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CHAPTER 5

Interactive prototypes in teaching user-centred design and business process modelling

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1. Introduction

In managing information technology (IT) projects appropriate organizing cooperation with prospective users of the system is one of key success factors, no matter whether the object of design is software, equipment or service. For a student – as a prospective project manager – acquiring relevant practical skills only during the classes is difficult, because courses are often overloaded with theory, so actual work on design tasks takes only a fraction of teaching hours. Moreover, interaction with the instructor during design project is restricted to instructor-student relation, with instructor's role limited mostly to correcting student's errors, hence developing relationship similar to the one between a real customer and a real developer is rather unlikely to occur in university settings.

At the technical university at any engineering course there are usually several courses related to (a) development of new product and (b) project management. Product development -related courses mainly develop skills relevant to understanding market rules and principles of consumer behaviour. Project management –related coursed include managerial topics, human resources management, decision making,

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risk management and other issues aimed to balance the "magic triangle" of typical project management constraints: cost, time and quality (Lewis, 2005).

For efficient managing it projects in the future, a student should also acquire the skill or effective communicating with project stakeholders, primarily with the customers (or prospective users). In the class it is very difficult to create work settings similar to actual project environment, especially due to lack of actual customer. For this purpose some role-playing exercises may prove useful, especially those ones in which students have to use visual communication techniques to communicate their design concepts to a simulated customer. Interactive prototypes and other visual communication techniques can not only improve communication within the students' team, but may also serve for collaborative evaluation of early design concepts.

2. Related research

Prototyping is a testing and evaluation technique being a crucial component of **User-Centred Design (UCD)** methodology, widely used in IT projects since the 1990s (Sharp 2005). Involving users in evaluation prototypes is also an important part of all iterative approaches for IT projects management, and Agile methodologies (Schwaber 2004) in particular. Originating from User-Centred Design, prototyping has also become a popular method for user-based validating design concepts in service design and development (Stickdorn and Schneider 2010).

In actual IT projects prototyping offers following benefits:

- identification and preliminary validation of user requirements already in early stages of the project;
- improves customer/user' attitude by showing that "something is already running", what develops user's "sense of ownership" for approved solutions;
- when prototyping is frequent, the greater frequency of contact with the customer, usually the less usability flaws and corrections needed at the end of work.

Prototyping is generally considered as an excellent tool for facilitating communication between the designers and other stakeholders (Dix et al. 2004, Snyder 2003).

USER INTERFACE PROTOTYPING is one of visualization techniques often used in author's classes. Prototyping not only helps to visualize design concepts in an interactive way, but also teaches students how to present the concept to instructors and to classmates.

Among various visualization techniques useful for developing communication skills related to project management, following ones should be noted:

1. **Hand drawing design** techniques – useful for expressing design concepts, like:
   - formal diagrams and notations, like UML - Unified Modelling Language or BPMN - Business Process Modelling Notation (Schedbauer 2010), with their

formalized symbols, useful for depicting transformations and relationships which occur during system operation located in a specific business context;

- informal drawing techniques:
  - *Rich Picture*, a freehand drawing technique originating from SSM - Soft Systems Methodology (Checkland 1990), aimed on depicting a bird-view of the system and its multiple relationships with other actors in business environment; helpful in understanding the business context of the system operation and the roles of various stakeholders affected by the system;
  - *Mind Mapping*, a freehand drawing technique aimed to boost individual creativity by stimulating the right hemisphere of the brain, very popular and often used in both education and creative meetings (Buzan 2005).

2. PowerPoint presentations – commonly used (and overused), and even called infamous and trivial standard for office communication (Tufte 2006); on the other hand, with growing popularity of electronic documents and devices with screens in landscape mode, PowerPoint has gained growing popularity over textual documents for visualizing ideas or even preparing concise analytical reports, especially if they are going to be distributed via networks, displayed and discusses without hardcopy printing.

