

# An Iterative and Participatory HCI Design Process in the Industry Context: Bringing together Utility, Usability and Innovation ...within Budget

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Industry (Aerospace, Telecom, Defence, Automotive, Consumer, etc.) has developed a growing interest in Human-Computer Interaction, as powerful and numerous features do not ensure a successful product without a clear usage understanding by their target users (the “feature creep” syndrome). As the most visible part of the product, the user interface plays a central role in user’s adoption, leading (or not) to a strong competitive advantage. The “bad user interface – bad product” connection is rapidly inferred and the consequences for the company can be dramatic. Since the the Graffiti alphabet on Palm Pilot and the iPod wheel device, the industry also considers user interface and user interaction as a competitive differentiator. Innovation in HCI has therefore become a strategic initiative for many players in the industry.

Hence, the challenge of Human-Computer Interaction design in the industry context is to bring together utility, usability and innovation, while staying on budget and within project deadlines. IntuiLab has tailored and formalised an iterative and participatory HCI design process and developed related technologies to answer these industry needs. In this article, we first present the stakes of HCI design and development in the industry context. We will then detail IntuiLab’s iterative and participatory process and, finally, summarize its benefits.

## HCI design and development in the industry

Design and development of interfaces and interactions requires a great variety of expertise and skills: users, domain experts, human-factors experts, interaction designers, developers, graphic (or sound or haptic) designers. Bringing all the skills together in the common objective of designing useful, usable and innovative interactive software requires methods. Participatory design is one of the key processes that make it possible to benefit from the creativity and the experience of each of the players. The final user is involved in the whole design process for validating the needs addressed and evaluating the designed solutions. Iterative design makes it possible to refine the proposed solutions or to address new design issues during the process.

IntuiLab has successfully applied iterative and participatory design process in more than 40 user interface industry design projects as well as research projects during the last five years. The four types of need addressed are the redesign of applications interfaces (Figure 1a), the digitalization of business processes (Figure 1b), the translation of ideas into intuitive products or services (Figure 1c) and the anticipation of future interaction modes (Figure 1d).

