

E-Gov Field Force Automation: Promises, Challenges, and Stakeholders

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Abstract.

With the growing pervasiveness and maturity of fully mobile and wirelessly connected technologies (FMWC), many organizations have begun to equip their field workforce with such information and communication technologies (ICT). The aim of these projects is to automate fieldwork operations, that is, to make them more effective, to improve field force responsiveness, and to speed up the field processes, while using resources and assets more efficiently. In both private and public sectors, such projects have been pursued, yet the specific promises and challenges are not deeply understood. We share early but already robust results from a multi-year research project, which studies the nature and interaction of organizational, social, technological, and human-actor related variables in local government field workforce automation, or short, field force automation (FFA). According to our findings, the ICT-based automation of fieldwork and field workforce appears as a far more demanding undertaking than other successful automation projects. However, the high potential for significant gains in productivity and fieldwork efficacy seem to justify a sumptuous and at times arduous adaptation process.

1 Introduction

In this article we refer to work in the field or fieldwork as a type of work being performed by fieldworkers, or the field force, outside the office, outside the plant, or outside a laboratory environment. Fieldwork under this definition has a wide range of instantiations, for example, equipment installation and maintenance, construction of any kind and of any order of magnitude, delivery of goods, in-situ services of all sorts, environmental scanning, site inspection, exploration as well as recovery of objects, surveillance, as well as emergency and disaster responses. What this incomplete list illustrates is fieldwork widely varies in kind and sorts. It occurs in contexts, in which management has limited control over important, mostly external variables. In contrast to controlled environments such as the office, the shop floor, or the laboratory, it also appears more challenging to support fieldwork with appropriate information and communication technology (ICT). With the advent of fully mobile and wire-

lessly connected (FMWC) ICT, field operations, it is believed, can now more readily expect to gradually grow up and into similar levels of ICT enablement, which the back office, the shop floor, and the laboratory environments have enjoyed for a long time (Gorlenko & Merrick, 2003; Scholl, 2005; Scholl *et al.*, 2006).

Field Force Automation (FFA) based on FMWC ICT seems to promise significant gains in field force productivity and in the management of geographically dispersed assets. In the private sector, large service organizations such as General Electric and Sears employ tens of thousands of mobile workers in the field. Reports on early automation projects mention material gains in per-worker productivity, improved route management, and increases in service levels (Anonymous, 2006). In the public sector, significant productivity gains and also substantial cost avoidance have been observed in smaller scale projects (Bleiler, 2003). However, FFA also poses an array of complex and new challenges to managerial decision makers, the field force, and ICT staff and developers alike.

In this article we report on early and preliminary findings from a multi-year research project, which studies the nature and interaction of organizational, social, technological, and human-actor related variables in a local government FFA project at the City of Seattle's Public Utilities (SPU) unit. This study site provides a rich FFA environment thanks to Seattle's long track record of novel ICT utilization (cf., (Ho, 2002; C. Kaylor *et al.*, 2001; C. H. Kaylor, 2005)).

In 2001, SPU launched the *GoMobile* FFA project in its Water Operations Division (WOD). SPU leadership intended to give online access to backend databases and geographical information to crews and supervisors when working in the field. Also, work orders were to be dispatched online to workers in the field. As mentioned productivity gains and service improvements in that FFA project were so significant at WOD that SPU leadership hurried to expand the FFA into other SPU divisions (Bleiler, 2003). In fall of 2005, the *GoMobile* project was expanded to the Drainage and Waste Water Division (DWWD). However, while the FFA pilot was "straight-forward" (Newcombe, 2002, 2), the DWWD rollout proved problem-stricken from the outset. It appears that the pilot might have represented an ideal case. We began studying the FFA project shortly after the rollout at DWWD had begun.

Most studies look at projects involving an ICT component through a technology-centric lens. In our study of the SPU FFA project we employ a markedly different perspective, in which "the system" remains a "constraint" when working towards an end rather than an end in itself. Consequently, in our study we look at human actors rather than at "users" (Lamb & Kling, 2003). We have centered our research in a work and task domain perspective, which strives to connect human-actor-related, organizational, social, and technological aspects. The study intends to identify the main constraints (including ICT), under which the human actors perform their work. In this report, among others we highlight stakeholder relations as an important set of such constraints.