3. Prototyping – aimed at presenting how the design outcome will look like and to facilitate communication within the team and with external partners (customers, executives):

- low-fidelity (paper) prototypes, aimed to communicate general concept of the prospective system;
  - *storyboards* show in a hand-drown cartoon-like style the general sequence of screens when the user follows a network of specific operations (Snyder 2003);
  - *paper prototypes* may present the general layout of screen elements; they are usually "flat" two-dimensional prototypes laid on the surface of the table and can be used for optimizing their location and gathering first evaluations from prospective users or customers (Snyder 2003);
  - *service prototypes* are 3-dimesional prototypes made of paper and other stationery materials for visualizing how the designed service will work, who will be involved and what sort of User Experience will be created at subsequent stages of the service (Stickdorn and Schneider 2010);
  - interactive prototypes, prepared with a specific software prototyping tool, which lets simulate operating an actual system on a computer screen; such prototypes may be easily used for usability testing and for gathering requirements from prospective users (Warfel 2009).

All abovementioned techniques are useful for developing students' communication skills for prospective IT projects management. Nevertheless, practical competences have to be gained not by listening to lectures but by performing design tasks in a group.

This chapter describes experiences gathered during IT-related courses, where students - prospective software developers and project managers – build an interactive prototype of a touch-screen kiosk and learn how to recognize requirements of end us-

ers. The remaining part of this chapter will be focused on prototyping, extensively used by the author in several courses like "IT Project Management", "Human-Computer Interaction" and "Interactive Services Design".

3. Method description

The courses discussed here are a balance of theory and practice. In the final assignment in the HCI course each student has to design and present an interactive prototype of a specific system.

This teaching method has been designed with aim at achieving following **learning outcomes**:

- achieving higher involvement of students in work on their assignments,
- simulating a self-managed, small-scale project of a simple interactive system,
- developing a working, interactive prototype to be tested at the end of each semester,
- offering the students opportunity for developing communicating and collaborating skills; project work requires a lot of communicating, including also convincing, discussing, defending own ideas, developing constructive critique – all of them will be useful in students' future career, no matter if in engineering or in business management area.

Learning outcomes nay vary among specific courses, but all they have some common elements:

- course structure: 15 weeks, 15-30 lecture hours, 15-30 hours of labs/project in groups of 10-16 students;
- main learning objective: to teach students UCD approach in a role-played simulated project of an interactive system;
- lectures and assignments guide students through subsequent steps of a User-Centred Design project, based on the author's textbook in Polish (Sikorski 2010) or in English (Sikorski 2011).

The typical design task in the undergraduate level course is to design **a touch-screen kiosk** for tourist information or a similar relatively simple device.

The assignment handed in to students covers a brief 1-page description of typical tasks to be performed with the system and requirements for the interactive prototype to be demonstrated at the end of the course. The assignments are distributed in the 4-5th week of the course, so the students have remaining 9-10 weeks to complete a sequence of following **milestone tasks** for their project:

A. Performing context of use analysis
B. Preparing requirements specification document
C. Performing conceptual design
D. Building a paper prototype of the user interface

E. Building an interactive prototype and perfuming its usability test with potential users.

This assignment is a **role-playing project** because:

- students work in teams of 2-3, where one of the students is the project team leader;
- the instructor plays the role of a customer, who places the order for developing the interactive kiosk and demands its high usability and ease of use;
- during usability testing one of randomly selected students play the role of the user seeking information in the kiosk (developed by another group.

All prototypes are tested in the last week of the semester, and all the students take part in this group exercise, observing the tests and expressing comments and opinions about each of the presented prototypes. In the meantime, during the semester the students have to deliver the outcomes of their milestone tasks, and the outcome of each task is a starting point for the next task.

4. Design cycle and deliverables

As aforementioned, the assignment is a role-playing task: an instructor is a "customer" who places an order for an interactive system; a working prototype to be presented by a "developer" (student) at a given deadline, giving the customer the impression look-and-feel of a real system to be developed.

The **design cycle** in this course (Sikorski 2010) consists of following steps, with key deliverables marked *:

1. Accepting the assignment.
2. Information search, context of use.
3. Requirements specification document.
4. Visual metaphor of the system.*
5. Paper prototype.*
6. Interactive prototype.*
7. Usability test of the prototype.
8. Comments and improvements.

