Lessons Learned from Using Personas and Scenarios for Requirements Specification of Next-Generation Industrial Robots

Petra Björndal[1], Mikko J. Rissanen[1], and Steve Murphy[2]

[1] Industrial Software Systems, ABB Corporate Research
Forskargränd 7, 721 78 Västerås, Sweden
[2] ABB Discrete Automation and Motion, Robotics,
Lunnagårdsgatan 4, 431 90 Mölndal, Sweden
{Petra.Bjorndal,Mikko.Rissanen,Steve.Murphy}@se.abb.com

Abstract. As development and productization of complex technology for new markets is challenging, it is crucial to get valid information about the intended future users and represent that information in a proper way to technical experts and project management. This case study describes experiences from using the "engaging personas and narrative scenarios" approach [1], [2] for defining requirements for next-generation industrial robots. We found that additional steps were necessary to supplement the methodology to fit the development of complex industrial robots, namely globalization, validation of personas among end users, prioritization of personas, creation of common vocabulary, identification of business critical scenarios and identification of safety critical situations. The main benefit from using personas and scenarios was their role as communication catalyst and how the descriptions facilitate building a common vision within the project team.

Keywords: Persona, Scenario, UCSD, Robot development.

1 Introduction

This paper discusses the use of the "engaging persona and narrative scenario" [1] methodology during the requirements specification phase of a development project for next-generation industrial robots at ABB. User-centered systems design (UCSD) [3] and Human-computer interaction (HCI) have been found to add value to the Human Robot Interaction (HRI) domain [4], but UCSD has not evolved into widely accepted practice for developing industrial robots. The discussion around the definition of User Experience (UX) has been ongoing for a long time in the HCI community, but Law et al. [5] found with the help of systematically gathered views on the nature and scope of UX in the HCI community that the (by then) draft definition in ISO 9241-210 [6] *"A person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service"* is agreed upon. UX is perceived as grounded in UCSD practices and part of the HCI domain and deals with different possible benefits users may derive from a product. User Experience (UX)

A. Marcus (Ed.): Design, User Experience, and Usability, Pt I, HCII 2011, LNCS 6769, pp. 378–387, 2011.

takes a broader perspective than HCI and HRI, which mainly focus on user-technology interactions. UX considers design, users, and business aspects. This perspective is used in this work.

2 The Project

The project referred to here is an implementation of a future vision of next-generation industrial robots. The goal is to develop a robot with increased flexibility and user-friendliness and reduced need for safety equipment like fences surrounding the robot. Purely technological discussion about future possibilities had been going on for several years. Now there were five large technical sub-projects, of which each had their own vision and specific technical focus (Fig.1). Early in the project a high level concept was formed, but it gave little guidance for technical development toward a robotic product. In absence of a detailed enough common vision, sub-projects formed their own visions about what features the product should have and perspectives to the most difficult technical problems. The lack of a common vision obstructed further requirements specification for the robot. After a period of technological development, a need of overall understanding of both intended users and the context of use was identified by project management. One of the sub-project leaders recognized the need for usability work to support the requirement specification process and asked for support from the usability team in ABB Corporate Research: "*You need to help the technical team to overcome the points where we are stuck.*" There was a need for a consensus about key features of the new robotics product and the consensus had to be based on solid data about the intended users.

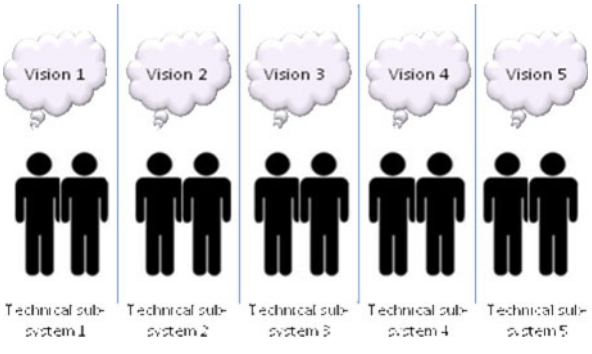

Fig. 1. Setup: Sub-projects had their own visions. Common vision was undefined and requirement specification therefore difficult

A structured way of working and the ability to facilitate discussions were desired by the project management. Based on previous own experience, and documented good effects on communication between teams and an ability to facilitate user-focused design discussions [7], the "persona" and "scenarios" methods were chosen

[1], [8], [9]. Because of intellectual property concerns, the project was kept confidential and field-trips to end-customer companies were kept to minimum. Five trips to customer sites were done, including workshops with managers to find interviewees, observations, and 21 interviews with potential end-users relevant for the project. In total, 49 person hours were spent on doing face-to-face interviews. Field-trips were done to three different countries in Europe, but trips outside of Europe were not possible within the expected schedule, though the target market for the product is the whole world. The two person usability team cooperated with 30 project members distributed over 4 countries during the project time. Another 56 project members had access to usability material through a network server.