In the following, we first discuss FFA in light of the relevant literatures including our earlier findings. We briefly introduce our analytical framework and present our research questions specifying how stakeholder analysis relates to the other parts of

this study. We then report on our results and discuss how those relate to our own and other findings recently gained in Computer Science research on FFA.

2 Literature, Theoretical Framework, and Previous Findings

In our study on FFA in local government: we have drawn on four streams of literature: (1) the (technical and non-technical) FMWC FFA literature, (2) the literature on organizational structuration, the (3) literature on cognitive work analysis, and on (4) stakeholder theory.

Fully Mobile Wirelessly Connected Field Force Automation

FFA might ultimately head towards the ubiquitous computing model with high levels of both (environmental) embeddedness and (application/actor) mobility (Lyytinen & Yoo, 2002); however, for the time being and as reflected in the following review we see FFA emerge more strongly along the lines of the mobile computing model requiring only relatively low levels of embeddedness and context awareness. Also, while the boundaries may be blurred, below we distinguish between the non-technical and technical FFA-related literatures. Interestingly, though, the two literatures converge with respect to some major issues.

So far, the non-technical FMWC FFA literature has predominantly developed a number of analytical models and theoretical lenses (for example, (Al-Khamayseh *et al.*, 2006; Antovski & Gusev, 2005; Borucki *et al.*, 2005; Burja *et al.*, 2006; Chowdhury *et al.*, 2006; Feenstra *et al.*, 2006; Foghlú, 2005; Garg *et al.*, 2005; Gouscos *et al.*, 2005; Knopp, 2005; Sandy & McMillan, 2005; Schmidt, 2005; Sundar & Garg, 2005); however, comprehensive empirical studies using these frameworks have not yet surfaced in numbers. Strategically, some authors see FFA mainly geared at (a) fieldwork process improvement, (b) more instantaneous information sharing, and (c) field work/worker efficacy (Sheng *et al.*, 2005). With regard to FFA, fieldwork can be divided into two basic types (Scholl, 2005): (1) work that has existed before regardless of FFA (for example, solid waste collection), and (2) work that is new and made possible only by means of FFA (for example, on-site one-stop service to elderly citizens).

Hence, five FFA cases are distinguishable: (1) An existing type of work is improved or reorganized via a genuine FFA application, (2) an existing type of work is improved or reorganized via an adapted stationary application (adapted FFA), (3) an existing type of work cannot be improved nor reorganized via FFA, (4) a novel type of work emerges via a genuine FFA application (this is the truly innovative case), and (5) a novel type of work emerges via an adapted stationary application (adapted FFA) (Scholl, 2005). So far, most studies have focused only on case 2 FFA (existing/adapted), while reports on true innovation (cases 1 (existing/genuine), 4 (novel/genuine), and 5 (novel/adapted)) or on FFA inapplicability (case 3 (existing/unsuitable)) are still in short supply.

A 2004 Human-Computer Interaction (HCI) oriented review of seventy-two recent studies on mobile computing in the broadest sense found that most technical studies

on mobile computing/FFA were dedicated to computer and interface architecture, while fewer studies dealt with aspects of implementation, use, and context (York & Pendharkar, 2004). Those studies found that FFA uses, contexts, and users expose a far wider variety and variability than known from traditional stationary ICT (see also (Perry *et al.*, 2001)). The needs of the field force also vary widely (*ibid*). Robust and versatile architectures and applications are far more challenging to design and build for the FFA environment (*ibid*). FMWC technology, which requires lengthy training, or worse, disrupts the natural flow of and focus on fieldwork is likely to fail (*ibid*). The design of FMWC FFA applications and architectures, hence, needs to start with the specific resources and needs of the field force in mind rather than other aspects like managerial control or reporting (*ibid*). Other studies confirm the dependency of FMWC FFA success on addressing and emphasizing specific fieldworker needs, which via perceived usefulness and ease of use lead to workers' acceptance and actual FFA use (Wu *et al.*, 2007). Fieldwork occurs within multiple and changing contexts along the three dimensions of spatiality, social setting, and temporality (Henfridsson & Lindgren, 2005), which represent unique constraints on work and worker even on lower levels of embeddedness.

