On the Use of XP in the Development of Safety-Oriented Hypermedia Systems

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1 INTRODUCTION

Hypermedia development raises many challenges that cannot be solved with classic software development methodologies and processes. The hypertext relationships included in any hypermedia document introduce some new dimensions in the development process (e.g. the navigational structure of the hyperdocument) and the need for models that are not included in a general-purpose methodology [7]. To overcome this, in the last years a number of hypermedia development methodologies have been proposed (e.g. [2, 4, 8]), many of which have had a reasonable success as they address very well the problem of

web-based application development. A detailed survey of hypermedia development methods can be found in [6].

Formal methodologies (term used in the hypermedia community) are well suited for domains where the stability of the different models is rather high. But they do not fit so well into other classes of application domains. In this paper

we report our experience in applying some of the XP practices during the development of a complex hypermedia application targeted to improve safety in public transportation.

2 THE NEED FOR FLEXIBLE PROCESSES IN THE DEVELOPMENT OF SAFETY-ORIENTEDHYPERMEDIA SYSTEMS

As mass protection is becoming more and more important, especially after the terrible attacks of the 11-S, it is likely that systems targeted to improve safety will be conceived and developed in the near future. We call them *Safety-Oriented Systems* or SOSs for short.

Our project addressed the development of a SOS including all the procedures for emergency handling in the underground metropolitan transportation system of Valencia. Special emphasis was placed on providing as much information as possible for reducing the response time before an emergency. To create the Hypermedia Emergency Plan (HEP), an analysis of the current situation was performed, and the improvements planned were enumerated by the *Metro Valencia's* Safety Office (MVSO) Director. We soon realized that formal methodologies would be only of partial help in the HEP development due to several reasons:

1. The project was considered "of high risk" by MVSO, since a correct operation of the HEP was mandatory. Such a critical application required extensive testing during the development process was required.
2. The HEP should be an enriched version of an existing document: almost every piece of information to be included was already defined in a text-based Emergency Plan (EP); therefore, the improvements came from the addition of multimedia information, rather than from a redesign of its philosophy leading to structural changes. Actually, the multimedia elements to be added replaced or extended the graphical components of the EP. Hence, a strict domain analysis was not required as the information to be included in the HEP was mostly contained in the textual EP.
3. A high number of special cases were detected, corresponding to specific installations in parts of tunnels, stations, etc. that required a special view in the HEP (e.g. emergency exits located between stations). This would eventually led to changes in the HEP design

long after the preliminary design (the abstract design in the OOHDM terminology [8]) was made.

4. To ensure the consistency of the information contained in the HEP, the involvement of the MVSO staff in the development was also a must. This led to a development at the MVSO site and the approval by the MVSO Director of almost every decision taken during the design and implementation processes.

Consequently, only a conceptual design (consisting of an object-oriented model of the entities described in the textual EP) and a basic navigation model for the HEP were initially elaborated. During the development, however, we actually followed a much more flexible approach. We applied several rules of XP, specifically these related to the incremental development by small additions of information that were immediately tested to check consistency. The development environment was Macromedia Director [3]. Team programming was enforced with the participation of domain experts at almost every stage of the development. A significant amount of time was spent on the synchronization of the different multimedia elements and the corresponding tests.

3 THE ROLE OF XP IN SAFETY-ORIENTEDHYPERMEDIA DEVELOPMENT

So far, we have shown how some of the XP rules and practices were used during the development of the HEP. In the remainder of this section, we discuss in depth this issue taking as basis the Core XP practices enumerated in [5]. We only include those practices for which hypermedia introduces some specificity. The non-included practices should be understood as usual.

Whole Team. This is orthogonal to the type of application being developed, but in the case of hypermedia SOS there are two roles to be included in the team. On the one hand, experts in multimedia design must create user interfaces that are intuitive (that is, easy to use), precise and consistent (avoiding context-dependent behaviour of the interface objects). On the other hand, safety experts have to supervise all the development process; in general, they will be representatives of the Customer.

Planning Game. For SOSs, deadlines are less important than accuracy, so planning is not one of the key requirements. However, relaxed release and iteration planning can help to drive an ordered development process.

Customer Tests. Undoubtedly this is one of the distinguishing XP practices. Testing is crucial for having a reliable SOS. There are two different aspects of the application that must be checked for correctness: the behaviour of the interface objects (that can be tested in an automated manner) and the navigational structure (for which manual tests are recommended).

Simple Design. For hypermedia applications, a simple design may not be enough. To ensure consistency of the presentation and the navigational structure, some preliminary design work should be performed. At its end, an abstract representation of the user interface, as well as a navigational model should be available. Both models are usual in formal methodologies. The integration of a new piece of the application should be made compliant with both the interface and navigational requirements.

Pair Programming. The composition of the pairs may be heterogeneous, putting together a programmer and a domain expert. Even three members would be fine, adding the expert to a classical XP pair. This ensures not only the review of the code by another programmer, but also by the safety expert, resulting in better consistency from the end-user point of view.

Collective Code Ownership. The dual nature of hypermedia documents (content + navigation) can make collective ownership a problem rather than a solution. We do not have a final position on this point, but separate ownerships for content and navigation could be a good strategy to keep the project sound.

Coding Standard. Sometimes the coding standards in the case of hypermedia are constrained by the development environment. Despite of this, we agree about the convenience of this practice.

4 CONCLUSIONS AND FURTHER WORK

In this paper, we have described our experience in the development of a large hypermedia project. The *Metro*

Valencia's Hypermedia Emergency Plan was conceived as a tool to improve response time before an emergency by showing in a single screen all the information needed to make a decision. From the development point of view, its critical nature forced us to follow a continuous improvement process, where changes on the fly and exhaustive testing were an absolute need. This led us to evolve from an intended top-down approach, supported by a formal development method, to a direct design at the instance level with feedback loops and generalization (when applicable).

Our experience in this project motivated us to propose the use of XP practices in the development of safety-oriented hypermedia systems. We have discussed to which extent the XP practices could be refined when dealing with this kind of systems. A motivating issue for future work is scalability: even in a case of a moderate-size transportation network, the HEP has become a large application; how to handle a similar development for a big city's network following the same principles is a challenging point.

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REFERENCES

1. K. Beck, Extreme Programming Explained: Embrace Change. Addison-Wesley, 1999.

2. F. Garzotto, L. Mainetti and P. Paolini. "Hypermedia design, analysis, and evaluation issues". *Communications of the ACM 38(8)*, August 1995.

3. http://www.macromedia.com/software/director/

4. T. Isakowitz, E. A. Stohr and P. Balasubramanian. "RMM: a methodology for structured hypermedia design". *Communications of the ACM 38(8)*, August 1995.

5. R. Jeffries, "What is Extreme Programming?". XP Magazine, Nov. 2001. On-line at http://www.xprogramming.com/xpmag/whatisXP.htm

6. Koch, N. A Comparative Study of Methods for Hypermedia Development. *Technical Report, Ludwig-Maximilians-Universität München,* November 1999.

7. J. Nanard and M. Nanard. "Hypertext design environments and the hypertext design process". *Communications of the ACM 38(8)*, August 1995.

8. D. Schwabe, G. Rossi and S. Barbosa."Systematic Hypermedia Application Design with OOHDM". *Proceedings of the ACM International Conference on Hypertext (Hypertext'96)*, Washington, March, 1996.