upgrade of existing software). For us this is the biggest challenge for the mid and long term, and it's extremely important.*" explains a Mobile Solutions Leader. This kind of service is relevant to the success of WFFA projects, especially when the company has equipped a large number of field workers with WFFA and this field force is geographically dispersed. "*Device management is a critical factor of project success if you have hundreds of regional or international collaborators*" Mobile Solutions Leader.

5 Conclusion

In our research we explore critical factors for success in WFFA projects. The eight most prominent keys to success that we identify in WFFA projects are action plan and vision, change management, project management, top management support and sponsors, communication, technological factors, and mobility factors.

This paper reveals that, in addition to classical CSF outlined by Nah and Delgado (2006), "mobility factors" are also critical to WFFA project success due to the dispersed localization of field workers. Mobility factors integrate three sub-elements; helpdesk, mobile device management, and mobile administration. These sub-factors

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7 *Tele-distribution is a kind of middleware (a sort of software) that acts as a communications and command center for multiple applications, content types, and devices (Sabat, 2002).*

can be integrated either separately or simultaneously by a company wishing to undertake a WFFA project.

The paper provides useful guidelines for IT consultants, firm IT managers and project managers in the implementation of a WFFA system. If the factors presented in this study are taken into account, the likelihood of a successful implementation is greatly improved.

As with any research, this paper has certain limits that can serve as an starting point for future research:

- The CSF in WFFA are studied without consideration to company size or sector. A comparative study of projects carried out in companies of differing sizes and in different sectors is an interesting avenue for further research.

- In this paper the factors aren't classified by degree of importance, however, this is an interesting subject for further research. Quantitative research is necessary in this type of investigation.

- This study has not explored the pre-adoption or post-adoption order of CSF importance or shifts in importance between these stages. (Vas, 2005) has undertaken this sort of analysis, but only for change management factors. Thus a longitudinal investigation of the evolution of all factors identified in this study is an interesting area for future research.

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Appendix

Some definitions of WFFA proposed in the existing literature:

• FFA is the association between software and hardware, which are used by a specific number of staff, who are responsible to build relationships with customers, maintain expensive corporate and government assets and gather critical data that keep organization running (Rodina et al., 2003).

• FFA is a generic term for mobile applications used in real-time support orders, scheduling, supervising and reporting in the field (Olofsson and Emborg, 2004).

• Wireless FFA is usually used to describe mobile employees, remote from their base of operations, utilizing wireless technologies to perform their specific business tasks (Barnes et al., 2006).

• FFA applications are used by employees such as field service teams, technical teams, or more generally, staff that do not carry out any sales activity (Rangone and Renga, 2006).

• Compared to traditional FFA applications, Wireless FFA offers a substantially increased scope for benefits – particularly through real-time, location independent network connectivity (Barnes, 2004).

• Fully Mobile Wireless Connected (FMWC) is defined as Information and Communication Technologies are assumed to have high potential for improving field operations Gorlenko, and Merrick, 2003) cited in (Liu et al., 2007)).