Context, in HCI terms "the location, identity, and state of people, groups, and computational and physical objects" (Dey *et al.*, 2001, 106), due to its inherent complexity and ambiguity has increasingly convinced system designers to consider cross-disciplinary research and design approaches to building FFA applications (Bradley & Dunlop, 2005). Still, when building context-aware (Dourish, 2001; Fischer, 2001; Grudin, 2001; Hong & Landay, 2001; Rittenbruch, 2002) FMWC FFA systems, designers might fall into a similar trap as in the case of workflow systems, many of which disregarded the situatedness and potential ambiguity of workflow states and sequencing (Greenberg, 2001). "People began to fight the system, for the system view of context (in this case the workflow context) did not fit with what was actually happening. It took some time for the community to recognize the problem, and even longer for commercial systems designers to accept the limitations of procedural workflow" (p. 264). According to the author, human actors need to maintain an easy control over automatic context-inferences provided by the mobile applications, otherwise they will most likely choose to abandon the system (*ibid*, also, (Bellotti & Edwards, 2001)). However, "building inappropriate context-aware software and hardware is already happening" (Greenberg, 2001, 265)

In summary, as a subsection of mobile computing, FMWC FFA faces both technical and non-technical challenges, which appear to go far beyond those known from traditional designs and uses of ICT in stationary environments such as the back office or the shop floor. Appropriately addressing and serving the work-related needs of fieldworkers seemingly plays even a greater role for FFA success than for traditional ICT uses. Frequently, however, pre-existing or otherwise inappropriate applications are pushed into the fieldwork environment, which do not sufficiently take into account the nature of the fieldwork or the context, in which the fieldwork occurs, leading to unnecessary disruption and ultimate failure of those systems.

The Integrated Structuration-CWA Framework

Human actors are more than merely at the receiving end of information systems or other technology (Orlikowski, 1992; Orlikowski & Robey, 1991), rather, they actively shape the instantiation of any technology artifact regardless of the artifact designer’s assumptions and intentions (ibid). Basically a similar statement can be made regarding institutional settings (DeSanctis & Poole, 1994; Giddens, 1984): While those settings frame and constrain human actors’ behavior, at the same time those very actors enjoy many degrees of freedom to interpret and actively shape those constraining settings in ways they wish (Orlikowski & Robey, 1991).

We have argued that beyond (1) the formal institutional setting, (2) the technology artifacts, and (3) the individual or organizational actor variables a fourth aggregate variable needs to be considered as an important interacting element, which we have referred to as the informal and social organization (Katz & Kahn, 1978; Scholl et al., 2006; Taylor & Van Every, 2000). We have further claimed that these mutually influencing variables can be studied without unduly reducing the complexity of their interactions by means of CWA leading to an *integrated structuration-CWA framework* (see figure 1). CWA distinguishes seven dimensions of analysis of (a) the environment, (b) work domain, (c) (formal and informal) organization, (d) work-domain-related activity, (e) activity related to decision making, (f) activity related to actor-preferred strategies, and (g) actor’s resources and values. The individual impact of the four aggregate variables as well as certain effects of their interaction can be captured within the layered seven-dimensional analysis which CWA employs. The resulting integrated structuration-CWA framework we find provides advanced analytical and explanatory power for understanding a complex organizational/socio technical phenomenon such as FFA (Fidel et al., 2007; Scholl et al., 2006).