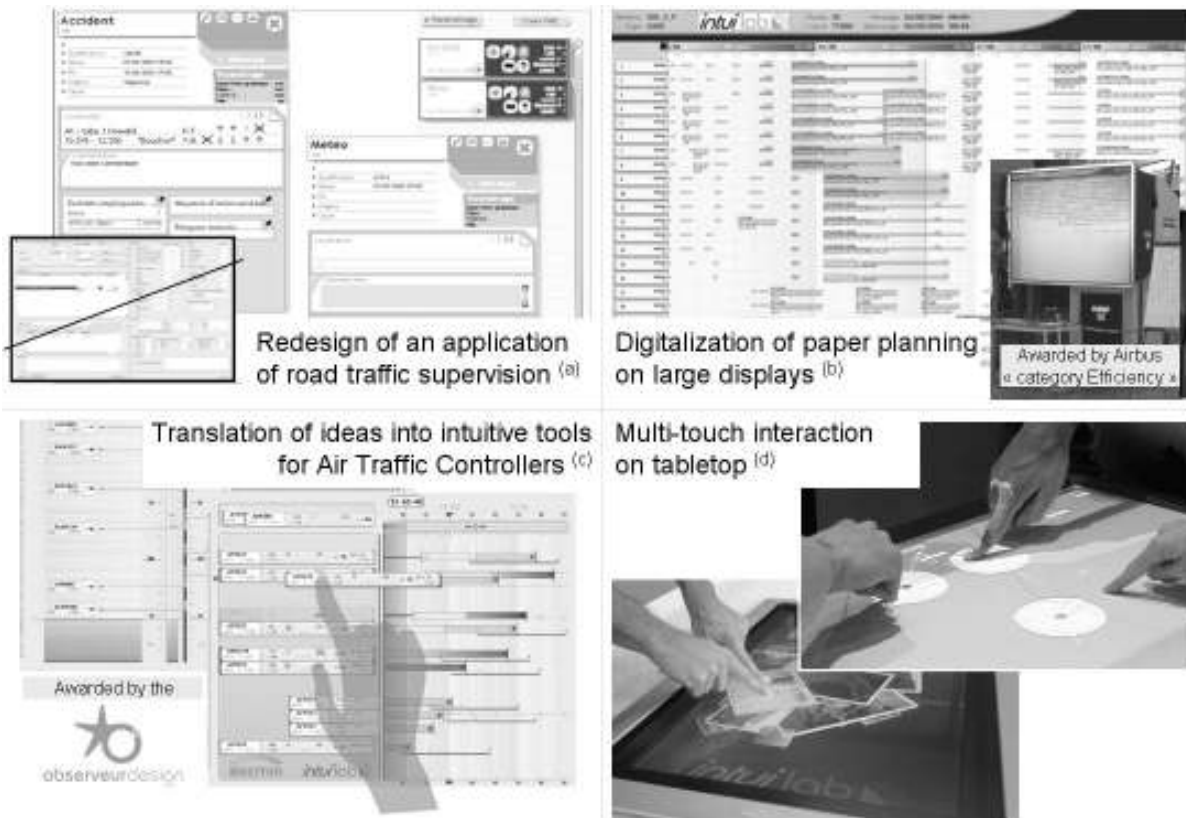


Figure 1: Examples of IntuiLab’s realisations

While successfully applied in the academic context, iterative and participatory design process is not widely used in the industry. Our five-year long experience provides us with some understanding and lessons learned about the difficulty of introducing such process in the industry context:

- *The prominence of other processes such as the “V” cycle.* The main perceived issues with the iterative and participatory process are the project duration (when does the process stop?) and the management of the participation of final users with the other project actors (how to manage conflicting needs or aspirations?). The industry has to be convinced of the real benefits provided by an iterative and participatory design process that is perceived as incompatible with predictability.
- *The business relationships within the industry are contract-based,* most generally relying on deliverables detailed and scheduled at contract time: solutions have to be produced within the project deadlines while staying on budget. As the design issues are concretely addressed in iterative and participatory process, new problems often come to light. They have to be managed within the same constraints, which require project management skills from both, the designer and the customer.
- *Time allocated to HCI design is still very small* (compared to other parts of the application). Iterative and participatory design requires time. As a consequence, all design issues cannot be addressed with the final users and all project actors; strategic choices have to be made, guided by expert recommendations.
- *Managing different lifecycle for HCI and the other components of the application is difficult.* Today, the same design processes are used in the industry for the HCI and for the rest of the application. Introducing a different design processes for HCI requires a close collaboration between the HCI design and application development teams as well as a good (and continuous) integration of the delivery from both teams.
- *Access to the end user.* It is often difficult to have access to real or future users of the HCI to be designed. For example some of our customer have no access to their own customer’ users

In order to provide the industry players with answers to their main concerns about such iterative and participatory process, IntuiLab has tailored and formalised an HCI design and development process named IntuiSign™ whose objectives are to bring to the end user such benefits as optimum efficiency, safety, accessibility and enjoyment in the use of the future product, while providing predictability (both in term of cost and results) to the industry. IntuiSign enables these by establishing a close-loop process between the designers, the customer and its users to always “stay in sync”, and thus avoiding the classical “tunnel” effect found in many other development processes.

## IntuiSign: IntuiLab’s iterative and participatory process

IntuiSign is composed of three main phases:

1. User requirements and interaction technologies collection and analysis
2. Iterative design and prototyping
3. Development

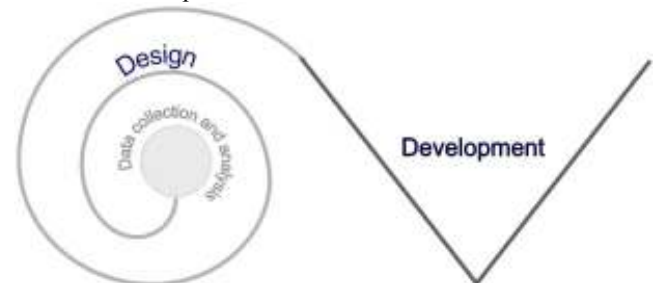


Figure 2: IntuiSign

IntuiSign brings together user requirements and technological possibilities to translate them into mock-ups and prototypes that are iteratively evaluated and refined. It then leads to validated detailed specifications of the user interface and interactions that will further be developed for the final application using a more classical approach. From user requirements to validated specifications, IntuiLab’s multi-disciplinary team (human-factors experts, interaction designers, graphic (or sound or haptic) designers, software developers, researchers, all specialised in Human-Computer Interaction) works in close collaboration with the final users of the application, as well as with the customer (engineering and marketing).

### User requirements and interaction technologies collection and analysis

The collection and analysis phase consists in gathering information to feed the design process. The objectives are to identify the user requirements and the technologies that are relevant to the project.

