Usability evaluation of mobile ICT support used at the building construction site

Per Christiansson
Kjeld Svidt

Aalborg University
http://it.civil.aau.dk

World Conference on IT in Design and Construction
INCITE/ITCSED 2006
New Delhi, India, 15 - 17 November 2006.

CONTENT

- The ‘IT at Construction site’ project
- Today’s and tomorrows ICT support
- User needs and requirements capture
- Tests methodology and results
- Conclusions

THE PROJECT

The paper summarizes findings from field evaluations and *controlled laboratory usability evaluations* of new mobile Information and Communication Technology, ICT, support used by craftsmen at construction sites as well as a discussion of methodologies for user centred ICT tools design. The findings are derived from the Danish project *'IT at the Construction site'* started in 2003 and ended in may 2005. (Follow-up project ongoing).

The project was financed by the Danish Ministry of Science Technology and Innovation. (5+ SMEs participating).

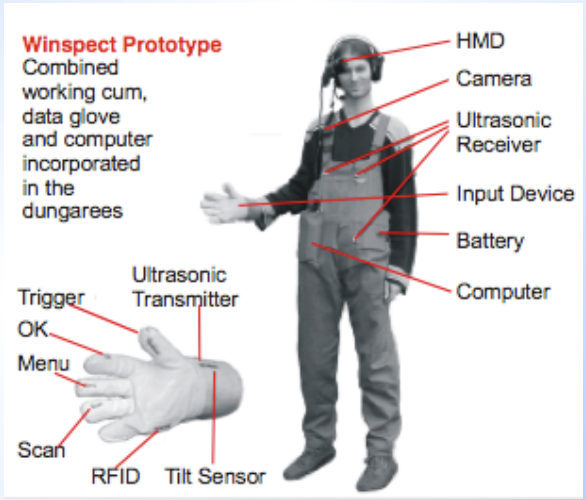
The project was started grounded lack of assembled activities to better utilise and develop Information and Communication Technology, ICT, tools at the building site.ICT domains covered in the project were

- Construction web portal
- Digital document handling
- Mobile telephone technology for registration
- Education activities
- Collaboration between industry and research institutions
- Evaluation of construction site ICT tools
- Knowledge transfer