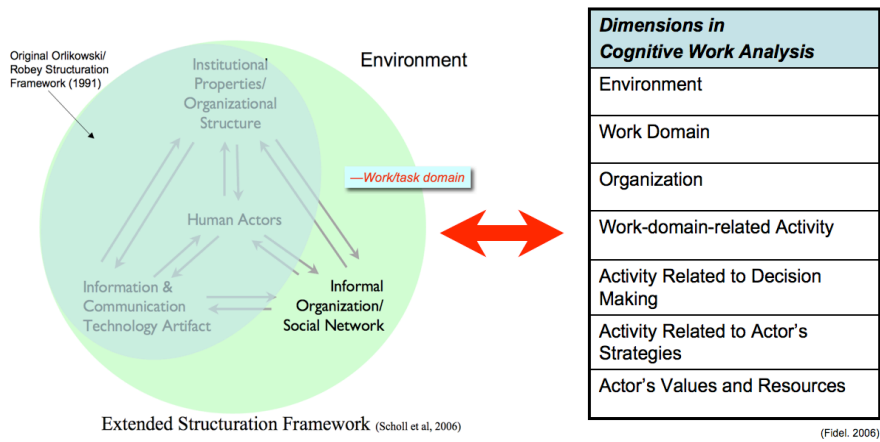


Figure 1 Integrated Structuration-CWA Framework

While CWA helps analytically distinguish the constraints exerted on an actor’s work in the various dimensions, the integrated framework puts those constraints into

the context of the interacting variables. Or, put another way, the structuration portion of the integrated framework guides the cross-dimensional analysis of the constraints.. In that capacity, it fosters the understanding of both ends of the analytical spectrum, the micro-level work analysis, and the mezzo-level aggregate variables, by explaining the interdependencies imposed on the former and by characterizing and qualifying the particular nature and influence of the latter. In summary and more generally, in doing so the integrated framework also provides an organizational platform for interdisciplinary research interested in theoretical contributions from other areas of academic knowledge.

Findings From the First Phase of the Project

Based on the integrated structuration-CWA framework we have begun to derive a formative model, which describes the work being done by the field workforce and their contextual interaction (Fidel et al., 2007). In table 1, we briefly summarize our findings from the first phase of our FFA research project with the Seattle's SPU.

| Research Questions | <i>Work/task Perspective</i> |
|--|--|
| What are the current constraints on the fieldwork? | (1) Work is initiated via work orders; (2) oriented towards preventive maintenance of assets; (3) consists of scheduled repair jobs, and (4) emergency handling; (5) high asset specificity and asset history, that is, asset-specific information required; (6) casual use of task lists and equipment lists; however (7) much information on assets and procedure is tacit or undocumented (color of water, smell, sound etc); (8) high degrees of situational decision making; (9) work is semi-structured with many variations and exceptions (task specificity); (10) detail complexity |
| How does the FMWC FFA influence those constraints? | 1) Work order support via FFA system; 2) new asset and service management system; 3) new mobile application; 4) no information carry-over from old to new system; 5) no systematic training of all crew; 6) mismatch between FFA system and fieldwork flow; (7) work-related information missing; (8) information noise; (9) proposed procedures at times irrelevant; (10) system does not support situational decision making; (11) FFA system incorrectly assumes standard structure with little variation; (12) fieldworker frustration with FFA system considered useless |
| | <i>Organizational Perspective</i> |
| What are the current constraints on the fieldwork? | (1) Lack of leadership; (2) lack of organizational stability (frequent reorganizations); (3) scheduled job rotation partially detrimental to productivity and information sharing; (4) high training needs. |
| How does the FMWC FFA influence those constraints? | (1) Technology adaptation suffers from frequent leadership and directional changes; (2) FFA system does not support all organizational procedures; (3) drive-by inspection procedures not supported; (4) lack of sufficient FFA training |
| | <i>Social (Network) Perspective</i> |
| What are the current constraints on the fieldwork? | (1) Esprit-de-corps among field crew/crew chiefs; (2) long-term relationships due to multi-decade continued employment; (3) social network fills many gaps the formal organization has created |

| | |
|--|--|
| How does the FMWC FFA influence those constraints? | (1) FFA system widens the gap and creates enormous tension on the social network; (2) frustration about FFA system easily communicated through the social network; (3) some attrition observable due to this frustration |
| | <i>Human-actor Perspective; (2)</i> |
| What are the current constraints on the fieldwork? | (1) High work ethos and commitment to mission; (2) interest and willingness to learn new methods and tools; (3) feeling that leadership does not understand the nature of the job or is not interested in workers' view |
| How does the FMWC FFA influence those constraints? | (1) Growing frustration with FFA system; (2) lack of functionality and flexibility; (3) FFA perceived as a burden with no recognizable benefit to fieldwork or worker |

Table 1 Summary of findings from first phase of research project (Fidel et al., 2007)

With regard to the type of FMWC FFA applications (Scholl, 2005), we found only adapted (type 2) applications at SPU, which assume very structured workflows rather than a lot of ad-hoc variance in task flow sequence as seems to be the norm in the division we studied.

