Choices and Challenges in e-Government Field Force Automation Projects: Insights from Case Studies

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Overview

- What is Field Force Automation, and why is it important?
- The FFA Project at the City of Seattle, WA and the mCity research project
- What we know about fieldwork and field operations
- What we know about the uniqueness of business process redesign in the public sector
- Our analytical lens
- Research Questions
- Technological findings
- Organizational findings
- Discussion and Recommendations
- Concluding remarks
What is *Field Force Automation*? And why is it important?

- **Field Force Automation (FFA)** stands for information and communication technology (ICT)-enabled field operations on the basis of *fully mobile wirelessly connected (FMWC)* applications, which are frequently linked with back-end Enterprise Resource Planning (ERP) systems.
- FFA targets the enormously diverse area of fieldwork, which has enjoyed far less attention than proximal organizational areas such as back offices, front offices, or shop floors.
- So far, fieldwork has lacked dramatic gains in productivity or improved decision-making.
- With *FMWC* technologies, or FFA, field operations have become a viable target of automation and ICT-enabled process and workflow-redesign efforts potentially leading to significant gains in productivity.
## Types of FFA Applications

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SPU Field Operations

- **SPU Drainage and Waste Water Division (DWWD)**
  - 45,396 catch basins; 1,491 miles of combined sewer and sanitary pipelines; 450 miles of storm drainage pipelines; 212 miles of ditches and culverts; 69 pump stations
  - In the midst of field force automation project phase 1

- **SPU Water Operations Division (WOD)**
  - 1.3 million people served; 696,350 wholesale population; 619,250 retail population; 26 purveyors; 148 million gallons used per day; 1,800 miles of pipeline; 2 watersheds, 3 wells
  - Field force automation project phase 1 completed

- **SPU Solid Waste Division (SWD)**
  - 228,400 commercial garbage tons; 145,800 residential garbage tons; 42% recycle rate (estimate); 5,500 multi-family residential accounts; 143,000 single family residential accounts; 9,500 commercial accounts
  - Field force automation project not yet started
SPU Management:
Needs and Expected Benefits from FFA

- Improvement in the management of (aging) assets
- Increase in field force productivity and efficiency, and
- Reduction in operating costs

Bleiler, 2003; Haskins, 2006
Itronix fex21 Husky Handheld

Panasonic CF-28 Toughbook
The “mCity” Project

- NSF Grant # 0535088, 2005 to 2008

- Studying the impact of and challenges in the City of Seattle’s Public Utilities (SPU) GoMobile Initiative (a FFA project)

- SPU Field Operations with approximately 400 Fieldworkers and crew chiefs
“mCity” Project Phases

- **Phase 1**: Research design development, piloting, & training (complete)
- **Phase 2**: First 18 cases (of 50) studied in situ at one SPU unit (Drainage and Wastewater Division- *DWWD*)
- **Phase 3**: Stakeholder Analysis at *DWWD*
- **Phase 4**: Next 18 cases (of 50) studied in situ at the same SPU unit (Drainage and Wastewater Division- *DWWD*)
- **Phase 5**: Stakeholder Analysis at another SPU unit, that is, the Water Operations Division *WOD*
- **Phase 6**: Final 14 cases (of 50) studied in situ at *WOD* ←
- **Phase 7**: Comparative analysis of all cases; consolidation and interpretation of results
- **Phase 8**: Preparation of final reports and papers: archiving
Sub-categories of Field Operations

• (1) Highly structured field operations such as in the cases of the police, fire guard, or real estate assessors with comprehensive and pre-programmed routines

• (2) Primarily structured field operations such as construction, transportation, and landscaping with mostly pre-programmed routines, which occasionally have to handle exceptions, and

• (3) Semi-structured field operations such as field-service and maintenance work as well as disaster responses with pre-programmed routines, which have to cope with relatively frequent interruptions and exceptions [Trentham and Scholl, 2008]
Uniqueness of Fieldwork

- Low to relatively high complexity regarding task and work object coupled with
- Mid- to high-level tacitness of knowing regarding task and assets
- Traditional, context-unaware computing concepts might have much lower utility in fieldwork than in other work contexts
With growing tacitness regarding task or object it is harder to separate that specific task or that specific object/asset from the human actor who holds that intimate tacit knowledge about it:

- Unique asset-actor couplets

- Unique task-actor couplets

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.
The Uniqueness of the Public Sector and the Challenges of Business Process Redesign (BPR)

- Division of powers and the system of checks and balances
- Rapidly shifting priorities due to changes in
  - Political leadership
  - Short annual budgetary cycles
- Challenges regarding BPR include
  - Traditional civil service culture with its emphasis on continuity, predictability, and fairness
  - Lack of senior management commitment
  - Resistance to change
  - Misunderstanding of the requirements of the business
  - Lack of communication with staff
  - Lack of empowerment
In Summary, What We Know is

• Mobile FFA systems and applications are more challenging to design for field operations of the latter two sub-categories than for sub-category 1.

• The introduction of FFA, hence, needs to be aware of the high risks of failure, particularly, in cases of adopting and extending extant and well-structured applications from other organizational areas.

• BPR has been employed in the public sector within sector-specific constraints, which has required different approaches and emphases than in the private sector.