In the meantime, within the span of several weeks, a lot of communication will take place (within the team and between the team and the "customer"), with preference on discussing **deliverables** listed below:

- Visual metaphors and wireframes: design concept of the infokiosk has to be presented first as a graphical metaphor (several PowerPoint slides), giving the impression of a general look of subsequent screens. It gives also a cue about expected user interface consistency, interaction style and student's vision of the project.
- Storyboards: hand sketches of subsequent screens aimed to visualize "customer journey" through the prospective interactive system. It is actually seldom used

now, as students often tend to skip this stage, because storyboard is not a compulsory deliverable in this scheme.

- Paper prototypes: interactive paper prototype of the user interface has to be prepared and presented during the class hours. A small-scale usability test is performed, using tasks from the original assignment, and other students act as testers. The paper prototype is a first interactive visualization of prospective system, and resulting list of collected necessary improvements is usually long enough.
- Interactive on-screen prototypes: about two weeks after presentation of a paper prototype students are due to present an interactive on-screen prototype for final usability testing in a classroom. A 19-inch touch screen connected to laptop is used and as an input/output device, and three tasks randomly selected from the requirement specification document have to be successfully performed by a user - a randomly selected student from the group. Often enough, despite the prototype seemed to be sufficiently tested by now, surprising events in tasks execution frequently occur at this finals stage, sometimes making the "developer" very confused. Such an experience shown the need to make system yet more tolerant to human errors and to variability of human behaviour.

It is worth to mention that variety of delivered prototypes is very broad, because the students are given only a list of available prototyping tools, with no specific recommendations, which one is preferred or most effective. The choice of the tool is not affected by the instructor at all.

5. Outcomes and experiences

This assignment of developing interactive prototypes has been used in author's courses for about ten years, with about three courses running each year. Although the description of the system to be designed has changed several times in the meantime, this timespan allowed gathering some interesting experiences about the usefulness of this method, both advantages as well as some limitations.

Advantages:

- the assignment defines clear sequence of steps, milestones and deliverables, similarly like in a real project; it also invokes similar communication problems like in real settings;
- problem solving is easier when student is able to show visual evidence of the concept, idea or user interface element, so the use of styleguides, visual aids and standard widgets is promoted;
- prototyping offers ability to design and test dynamic behaviour of the system; even small-scale testing of paper prototypes give helpful design hints;
- preparing the on-screen interactive prototype for final usability test is also a motivating stage, because the students know the final acceptance will be based

on successful task completion (in fact, there are also additional evaluation criteria: functionality, ease of use and aesthetics).

Limitations:

- some students produce visual metaphors which are simply ugly but they think it is all OK as a "technical concept"; explaining them again what the role of metaphor actually is, and how its quality affects customer's attitude brings a delay;
- students have general problem of keeping the whole design consistent as to the look (screen layout) and feel (system behaviour);
- code bugs and other technical failures very often send the usability issues to the background; it happens usually if a student decides to work directly with the code, optimistically thinking s/he is a good programmer (but often is not);
- if a dedicated prototyping tool was used, produced code and graphics are not reusable, what makes the students much frustrated if they want to go further with their project;
- in exercise teamwork failed completely; formerly the students worked in pairs but it resulted that the design often enough was made almost entirely by one person; this is still an important and unsolved issue in this course, because the main objective of all group projects was enabling students to work in teams, as it goes in real projects;
- only few students are able to keep the original deadline; usually few days before mays students inform they will not be ready on time; although it is a frequent situation in many IT projects, the instructors keep the deadline hard (and then there is a small bonus for bringing deliverables on time).

As seen from the above list, there is a mix of positive and negative effects. Anyway, each time in end-of-the term course assessment this prototyping project is highly evaluated by the students as a very practical and useful design experience.

From the instructor's viewpoint prototyping is also very valuable: as in a real project, requirements change; also as a consumer one has to make important decisions and some negotiation of project scope and conditions will always take place. In interactive product design without visualization as the way to present the evidences what has been made, facilitating communication between the designer and the customer would be difficult and much more error-prone. Visual communication upon discussing subsequent versions of the prototype motivates the student to go on, and helps to keep track on the progress of design work.

