

HCI issues in the design of a web based spreadsheet mediated collaboration system

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Outline

- A scenario-based approach to derive user requirements from the context of study
- Usability issues
- The adaptation of appropriate HCI interactive collaboration design patterns
- User interface requirements
- Future work

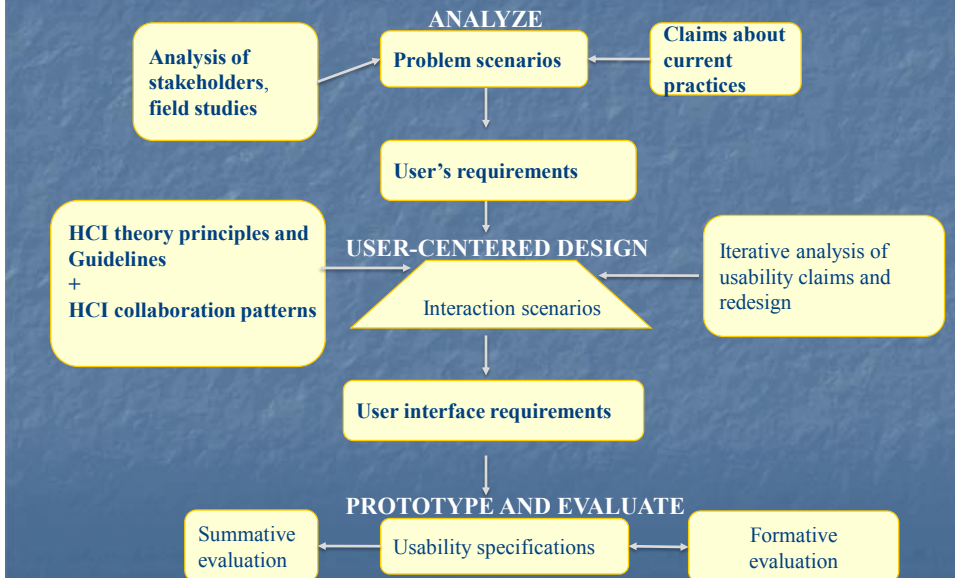
The general context of investigation

- A methodological roadmap for cost-effective “eTransformation” of SME’s [Ginige&Hol2008]
- A wide project involving a cluster of 30 companies operating in the NSW Metropolitan Region

The case study of spreadsheet-mediated collaboration

- *The goal:* develop a web based spreadsheet mediated business collaboration system that could notably enhance existing business processes while retaining all the positive features of standalone spreadsheets that are extensively used by business
- *The challenge:* to encourage the transition to a more effective and efficient form of collaboration, by means of usable user interfaces.
- *The method:* focus on HCI issues to design an interactive web based collaboration system, which effectively combines the benefits of spreadsheet applications with information sharing and access control mechanisms that web provides.

A scenario-based design process



The initial step – an ethnographic study^(*)

- A survey on the use of spreadsheet applications conducted among people with different backgrounds and operating in different application domain
 - *aim*: to understand the extent to which spreadsheets are currently shared and set up appropriate templates for the next fieldwork.
- A fieldwork for contextual inquiry and observation:
 - *aim*: to gain a comprehension of collaborative activities requiring the use of spreadsheets, as they really occur in small working environments and to identify requirements, within such contexts of use, for a web-based spreadsheet environment.

(*) Richa Shirodkar's Master thesis

The fieldwork

THE MAIN GOAL OF OUR OBSERVATION

To identify requirements within context of use, i.e. small working environments

What obstacles in the current setting of the observed SME hinder a better exploitation of the powerful functionalities of spreadsheet applications?

The fieldwork (*cont.*)

For each company we observed:

- the physical settings in which collaborative activities using spreadsheets are performed (e.g., whether co-located or distributed offices are involved),
- the means by which those activities are usually coordinated (e.g., whether in a face-to-face manner or by telephone/computer mediated communication),
- the means by which one participant make aware other co-workers of the actions he has performed to get the activity done (e.g., by explicit notification or letting information on those activities to be sought on the shared spreadsheet).

Capitalizing the acquired knowledge: *PERSONA*

BIOGRAPHY

Fanny Price is a full-time experienced officer belonging to the administration staff of a community service centre. She works on training services and, often in cooperation with 3 colleagues, who work on different business units and at different locations, she manages customers' records, planning activities, budgeting, wage records and so forth. She makes use of spreadsheets and often shares them by e-mail with colleagues and with two supervisors, a General Manager, who performs cash flow analyses and periodically reports results to the Board, and a Chief Executive Director, who is responsible for the overall community development.

MOTIVATION

GOAL

Fanny often experiences version consistency problems with the processed spreadsheet files. She believes that great benefits would come from a synchronized sharing of spreadsheet data.