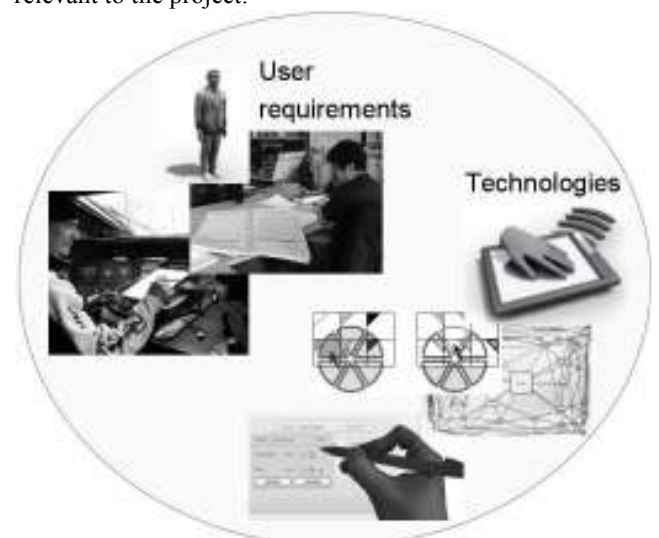


Figure 3: User requirements and interaction technologies collection and analysis

#### 4. Mock-up/Prototype evaluation and test

##### *User requirements*

IntuiLab's human-factors experts perform user requirements identification, interview the final users as well as the subject matter experts, perform in-situ observations, and analyse and evaluate existing systems in order to understand the user's activity in his/her working environment. Information collected enables the description of the user's activity and the gathering of the main requirements and constraints for the new application. Usage scenarios also result from this phase. Scenarios validated by the user and by the customer are essential to the design phase: they help all the actors to share the usage context and help them to focus on the relevant situations.

The analysis ends up with a decision step. As described in the previous section, in the industry context the time and cost constraints are important. The design must therefore focus on the most critical issues. IntuiLab's interaction designers perform an expert review of the user requirements in order to identify high-level design issues to be addressed in the project (i.e. how to display a 30-days planning? How to enable efficient text input without keyboard?). In regard with the project objectives and requirements, they prioritise the issues. The human-factors experts and the interaction designers present, justify and discuss the user requirements and the design priorities with the customer. Concerted decisions are taken for the design phase.

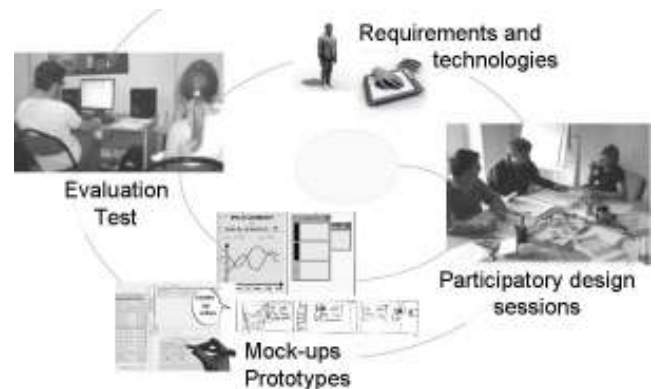
##### *Interaction technologies*

One of the challenges of HCI design in the industry context is innovation. In parallel with user requirements analysis, IntuiLab's interaction designers and researchers perform a state of the art of interaction technologies best suited for the project: hardware (large display, touch screen, tabletop, etc.), visualisation (fish-eye, perspective wall, transparency, etc.), interaction techniques (multi-user interaction, multimodal interaction, etc.). The technologies are illustrated with scientific/press articles, screenshots, videos or demonstrations. The state of the art provides the identification of the last technological advances and the illustrations are used to share them with all the project's participants.

#### **Iterative Design and Prototyping**

The challenge of the design and prototyping phase for the industry is to *find and implement innovative ideas that meet (even exceed) user expectations and which are technically achievable within the time and resource budgets of the project*. The objective of this phase is to provide the developers of the final user interface and interactions with detailed specifications. The iterative and participatory process enables to generate, illustrate, test and refine design solutions to be described in this detailed specifications. This phase of IntuiSign is a sequence of iterations, managed by an IntuiLab lead interaction designer. Each iteration is composed of four steps:

1. Requirements and technologies
2. Participatory design session
3. Mock-up/Prototype implementation



**Figure 4: Iterative and participatory design**

##### *Requirements and technologies*

For the first iteration, requirements and technologies result from the collection and analysis phase described in previous sections. For further iterations, new requirements can be derived from the evaluations and tests step of the previous iteration. Human-factors experts then analyse and refine the new resulting requirements while interaction designers and researchers refine the selection of candidate technologies.