In addition to the above, it worth to mention that presenting visual evidences of student's designs has also a positive impact on other classmates in the group (usually 10-15 students); they can see a variety of design concepts and discuss pros and cons of proposed solutions.

Fig. 1. shows examples of interactive prototypes made by the students in the author's course.

Fig 1. Interactive prototypes of a touchscreen information kiosk on cultural events. Sources: R. Swierczynski, I. Heimowska

6. Interactive business process prototyping

Interactive prototypes can be used not only for testing user interfaces or interactive services, but also for visualizing interactions taking place within specific business processes.

Business processes such as data flows, document workflows so far have been widely modelled with BPMN or other diagramming techniques. Teamwork in this area has been supported for instance by interactive whiteboards, helpful in concept mapping, however their functionality in mostly restricted to collaborative drawing of process diagrams.

Far more advanced solution is an interactive touch screen table, produced by a German company Metasonic, which supports S-BPM (Subject-Oriented Business Process Modeling) methodology (Fleischmann 2012). The interactive table, known as Metasonic Touch®, enables interactive prototyping of business processes and it supports teamwork in business process modelling and visualization (Fig. 2). For companies re-designing their business processes interactive prototyping stimulates team discussion, increases group dynamics, as well as it results in better understanding among team members by sharing acquired knowledge about the specific business process.

The Metasonic Touch table enables visual prototyping of the business process and it can be used to simulate the process supported by specific interactive system. As an educational tool, it can be also potentially especially useful for students of IT and management, aimed at spurring process-oriented thinking, while the interactive prototypes of the user interfaces stimulate user-centred thinking for project management.

As the website of metasonic.de says, "with Metasonic Touch, processes can be modelled graphically on a large table surface, from the perspective of the respective parties involved, easily using building blocks. Once the involved subjects – persons, computers or machinery – are defined, their behaviour is defined through these blocks. A keyboard is used to name the subjects and work steps. The modelling units have

codes on their undersides, which the integrated camera recognizes automatically. When two blocks are pushed together, a link is created between them and projected onto the table surface. Once everything has been modelled on the table, the individual work steps of the respective subjects are imported into the Metasonic Suite and compiled to form a process".

The potential of this touch screen-based method was a subject of a testing experiment performed during a seminar of the project Intranettime, aimed (among other research objectives) at exploring IT-based techniques supporting knowledge management and teamwork for developing intellectual of service organizations. The Metasonic Touch table was used as an experimental workbench for demonstration and testing new abilities for teamwork-based business process modelling and analysis (Fig. 2.). The session was attended by about 15 participants from business organizations and 5 PhD students from the university, plus seminar tutors and organizers.

Fig. 2. The Metasonic Touch TABLE used for interactive business process prototyping Sources: metasonic.de, J. Pniewska

The plan of the **experimental session** with Intranettime project participants was as following:

1. Introduction:
   - tutorial on the S-BPM methodology, within which Metasonic Touch table is operating;
   - participants were given a description of simple decision process taking part in a specific service institution.

2. Individual work:
   - participants were requested to (individually) map the decision process as a flowchart, identify actors involved and the logics of the decision process;
   - to identify values transferred among actors of the decision process, forms of this transfer and values (outcomes) received by process participants.
3. Teamwork:
   - basing on an individual understanding of the process, with the Metasonic Touch table the group started building an interactive prototype of the process using Metasonic Touch table;

- the Metasonic Touch table was operated by a Metasonic representative while the teamwork was moderated by the tutorial instructor;
- instruction how to connect the elements of the process came from the participants, who asked questions, discussed inconsistencies in their descriptions, and shared individual understanding about the process, coming to common consensual understanding how the process actually is performed.

4. Recap and discussion.

After performing experiment of interactive prototyping of a business process, following preliminary assessments could be gathered. In the opinion of seminar participants, interactive business process prototyping with Metasonic Touch table showed following **advantages**:

- increased group dynamics comparing to traditional methods of work based on use of flipchart or whiteboard, and provided more enjoyment;
- good visual overlook of the process, supported by zooming factions and adequate use of colours, allowed for explaining individual gaps in understanding the process;
- launched collaborative discussions on the diverse factors affecting the process and its outcomes.