Capitalizing the acquired knowledge *scenario of working practice*

Scenario –

Fanny has to organize the closing ceremony of an evening training course held for immigrants.

Fanny

- consults her copy of the financial spreadsheet to verify the amount currently allocated to her unit, focusing on the cells related to social events expenses
- formulates a budget scheduling for the event and sends an email to the general manager.

General Manager

- approves the event and properly updates the financial spreadsheet, distributing the updated version to all the units.

Capitalizing the acquired knowledge

Scenario (cont.) –

Fanny

- upon approval, consults the conference room agenda, which is again a spreadsheet file shared by all the business units, by e-mail transmission
- selects the date for the ceremony, indicates the details concerning catering expenses and number of people expected, and notifies them to the colleague from the Function and Conference Unit
- **The Function and Conference Unit officer**
- replies that earlier in the morning she has received a request for the same date from the Development Office

Fanny

- chooses another date and notifies it to the unit.

The Function and Conference Unit officer

- is now able to update the spreadsheet file accordingly.

What kind of collaboration for this Scenario?

The described scenario features two kinds of collaboration tasks. The former, between the officer of the Training Unit and the General Manager, is a collaboration meant to keep financial records correctly updated by the person who is responsible for them. The latter, which occurs between two officers of different units, is meant to keep the conference space properly allocated, avoiding overlapping of events. Both describe an ***asynchronous distributed collaboration performed through e-mail message exchange.***

Capitalizing the acquired knowledge – claims about current practices

What collaboration issues appear from the described scenario?

- spreadsheet sharing is partial – writing privileges are allowed to one person/unit for each spreadsheet and reading privileges are allowed to all the co-workers, not limited to the cells of interest
- possible flaws in the business process due to conflicting requests:
 - e.g., Fanny allocates 2500 AUD for social expenses , thus leaving an amount of 300 AUD in the corresponding cell. The officer from the Development Unit makes soon after his own request, and is not aware of the last modification until he receives the updated file from the General Manager.
- possible flaws in the business process due to human error:
 - e.g. Fanny fails in choosing the latest version of the spreadsheet file from her hard disk.

Considerations coming from the envisaged scenarios

The need emerged for more adequate techniques for sharing spreadsheets, able to yield an improvement in the efficiency of the related activities and, hence, of the overall business process, while fulfilling collaboration specific requirements. In particular:

- privacy and data access rules actuated so far should be preserved (with a suitable separation of concerns and privileges).
- concurrent accesses and modifications to the same portion of a spreadsheet should be adequately ruled and
- a proper versioning control should be designed, so as to keep track of *who* modifies *what* in the spreadsheet.

Summarizing from the initial fieldwork

UReq 1 Little learning effort

UReq 2 Low external costs for maintenance activities

UReq 3 Preservation of existing privacy and data access rules

UReq 4 Appropriate synchronization policy among users

UReq 5 Versioning control and detailed modification loggings should be devised at cell level.

Investigating usability issues

**From the analysis of user requirements and
from the observed behaviors of co-workers**



What usability factors are especially important?

Why usability is our concern?

- **ISO 9241-11 *Ergonomics of Human System Interaction -Guidance on Usability*** (1998)

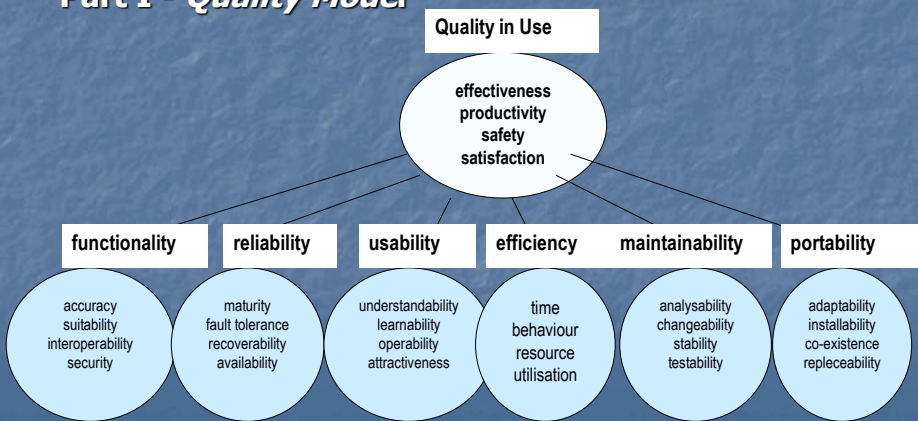
Usability is "*the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use*"

- *Usability of a software product* is one of the factors contributing to **quality in use**.

Why usability is our concern?