Stakeholder Theory

While it has seemingly fallen out of favor as a central theory of the firm in its areas of origin (strategic management, management science) (Englander & Kaufman, 2004), stakeholder theory (Brugha & Varvasovszky, 2000) has made major contributions to the practices and theories of, for example, ICT project management (Boonstra, 2006; Pan, 2005), public administration (Tennert & Schroeder, 1999), and e-Government information systems (EGIS) (Scholl, 2001, 2004). The stakeholder perspective posits the thorough accounting for and adequate consideration of individuals and organizations, who “can affect or be affected by the achievement” (Freeman, 1984, 25) of an organizational purpose, goal, or project.

Stakeholder theory has been operationalized for analytical and practical managerial purposes mostly by distinguishing stakeholder *stance* (Blair & Whitehead, 1988) and stakeholder *salience* (Mitchell *et al.*, 1997). Stakeholder stance has been defined in a two-dimensional space of the potentials for support and threat resulting in four distinct cases (1) full support, (2) full opposition, (3) mixed (support/threat), and (4) indifference. Stakeholder salience has been introduced as a three-dimensional phenomenon of power, legitimacy, and urgency. Scoring models, which rank-order stakeholders along those dimensions of salience and stance, have been used in practice (Scholl, 2004) demonstrating a high accuracy in correctly identifying strategic stakeholders and their likely stances in EGIS projects. In the context of the integrated structuration-CWA framework, stakeholder theory helps identify salient influencers among the human actors and institutional groups and their likely stances relative to a problem at hand. Stakeholder theory might also help uncover stakeholder coalitions (Weible, 2007).

Specific Research Questions in this Phase of the Project

Our findings indicated that the stakeholder landscape was unclear (not only to us) and needed clarification for understanding important organizational and social network relationships with respect to the *GoMobile* FFA project, which led us to the following research questions:

- (R1) Who are the key stakeholders in the FFA project?
- (R2) What are their respective stances and alliances?
- (R3) How do the findings from stakeholder analysis match up with our earlier results?

Addressing these research questions we hoped would give us, the researchers, as well as the practitioners, valuable insights for further action and direction in research and practice.

3 Method

SPU field operations comprise some 200 staff and management. From our transcripts of ten completed case analyses at SPU we were able to identify individual and organizational stakeholders as well as various groups of stakeholders (for example, crew chiefs, influential fieldworkers, SPU management, etc.) along Freeman's definition (Freeman, 1984, 25). We checked our list with a number of individuals from various stakeholder groups for correctness and completeness. Our final list comprised 76 stakeholders. Stakeholders could be listed more than once due to different roles and responsibilities (for example, a unit manager could be mentioned in her functional role and also in her role as a member of the Steering Committee).

We developed an instrument, which listed all stakeholders by number and name. At the bottom of the instrument, we provided ample space for incorporating additional stakeholders. For each stakeholder, the instrument contained entry fields for "I know/I don't know that stakeholder," the rankings of power, legitimacy, urgency, potential for support, and potential for threat, and also for the participant's own confidence in her ranking.

Before we asked participants to perform the rankings, we went through the list of stakeholders, and asked them to add additional stakeholders to the list if they felt it necessary. Before participants were asked to perform the rankings, we introduced to them the ranking criteria and also provided lists with guiding questions for each criterion (Tennert & Schroeder, 1999). We then asked participants to use a 1-to-5 Likert scale for ranking stakeholders from high (=5) to low (=1) along the saliency, stance, and own confidence criteria. In case participants did not know a particular stakeholder or felt unable to rank a given criterion, they were asked to use a zero or a blank for that entry.

We used a purposive sampling approach for selecting participants (Ritchie *et al.*, 2003) and found four field operations managers, one ICT manager, two crew chiefs,

and three crew members, that is, a total sample of $n=10$, who agreed to participate and perform the ranking exercise. Since crew chiefs are normal crewmembers that only temporarily assume the responsibility of a crew chief, we essentially had a 50-to-50 ratio of managers and fieldworkers in the sample. Completing the questionnaire took participants between 35 and 45 minutes. The ranking criteria seemed to be well understood. There were very few questions for further clarification.