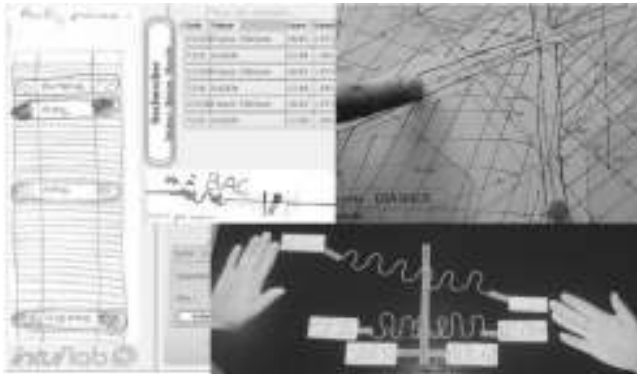
##### *Participatory design sessions*

To address prior design issues selected to be solved during user requirements analysis, IntuiLab's lead interaction designer set-up participatory design sessions. Participants are the final users, the customer, the application developers and the experts in the HCI field (human-factors experts, interaction designers, graphic designers, software developers, researchers). The various viewpoints and experiences of these players stimulate creativity and efficiently provide innovative solutions.

In the industry, such sessions are difficult to organise: it is difficult to find a time slot that meets all participants' agenda and the number of iterations is limited due to the time constraints of the project. In that context, IntuiSign proposes two strategies. Within the prior design issues, IntuiLab's lead interaction designer identifies 1) issues that already have proven solutions, and 2) issues specific to the activity area that require creativity and innovation. Then he/she adapts the participants repartition in the sessions: for the first issues, participants are limited to IntuiLab's HCI experts; for other issues, HCI experts gather with the final users, the customer and the application developers.

For participatory design session, the lead interaction designer gathers the technology illustrations to stimulate creativity, the usage scenarios to meet user requirements and the mock-ups/prototypes to be completed or refined. After the presentation of the session's topic, the usage context, the available technologies and the results of previous iterations, he/she ignites a brainstorming between all participants with the objective of generating as many ideas as possible. At the end of the brainstorming, the best ideas are collectively selected. The session ends with concrete illustration of these

ideas using paper mock-ups, created from scratch or from mock-ups or screenshots of prototypes resulting from previous iterations.



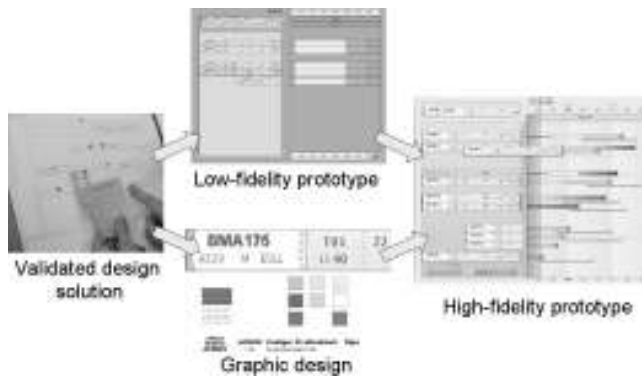
**Figure 5: Examples of paper mock-ups generated during participatory design sessions**

#### *Mock-up/Prototype implementation*

The design proposals arising from the participatory design sessions are analysed and implemented by interaction designers, graphic designers and HCI developers as mock-ups or as prototypes, depending on the design iteration.

Mock-ups are used during the early stage of a design issue exploration and can be produced in a very short time frame (sometimes a week) so to get maximum feedback early in the process. We call mock-ups the illustration of design ideas through supports which do not require software development. They can be paper mock-ups, to illustrate the composition of the interface, story-boards or video to describe interaction sequences or animations, or Adobe's Illustrator/Photoshop drawings to illustrate the graphical design.

Prototypes are implemented once design solutions have been validated or when different options need further exploration. Prototypes are software illustrations of the solutions/options. IntuiLab has developed its own environment, IntuiKit™, which enables to very rapidly implement prototypes (and then final application) as Rich Client. The industry is attracted by rapid prototyping: on the one hand, costs are reduced and, on the other hand, various solutions can be proposed, compared and tested.



**Figure 6: Software and graphic prototypes integrated into high-fidelity prototype**

With IntuiKit, HCI developers initially implement low-fidelity prototypes illustrating sub parts of the final user interface. Low-fidelity prototypes are then iteratively refined and completed with new interaction techniques and with graphic (or sound or haptic) design to eventually result in high-fidelity prototypes. The development of innovative interaction techniques and the integration of the design is facilitated and accelerated thanks to the model-based architecture of IntuiKit.