- **ISO/IEC-9126 (2001) standard on *Software Engineering — Product Quality***

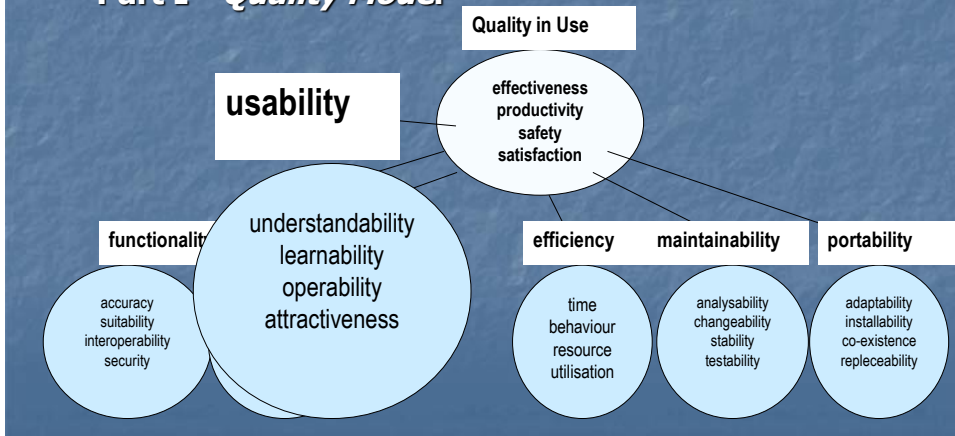
Part I - *Quality Model*



Why usability is our concern?

- **ISO/IEC-9126 (2001) standard on *Software Engineering — Product Quality***

Part I - *Quality Model*



Investigating usability issues

Learnability – ‘the ease with which new users can begin effective interaction and achieve maximal performance’ [Dix et al. 1998]

UReq 1 Little learning effort → *predictability* (choice of appropriate affordances)

UReq 3 Preservation of existing privacy and data access rules → *familiarity* and *consistency*

Investigating usability issues

Robustness – ‘the level of support provided by the system in the successful accomplishment and assessment of the user’s goals when using the system.’ [Dix et al. 1998]

UReq 2 Low costs for maintenance activities → *recoverability* (the principle ‘commensurate effort’)

UReq 4 Appropriate synchronization policy among users → *persistence*

Req 5 Versioning control → *task conformance*

What is the next step in our design process?

Usability principles and guidelines are a necessary background for our design choices but...

... a more concrete support may come from a pattern –based approach to design

Therefore our next step will be:

The adaptation of existing cooperative interaction design patterns to spreadsheet-mediated cooperation

Design patterns – from Architecture to HCI

Seminal work by Christopher Alexander's et al. in 1977

- patterns, defined as rules relating a recurrent, common problem in a given context to its solution
- a powerful tool offered to architects to tailor appropriate design solutions, exploiting a wealth of knowledge and experiences derived from traditional architecture
 - example: *Light on Two Sides of Every Room*

Since the middle 1990s, idea adopted in the domain of Software Engineering [Gamma95]

- patterns as a considerable body of knowledge capturing the best practices of system design
- patterns as reference knowledge in other phases of software lifecycle, e.g., software testing, project management and software architecture

Design patterns – from Architecture to HCI (cont.)

A few years later patterns reached the HCI community:

- the pattern approach as mostly appropriate to user interface and interactive system design [Tidwell97, Bayle98, Borchers2001]
- Several pattern languages have been introduced in the last decade, as *lingua franca* [Eriksson2000]:
 - interface designers are able to share their expertise with one another
 - an effective 'user-centered' design process can be carried out, thanks to a clear and formal documentation of the design choices
 - most HCI patterns conceived so as to allow non-expert developers to actuate usability principles even when they lack the due theoretical background

Design pattern in HCI

HCI Design Patterns capture the essence of a successful solution to a usability problem that often recurs in interactive systems. The common structure of a pattern is:

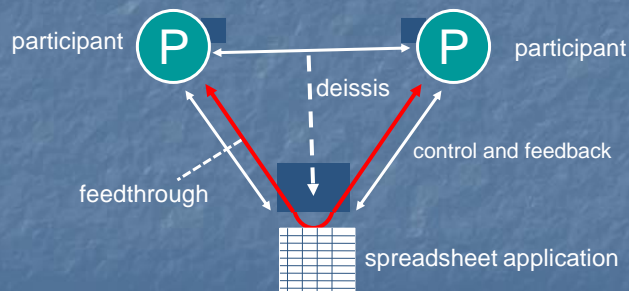
- *name*
- *ranking*
- *image*
- *context*
- *problem statement*
 - *forces*
- *examples*
- *solution*
- *sketch or diagram*
- *references to other patterns*

Interactive collaboration patterns for our case study

- a subset of 6 patterns introduced by Martin & Sommerville in 2004 exploited for the design of a web environment for spreadsheet-mediated collaboration :
 - Artifact as an audit trail
 - Public artifact
 - Multiple representations of information
 - Accounting for an unseen artifact
 - Working with interruptions
 - Collaboration in small groups

The model of interactive collaboration

- Our case study involves an artifact - mediated collaboration:



Artifact as an audit trail

Essence of the pattern: '... the artifact serves as a means of coordination between workers allowing them to locate who has done what work...'