We analyzed the results using descriptive statistics for both stance and saliency and grouped the results into three ranking buckets (“top 25,” “midfield,” and “bottom 25”). With the results of the stakeholder analysis in hand, we went back to the transcripts of our phase-1 interviews and re-evaluated our earlier insights.

4 Findings

While managers on average knew personally over 80 percent of the stakeholders, fieldworkers knew slightly less than 50 percent of the listed stakeholders. Only the managers added names of individuals to the list bringing the total count to 81 stakeholders. We incorporated those new names into the instrument used in subsequent interviews. Generally, participants had a good (=4) to high (=5) confidence in their rankings regardless of personal acquaintance.

According to all interviewees (both managers and fieldworkers), the *top ten salient stakeholders* relative to the *GoMobile* FFA project were identified as (1) the SPU management as a group, (2) the SPU general manager, (3) the FFA Steering Committee, (4) the project coordinator of the FFA Steering committee, (5) the SPU field operations manager, (6) the DWW division manager, (7) the City mayor, (8) the DWW division manager as a member of the Steering Committee, (9) the (technical) Project Team, and (10) the SPU field operations manager as a member of the FFA Steering committee. Except for the top 2 the standard deviation for the ranking of all other top 10 stakeholders was moderately to significantly higher indicating some variance in rankings. It struck us that all influential fieldworkers but one at DWWD were ranked in the bottom 25 regarding their saliency. Also in that low-ranking section we found the crew chiefs as a group, other City agencies, and the general public, that is, the ratepayers as dead last.

When comparing the rankings of managers with those of fieldworkers, we made the following discoveries: Managers’ rankings had a higher cohesion (and lower variance) than fieldworkers’ rankings. Managers ranked the top ten very similarly to the overall top ten salient stakeholders. Interestingly, managers without exception placed crew chiefs and influential fieldworkers (both individual and as a group) into the bottom half of their rankings; actually, crew chiefs as a group ranked 41, the highest-ranked crew chief made it to 51st rank, and the highest-ranked individual fieldworker had rank #56. Fieldworkers, in turn, while ranking the top five similar to their managerial colleagues and the overall results ranked two DWWD crew chiefs as rank #7 and #8, and all crew chiefs but one among the top 25 salient stakeholders. However, although they ranked influential fieldworkers in lower midfield as a group, as individuals all influential fieldworkers were ranked in the bottom 25. We were stunned to

find that the fieldworkers ranked the FFA (technical) Project Team as well as individual project team members at the very bottom in terms of saliency.

With respect to stance in the overall rankings of both groups, managers and fieldworkers, we found high scores regarding the *potential for support* of the FFA project of many salient stakeholders and no high scores regarding the *potential for threat* with any stakeholder (salient or not). However, while the Project Team, the Steering Committee, and SPU management (both as groups and individuals) were ranked as very supportive, just a single influential fieldworker and a single crew chief fell into the top half of the support ranking. Moreover, the vast majority of the crew chiefs and fieldworkers scored relatively low in terms of support for the FFA project. Conversely, while the threat scores remained moderate (<4), crew chiefs and fieldworkers (as individuals and groups) vastly populated the top 25 of the threat-related rankings. Also, the City Council, the City Mayor, and SPU management appeared in the top 25 of the threat-related rankings.

When juxtaposing the support-related rankings of managers with those of fieldworkers, we made the following observations: Managers ranked similarly to the overall ratings regarding the top 25 and bottom 25 supporters of the FFA project. However, to managers the DWW crew chiefs as a group appeared much more supportive (rank #14) than to fieldworkers (rank #49), although the latter ranked some crew chiefs in top midfield of support. While fieldworkers ranked individual members of the (technical) Project Team high on support, to them the Project Team as group ranked near the very bottom of support.

“Mixed Blessings” (Blair & Whitehead, 1988) are those stakeholders with relatively high scores regarding both support and threat potentials. While those stakeholders may support the project under certain conditions, they might threaten it under different ones, and vice versa. For managers those individuals and groups might need the most attention and dedication. It came as no surprise that influential fieldworkers and crew chiefs (as individuals and groups) populated the list of mixed blessings in numbers.