There were some **limitations** observed, too:

- size of the touch screen about 1x1m makes the device suitable rather for small-scale flowcharts or it becomes necessary to divide a big one into subprocesses;
- there are limited opportunities for simulating the process and experimenting with suggested changes;
- effective teamwork for interactive prototyping needs a skilled moderator, who would be:
  - encouraging humbler participants to express/present their ideas,
  - negotiating individual views of the process,
  - able to combine at the same time: operating the device, maintaining the logics of the process and running conversations at the same time may be a challenge;
- the device itself attracts much of participants' attention, diverting them from the problem focus;
- smooth interaction is necessary to provide high usability of the device, in particular no time delays, easy zoom control, easy switching views of the process;
- process map validation and detection of potential errors nevertheless may be easier using a process map printed/plotted on a bigger sheet of paper.

As a result, participants of the interactive business process prototyping sessions found the experiment quite interesting, delivering positive experience especially in areas such as:

- collaborative learning, knowledge transfer among participants, converting tacit knowledge into explicit knowledge, sharing knowledge and deeper understanding the process;

- invigorating group processes and local resources, creating fun during teamwork, as well as it was an inspiring exercise both mentally and physically (to some degree).

Interactive prototyping with Metasonic Touch seems to be potentially useful for collaborative business process modelling in consulting and analytical projects. Moreover its potential may be appreciated rather by business practitioners who can see and understand a specific business process in its context; it seems premature for students who usually have no industrial/business experience and they will be predominantly attracted by high interactivity of the device and its pleasing User Experience. Interactive business models prototyping with the Metasonic Touch table offers promising opportunities, but needs a large-scale validation experiments be performed in order to assess its efficiency compared to other methods. Metasonic Touch is a commercial product, with option for an academic license, but within timespan of the Intranettime project it was not possible to assess its suitability of the Metasonic Touch table for university teaching.

7. Conclusions

Two types of interactive prototyping have been discussed in this chapter:

1. **Interactive prototyping of user interfaces**: performed in small groups, aimed at visualization of design concept and using an interactive prototype to perform usability testing of a specific system. It is useful both for students' design skill development and for facilitating communication during the simulated project. Interactive prototypes in student projects support problem-focused communication and discussion. Finally, interactive prototypes create important visual link to the emerging design artefact, making realization of students' projects more enjoyable, more effective and thus more remembered.
2. **Interactive business process prototyping**: a small-scale experiment with Metasonic Touch table gathered observations and opinions from participants of teamwork, revealing advantages and disadvantages of this interactive modelling methodology. Interactive prototyping with Metasonic Touch was found more suitable for supporting analytical and modelling work of professional business analytics and potentially less useful as an educational tool for university students who usually lack sufficient knowledge of business and local organizational context.

Nevertheless, both types of interactive prototyping may be complementary for all types of projects aimed at developing high-quality interactive systems and business processes supported by these systems in specific organizations.

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Summary

This chapter describes experiences gathered during the use of interactive prototyping in two areas: design of user interfaces for a touch screen information kiosk and interactive prototyping of business processes. Prototyping is promoted here as a technique useful for both visualizing design concepts and for stimulating communication within relevant teams.

Developing interactive prototypes of use interfaces is discussed here as a technique with several major benefits: it useful for visualizing design concepts, for usability testing and also for identifying necessary improvements of a specific system. It offers students' an excellent opportunity to observe their own design "in action", what gives instant feedback on user-perceived quality of the system, but first of all it stimulates customer-centred thinking being an essential skill of a prospective IT project manager.

Interactive prototyping of business processes was evaluated in a small-scale experiment with the use of a Metasonic Touch table, which allows for the teamwork in analysis and modelling. Outcomes of this experiment were twofold: advantages point out collaborative learning, knowledge transfer among participants, converting tacit knowledge into explicit knowledge, sharing knowledge and deeper understanding the process. In turn, disadvantages show that the touch screen device itself draws too much attention from novice users, thus being suitable rather for experienced business analysts than as educational tool for university students.

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