Design implication A revision history of all the changes made in the spreadsheet, at cell level would be beneficial in this case

Public Artifact

Essence of the pattern: '... the use of a public artifact ... which serves as a shared object which provides a group of workers with some form of overall perspective on their activity.'

- ***Design implication*** - A common notice board should be designed allowing each participant to gain an overall view of the collaboration activities which are being performed on the spreadsheet.
- - This commonplace could also be a good design solution for the aforementioned revision history.

Multiple Representations of Information

Essence of the pattern: '... different views are utilised for different tasks such as visualising the here-and-now situation versus planning activities, or taking a global versus a local perspective of a problem...'

- ***Design implication*** – Flexible choice for the paradigm WYSIWIS (What You See Is What I See)
- - Revision history should be viewed only on demand.

Accounting for an Unseen Artifact

Essence of the pattern: '... the manner in which one actor can make available (or not) details of a local artifact ... and their interaction with it when involved in communicating with another actor...'

- ***Design implication*** – The interface should allow for *deictic* communication. Synchronized input pointers to the spreadsheet could be an appropriate solution for those situations where direct communication among participants is needed in reference to specific portions of the shared spreadsheet.

Working with Interruptions

Essence of the pattern: 'This pattern focuses on the nature of interruptions in the workplace. ... It is particularly concerned with looking at how groups of staff manage dealing with interruptions, how these interruptions are represented (or not) and their relationship to the on-going work they interrupt'

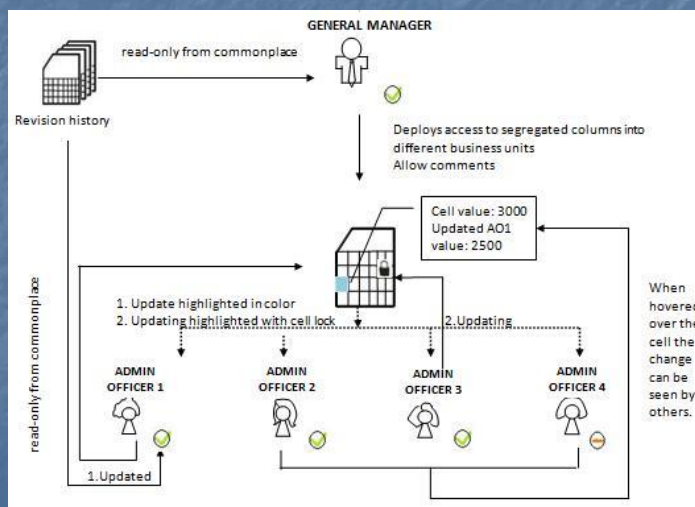
- ***Design implication*** – collaboration awareness also implies that when one participant is interrupted by external events, the environment should notify his temporary absence to other participants, as well as his return back to the activity.

Collaboration in small groups

Essence of the pattern: "... the manner in which small (collocated) groups carrying out various activities, collaborate to achieve them. It draws attention to the way in which collaboration is facilitated by artifact. '

- ***Design implication*** – Appropriate feedthrough should be provided, so that any participant is able to see the effect of others' actions on the interfaces.
- - flexible and fluid shift from individual workspace to shared workspace

A derived interaction scenario





Interface requirements

Grouped into 3 categories:

- *Collaboration environment awareness*
 - e.g. participants status visibility/setting, access control setting, synchronized/asynchronized views
- *Overall collaboration process analysis* and
 - e.g., revision history tool
- *Shared spreadsheet manipulation*
 - e.g., telepointers, multiple user conflict resolution, notification flags, cell color changes, spreadsheet restructuring.

Towards a low-fi prototype

- User requirements
 - +
 - Usability factors and Interactive collaboration patterns
- 
- A list of interface requirements
- 
- The design of initial mock-ups can start
 - The choice of the underline architecture will bias some interface design solution
 - Quick feedback from users and general stakeholders expected
 - Additional/refined requirements may results
 - New specific interaction patterns may be discovered.

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lunedì prossimo alle ore 14.00 nell'aula P6 si terrà un seminario sui FabLab tenuto da Amleto Picerno del MediterraneanFab Lab di Cava de' Tirreni. Vi pregherei di diffondere la notizia e incoraggiare la partecipazione dei vostri studenti/tesisti.

Andrea

SEMINARIO

La rivoluzione digitale e le nuove opportunità professionali
4/11/2013 ore 14.00-16.00 Aula P6