More than standalone prototypes, the industry customers also require integrated prototypes, i.e. prototypes that are connected to the rest of the application architecture, in order to perform real-life simulation. In collaboration with the developers of the application, IntuiLab developers connect HCI prototypes to any software environment or simulator or even specialised hardware using a dedicated message-based connecting middleware.

#### *Mock-up/Prototype evaluation and test*

IntuiLab's human-factors experts use the mock-ups and the prototypes to evaluate the benefits of different design options or to test the selected design solutions. Considering the objectives of the project (usability, efficiency, safety, ease of use, reduced learning curve...), they prepare the evaluation/test protocol and elaborate evaluation/test scenarios based on usage scenarios resulting from the user requirements analysis. They identify user actions to be observed (qualitative results) or to be measured (quantitative results). If necessary, interaction designers or developers modify the mock-ups or the prototypes in order to fulfil evaluation/test requirements. Finally, the human-factors experts analyse the results after the final users take the evaluation/test

The analysis of the results provides the validation of design choices, the comparison of design options and the identification of presentation, interaction or problem understanding. In addition, during or after the evaluation/test, the final users very often propose new design ideas and identify new requirements to be addressed in the application. All these elements are re-injected into the new design iteration or (if the last one) to refine the user interface and interaction specifications.

#### **Development**

In IntuiSign, the design phase provides validated detailed specifications of the user interface and of user interactions. The specifications very precisely describe the design principles, the composition of the user interface, navigation within the interface, the graphical design, the interaction techniques, the animations as well as the input/output devices and the technical constraints. The aim of the development phase is to translate the clear and already validated (against user requirements and tests) specifications into a quality product (with such attributes as reliability, supportability, performance, documentation or test) whilst staying on time and on budget. Furthermore, and in the case IntuiLab's technology is used for the production release of the HCI, assets from the design phase can be reused in the

final product (such its graphical skin), further accelerating the delivery of that HCI, perfect replica of the prototype look and interactions. Industry traditional development processes such as the V cycle have proved reliable when specifications are solid and can then be efficiently applied to achieve the project's objectives.

## Conclusion

IntuiSign, the HCI design and development process presented in this article, has been tailored and formalised by IntuiLab to provide the industry with the benefits of iterative and participatory process, well-known in the academic domain, while ensuring it fits within the industry constraints. The precise description and content of each phase and associated deliverables provides a solid framework for contractual relationships, and makes the customer confident in our ability to conduct the process. However, this framework is flexible and can be tailored to the specific requirements or contexts, like "plugging in" customer's human-factors experts or graphic designers instead of ours. Regarding the number of iterations, IntuiLab recommends performing at least two: the first one to produce and evaluate mock-ups and the second to refine them into software prototypes. Depending on the complexity of the project, several design cycles can be conducted in parallel on different design issues, and eventually merged into detailed specifications.

IntuiSign also brings together the expectations of the industry on utility, usability and innovation. Utility and usability of the final product are ensured by the participation of the users during the whole design process and the integration of their requirements and recommendations during each iteration. Evaluations and tests also provide qualitative and quantitative assessment of the expected benefits. The participation of the customer and the application development team during the process enables to share the understanding of the user requirements, to focus the HCI design on the most critical points and to check the feasibility of the proposed solutions. Innovative solutions are ignited by the state of the art technologies shared with all participants of the project and driven by IntuiLab's HCI experts.

IntuiLab has successfully applied IntuiSign on dozens of HCI developments and our customers themselves (and their customers!) praise its benefits: the risks are decreased thanks to the thoughtful requirements analysis, the design is focused on useful features decreasing the development costs, the development time is secured thanks to the clarity of the detailed specifications (and the availability of prototypes), the innovative solutions provide a strong competitive advantage, and the final users are satisfied as this process results in decreased support and post sales costs.



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Stéphane Chatty co-founded IntuiLab in 2002 and held the role of Chief Technical Officer until late 2006. After his PhD on the construction of animated user interfaces, Stéphane created a research group on user interaction for air traffic control. He worked on natural interaction styles, alarm notification, groupware, and software engineering for user interfaces. He worked with usability engineers, programmers and visual designers, and learnt participatory design with Wendy Mackay. Stéphane's conviction that user interface designer is a new type of engineering management job was at the core of the inception of IntuiLab. Stéphane currently works at ENAC (Toulouse, France) on the fundamentals of interactive software programming, and is the Scientific Advisor of IntuiLab.  
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