ICT developments 1/2

VuMan 1991, CMU

Digital Hardhat, UIUC, 1996



[wearLab] Bremen

Ontologies

Wireless

Peer-to-Peer

Virtual Spaces

Augmented Reality

Embedded Intelligence

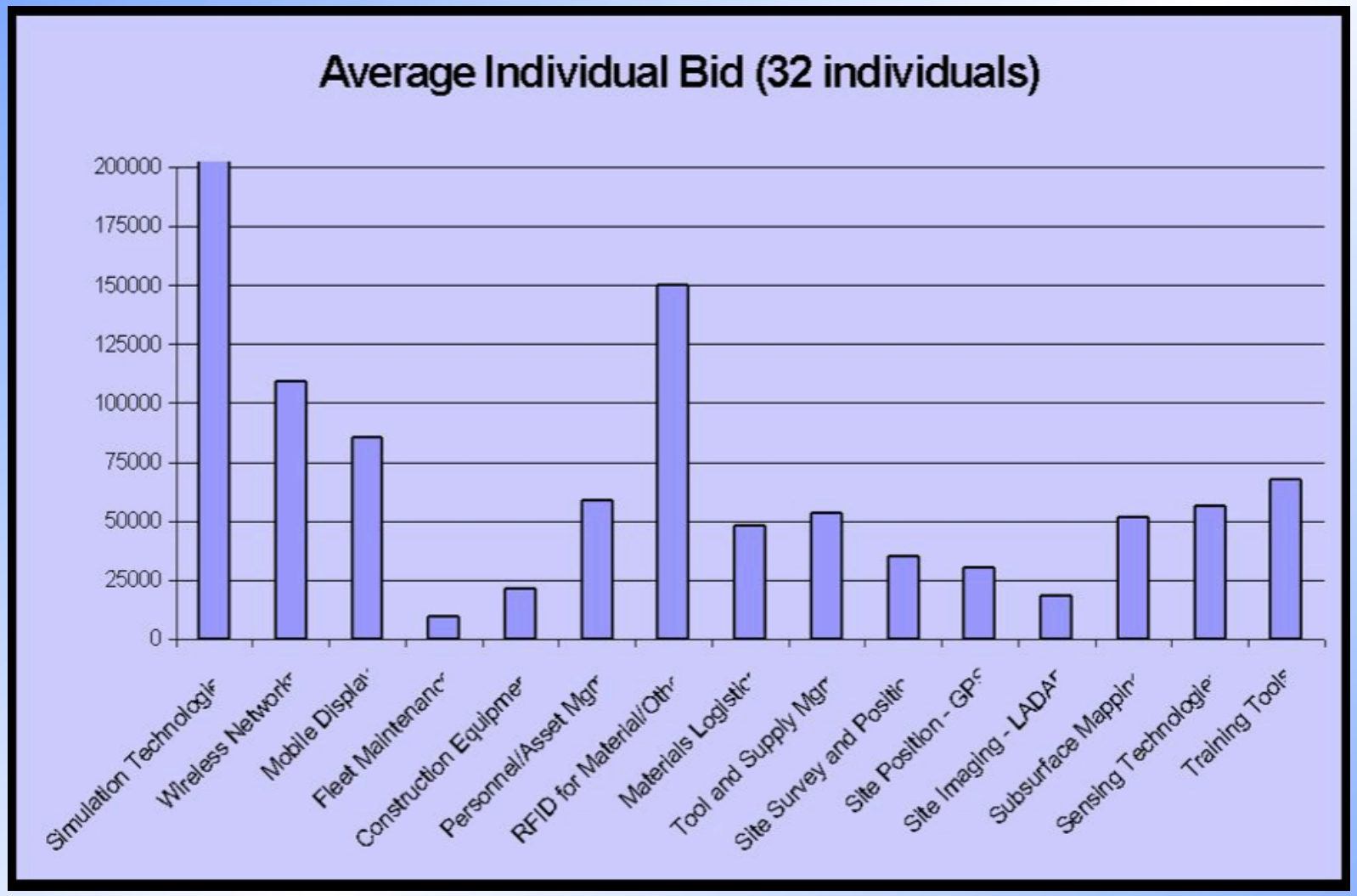
RFID

GPS

Grid Services

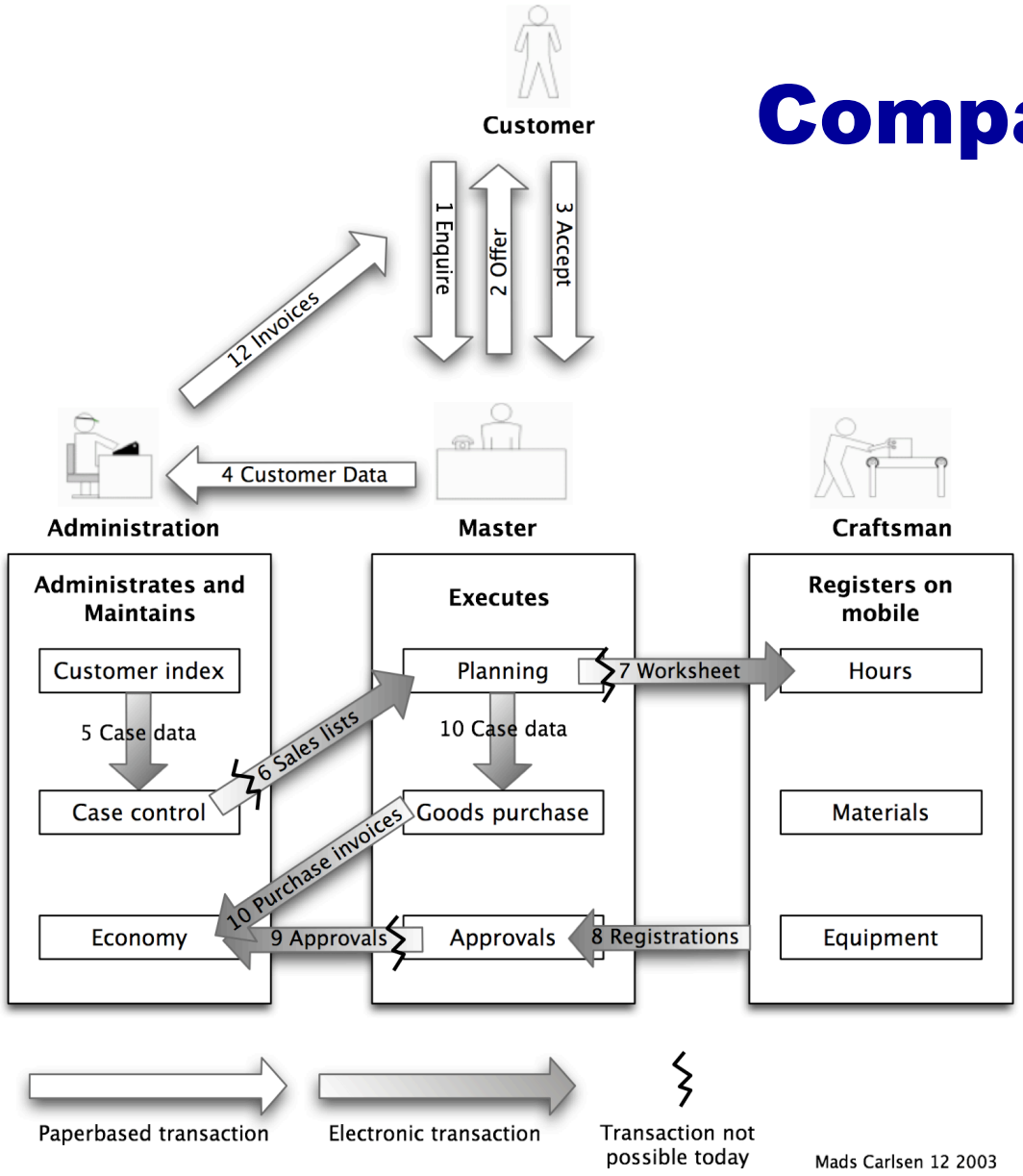
We are in an intense period of development where we can do creative design of future user environments.
High quality models of building products and processes can be used in augmented reality environments to make collaboration and 4D simulations more effective, supported by underlying models and efficient data transfer.