• Hence, BPR in field operations in government might present a double challenge, due to the uniqueness of both the specific work context and the sector specifics.
Theoretical Lenses #1 and #2:
Extended Structuration Framework & Cognitive Work Analysis

Extended Structuration Framework (Scholl et al., 2006)

- Institutional Properties/Organizational Structure
- Human Actors
- Information & Communication Technology Artifact
- Informal Organization/Social Network

Environment

Work/task domain

Dimensions in Cognitive Work Analysis

- Environment
- Work Domain
- Organization
- Work-domain-related Activity
- Activity Related to Decision Making
- Activity Related to Actor’s Strategies
- Actor’s Values and Resources

(Fidel, 2006)
Research Questions

- (R1) What are the particular technical problems encountered by the field force in their work, when using FFA systems?

- (R2) What are the particular organizational problems encountered in work in the field?
Technology-related Findings

- Lack of flexibility ignoring the semi-structured nature of that unit’s fieldwork
- Lack of synchronization
- Lack of local decision making authority
- Cumbersome work order management
- High burden of new reporting requirements
- Inadequate organization of information
- Inadequate ergonomics (in terms of both hardware and software human-computer interfaces)

In summary, the FFA system used at the Utility classifies as a type-2 (extended stationary) system, which makes available structured information and workflows in the field.
Organization-related Findings

- Lack of sufficient training and expert support
- Questionable adequacy of extant process design of work in the field
- Unfitting compensation schemes and levels in fieldwork
- Lack of standard operating procedures
- Managerial concerns and trust issues with regard to field operations

- In summary, the field operations, which we observed, heavily relied on the *informal* organization and on individual worker’s initiative to bridge the gaps the formal work organization consistently left open. Attempting to provide more structure in a not totally structurable work context might not be the ultimate solution
When using a stationary application in a mobile environment, and the application prescribes and imposes a rigid workflow structure, then chances are that such applications might rather stifle than support the mobile context.

Mobile FFA systems,
- should be designed and built from a fieldwork-centric perspective. Business process streamlining might also be more demanding in the field operations context.
- could play key roles in synchronizing field operations and peer crew collaboration, for example, in route planning, scheduling, and work order prioritization.
- enable the delegation of decision-making authority to the crews who operate in situ rather than relying on lengthy up-and-down-the-chain-of-command decision processes.

Mobile FFA system would still provide decision support in terms of suggested approaches; however, field crews need to have the means to overwrite any suggested decision path or pre-generated workflow sequence.
Discussion and Recommendations (2)

- Route optimization, equipment scheduling, and asset maintenance prioritization should be integral part of a mobile FFA.
- The field force must maintain the authority to rearrange routing and service assignments.
- Mobile FFA must have the capability of supporting the disruption of workflows in progress, which are to resume at a later point in time.
- Fieldworkers are closest to the point of service and, hence, typically understand best what needs to be done.
- Mobile FFA systems need to also entrust the field force with creating, amending, modifying, concatenating, splitting, closing, and reopening of work orders (full and in part).
- Mobile FFA systems have the capacity to rearrange the accounting and monitoring methods for work performed in the field. Billing procedures, for example, could be automated, and field crews could be offloaded of much of the reporting burden by the system automatically tracking the progress of work.
• Special care needed to determine, which information ought to reside on the FFA client, and which information needs to be updated through wireless connectivity
• Downloading static bulk files such as detail maps from servers might become less costly due to higher wireless bandwidths
• However, static information can easily be stored on client systems rather than transferred in real time
• Dynamic content such as new work orders or emergency calls, on the other hand, requires a high availability of wireless connectivity and, hence, should be given priority over static content
• Mobile FFA systems might benefit from a departure from a rigid client-server architecture (for example, by incorporating sensor-based network principles)
Discussion and Recommendations (4)

- Mobile FFA systems
  - should provide fieldworkers with search-engine-type search functionality, which is capable of capturing both structured and non-structured data.
  - contain a knowledge management component such as asset and location-specific wikis, which let fieldworkers easily record and update important information for sharing with coworkers. Such wikis could be centrally maintained and edited. Video and audio input and output might enhance the utility of such FFA wikis.

- New equipment generations have already emerged and provide
  - easier operation, better readability, and increased robustness.
  - high-quality and high-performance equipment for mobile FFA systems.

- Higher-quality hardware might more easily enable the design and deployment of novel types (type 1) of FFA applications, which might also have the capacity to enhance interpersonal and inter-crew communication and collaboration.

- Combined telephony and PDA functionality with high resolution LCD screens might turn out as versatile mobile FFA devices.
### Need for Native FFA Apps

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Concluding Remarks

• 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
• Over time fieldworkers accumulate high levels of idiosyncratic and tacit knowledge about tasks, task contexts, as well as work objects and assets
  ▪ → asset-actor couplet
  ▪ → task-actor couplet
• Mobile FFA systems
  ▪ cannot successfully be conceived from an administrative or back office perspective but decision makers rather need to revisit and potentially redesign the field workflows and processes from a fieldwork-centric perspective.
  ▪ might have a potential to hugely increase field force productivity; however, this will only be achievable if crews enjoy more “wrench time,” that is, operating in the field and on the job.
  ▪ currently mostly of type-2 (adapted FFA )
• Native FFA systems need to be designed for support of the unique field operations environment
• Requirements for mobile FFA systems must concurrently be identified on three interacting levels: system, organization, and human actor
Thank you! Any Questions?