With these findings in hand, we revisited both the transcripts of the cases analyzed before and the findings from that first project phase. It appears that planners and project team members spent little time with crew chiefs and fieldworkers to (a) understand the idiosyncrasies of the work at DWWD, (b) obtain input regarding the suitability of the new system before implementation, and (c) ask about specific needs and requirements of DWWD fieldworkers. Crew chiefs and fieldworkers uttered great frustration with not being heard before and during the implementation of the new system (“We knew it wouldn’t work but nobody wanted to listen.” “If they (management) only listened.” “The system actually does not support our work, it rather makes it more difficult.” “We are helping the system rather than the system is helping us”).

In summary, the findings suggest a major disjoint between key stakeholder groups of the *GoMobile* FFA project, that is, SPU management, the Steering Committee, and the Project Team, on the one hand, and crew chiefs and fieldworkers, on the other hand. Obviously, the project and unit leaderships have not managed to secure the support of the most immediately impacted stakeholders in the project, that is, the fieldworkers and crew chiefs. Upon checking the data from the earlier case analyses, we found ample support for this conclusion.

5 Discussion

The method used and the instrument employed helped identify and distinguish key stakeholders in the *GoMobile* FFA project (research question R1): the managerial group, that is, SPU management, the Steering Committee, the Project Team, and the field force group, that is, the crew chiefs, and influential fieldworkers are among the primary stakeholders of the FFA project. As said before, one challenge for the managerial group is to acknowledge the saliency of the field force group, which consequently needs to be reflected in an adequate involvement of the latter in setting the directions and specifications of the FFA project. So far, the disjoint between those two stakeholder groups has created disruptions in the project and frustrations for all groups involved; however, that situation has not escalated into an open conflict.

Regarding the stances and alliances (research question R2) the support levels of the FFA project among the managerial group are high, while they are low in the field force group. While the threat levels are very low for the managerial group, they are somewhat higher for the field force group. Overall the field force group exposes only lukewarm support for the project with a latent potential threat to the project at about the same levels. This represents an unstable and potentially dangerous situation for the project. Since the field force group comprises the human actors most affected by the project, this group's willingness to support it is absolutely critical. Likewise, since the field force group is the one, which can affect the project the most, this group's potential to threaten the project is a very serious matter. Human actors can strand ICT projects in many ways, which may not even be noticeable by management (Checkland & Holwell, 1998), such that ignoring the field force group's concerns is not an option. On the contrary, project advocates need to proactively focus on mitigation of the threat potential, which could be accomplished via co-opting the field force group, for example, by involving them into the project-related decision-making process.

With respect to the match-up of findings with earlier results (research question R3) we found clear evidence that the field force as an entire stakeholder group has strong reservations against the FFA project. This reservation seemingly is not based on some sort of stubborn resistance to change. Our accounts show that the field force's frustration with the FFA system can be summarized as due to the (1) lack of appropriate FFA functionality, (2) lack of ease of use, (3) lack of added value/usefulness, (4) lack of flexibility, and (5) burdensomeness (in terms of fieldwork-unrelated extra tasks). Although mostly initiated via work orders, fieldwork at DWWD is semi-structured, situational, at times even event-driven, and variable in sequence with a high degree of ad-hoc decision making required on behalf of the field force. In other words, contrary to the inherent assumptions in the logistics and asset management system MAXIMO[®] DWWD fieldwork does not follow standard procedures, which are highly structured and highly invariable. Mobile MAXIMO[®] qualifies as a type 2 FFA application, that is, an adapted-to-mobile stationary application, which obviously represents a mismatch to the requirements of the fieldwork.

With introducing the FFA technology, SPU management pursued three goals: (a) improvement in the management of (aging) assets, (b) increase in field force productivity and efficiency, and (c) reduction in operating costs (Bleiler, (2003); Haskins, 2006). In order to achieve those goals, better field force supervision, more decentralized decision-making capability, and higher quality and timeliness of field force re-

porting was seen as critically important (Bleiler, (2003)). Consequently, a central prerequisite for reaching those ambitious goals was seen in gaining more central control and oversight over the field force via the FFA, which would explain why the field force had hardly been involved in the planning of the FFA project. However, it also discloses a certain degree of unfamiliarity with the nature of the fieldwork on part of the FFA planners who did not discover the structural mismatch between the actual work performed in the field and the FFA system workflows.