ICT developments 2/2



"Technology "auction" designed to rank the candidate technologies in term of near-term perceived values". From (Wood & Alvarez, 2005) page 10.

Company information flow



Focus support areas were administration and
- Planning of man resources.
- Time registration.
- Registration of materials and equipment on projects (and cases/activities).
- Integration with existing administrative systems at the companies

The participating companies listed requirements on future systems that they meant should be paid attention to (grey arrows left).
- Reduction of double registrations.
- Secure digital registration of time- and resources spending.
- Registration of purchases.
- On-line access to detail planning system.
- Utilization of data through many systems (systems interoperability).

User Needs & Requirements Capture

- Define user involvement (often heavily underestimated) with regard to user *needs* and *requirements* capture, functional user environment design including computer user interface, and continuous end user evaluations
- The traditional system *efficiency*, *effectiveness* (do the system solve the targeted objectives), and *user friendliness* (how well do the system meet user expectations on the system) must be *evaluated* during system development and implementation.
- We have used *Contextual Design methodology* for formal process description to strengthen development documentations and communication between project participants. (The same approach is used to develop a *ICT support change process methodology* in the continuation project 'ICT and Resource Management at the Building Site')

Laboratory Usability Tests 1/5

Users were observed by recording think-aloud, several video cameras and user activity logging in tested system and tests ended by a NASA-TLX test for registering of user stress during test (March 2004).

The craftsmen (14, aged 18 - 36 years) were asked to solve 9 tasks, 40 minutes, (in short):

1. You are going to Mr Hansen to change a water stop cock in a ceramic tile. *Set-up the task*.
2. You have the following material and equipment in your car.
   The following equipment shall also be brought and therefore *registered*
3. You drive from the office to Mr. Hansen. Register *driven km*
4. After installation register the *material used*.
5. Another person from the company passes by and wants to borrow your flat chisel. *Remove* the equipment from the task.
6. You take a 10 minutes *break*. Register this in the system.
7. You discover that you only used 2 tiles and registered 3. *Correct* this information in the system.
8. You now get order from Master that you should continue on another task nr. yy, which is not completed. *Start* this task in the system.
9. Time to finish the day's work. Continue task tomorrow. *Correct* used time for today's first task (you actually started it 1 hour earlier).

Laboratory Tests 2/5

The laboratory test facilities at Aalborg University.

Laboratory Tests 3/5

Craftsmen to the left

Laboratory Tests 4/5

Ericsson T68i Mobile phone equipped with barcode reader scanning a laminated barcode sheet.

Laboratory Tests 5/5

Ericsson T68i Mobile phone mounted on video stand for capture of mobile phone keyboard and screen. The video camera is wirelessly connected to video recording device.

Laboratory Usability Tests 6/6

Test Results

- There is a great *potential* in barcode recording of especially components, material and driving activities
- The *user interfaces* must be further developed and take into account specific user interaction requirements
- Some *basic heuristics were not fulfilled* such as informative feedback on certain user actions, sometimes missing feed back on system status, not clear error codes, the user in charge of operations, and clear indications of status for different ongoing activities in the systems
- The end-users were in general *rather satisfied* with the performance of the tested systems and gave very positive feed-back from some users on the prospect of *better control* on resource use.

The project has pointed out that the *time* needed for *user needs and requirements capture* was underestimated, as is very often the case.

Main Conclusions 1/2

It is concluded from the project that small building construction firms' use of *ICT tools in production still is limited*. Some of the *barriers* recognized in the project are:

- Limited understanding of *possible achievements* by using ICT tools.
- Limited overview of *possibilities and barriers*.
- Uncertainty regarding ICT implementation *costs*.
- Poor *connection* between existing ICT systems.
- *Fear* of being *dependent* on ICT tools.

Main Conclusions 2/2

- The companies shall be *prepared* for the change in ICT tools support, and are keen to hear from other companies' experiences.

- *Anticipated effects* shall be *described* and *evaluated* to increase insight into investment goals

- *Collaboration* between *companies*, *system deliverer* and *university* is necessary for efficient development and implementation of systems.(Increased end user involvement)

- *Knowledge transfer* routines should be improved.

- *System usability and interoperability* must be improved including *business ontology* development.

- Increased focus on *education* within IT in construction is needed.

(The ongoing national Danish Digital Construction R&D program, DDB, will give important input to classification and use of building product and process models)

END

http://it.civil.aau.dk