As said before, fieldwork can be distinguished from other work such as back-office work or shop-floor work along various dimensions. First, we distinguish task complexity and a related tacitness of knowing about the task and work object. While other work may involve relatively low degrees of complexity and tacitness, fieldwork has a wide bandwidth of low complexity to relatively high complexity regarding task and work object (see figure 2). FFA systems need to account for this situation, that is, traditional computing concepts, which are context-unaware might have much lower utility in fieldwork than in other work contexts. Something similar can be said for two other dimensions, which distinguish fieldwork from other types of work, that is, fieldwork has also a wide span of structure from fairly well structured over semi-structured to lowly structured. This limits the potential for preplanning of fieldwork. FFA systems, hence, need to provide for flexible replanning and ad-hoc changes of schedules and sequences. Also, field force has ad-hoc needs of information that may not be available in well-structured and pre-configured formats. Furthermore, the recording of major portions of relevant information may defy easy structuring and may rather require an open input format (including other than typing or hand-writing (Lutters, 2004)). Consequently, the access to such unstructured information may better be served via search-engine support than traditional database queries.

At our study site, we also observed another phenomenon, whose extent and importance we became more aware of than ever before, that is, with growing tacitness regarding a task or object it is harder to separate that specific task or that specific object/asset from the human actor who has intimate tacit knowledge about it. In other words, the management of highly specific assets or tasks misses the point if it does not take into account the specific human actors who hold important tacit asset-/task-specific knowledge. In such situations, we introduce and propose to use the terms of asset/human-actor couplets and task/human-actor couplets rather than assets or tasks in isolation.

We also explicitly relate our results to those from HCI research on context-aware applications and systems, which find very different challenges and requirements in building such systems than for stationary- or single-context systems. From the work-

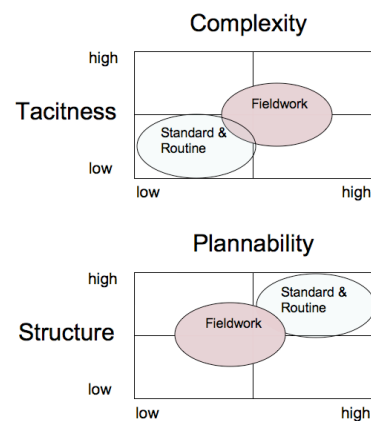


Figure 2: Dimensions of Fieldwork

domain perspective we confirm the reports on frustrated and desperate human-actors and their particular reactions to systems perceived inappropriate and burdensome.

6 Conclusion

This study is still in progress, and many results are early or preliminary. However, some of those results are already pretty robust, and they correspond to, and even confirm insights from other disciplines (e.g., HCI). Fieldwork is a unique “mix of planned maintenance activities, scheduled construction, and unplanned emergency repair attending to trouble calls” (Bharman *et al.*, 2006,2). The disruption of schedules and the rearrangement of priorities are other characteristics of this type of work (ibid). Tasks are highly specific, so are many assets and objects involved in fieldwork. Furthermore, over time fieldworkers accumulate high levels of idiosyncratic and tacit knowledge about tasks, task contexts, as well as work objects and assets. To emphasize this unique relationship we have introduced the terms of task/human-actor couplets and asset/human-actor couplets for further study. Supporting fieldwork by appropriate, that is, fully mobile, wirelessly connected, as well as work-, task-, and context-specific applications is very challenging to technology, process, and organizational designers. It appears that many early FFA projects fall into the “type 2” trap, that is, they rely on context-unspecific, adapted-to-mobile stationary applications as their first bet on FFA. This may be counterproductive in two ways: (1) It frustrates the field force and makes it less inclined to rely on FFA in their work, and (2) it may equally frustrate decision makers, since investments into FFA appear as unjustifiably costly and ineffective. However, appropriate FFA systems may yield tremendous productivity and efficiency gains as some of the more successful projects in the private sector have already demonstrated. In future research, we intend to specify characteristics of successful FFA systems and successful strategies of their implementation.

7 References

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