3 Approach

The approach of the usability team in this project was based mainly on Lene Nielsen's 10 steps to Personas [2] which were extended during the work with 6 additional steps in order to provide and communicate a holistic view of the needs of the end-users (see Fig.2). Below is a stepwise and chronological description of the experiences with persona and scenario development in this technically challenging project that involved several stakeholders, technical experts, project managers, a product manager and other key persons. Steps deviating from Nielsen's description are marked with "Additional Step" which indicates the need for practical adaptations in this UCSD methodology for developing complex robotic products.

3.1 Finding the Users

The usability team used already established contacts with customers through product management, and after customers were identified and Non-Disclosure Agreements finished, workshops were arranged with customer representatives to identify relevant interviewees. Interviews and observations were done by the usability team. The field data was collected using task analysis [10]. The task analysis was complemented by interview questions to collect information about interviewees' background, personality, interests and concerns - all important data in order to be able to build engaging personas.

3.2 Building the Hypothesis

All notes were written down in a consistent way and collected on the project server together with other background data. During this process the usability team started to build hypotheses about personas to be covered and asked questions such as "are there two main types of customers, high-tech and low-tech oriented?" Much of this discussion was done collaboratively with the project management.

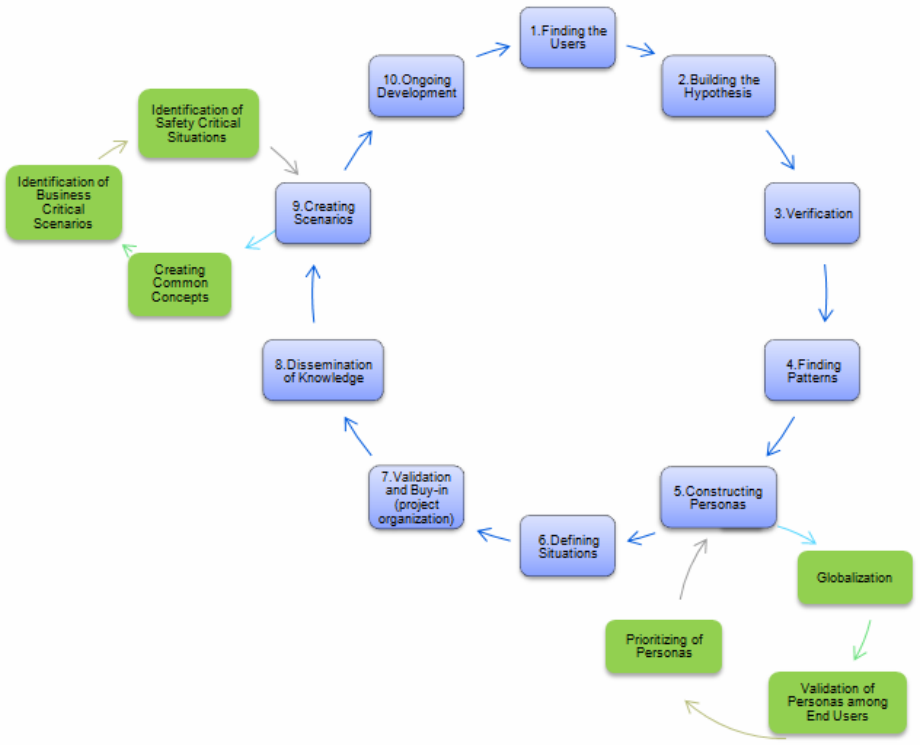

Fig. 2. Lene Nielsen's process 1-10 (blue) supplemented by additional steps necessary in this project (green)

3.3 Verification and Finding Patterns

The usability team wrote the persona descriptions in iterations. After each iteration other participants in the project reviewed the tentative persona descriptions in workshop sessions. Discussions in the workshops resulted in more detailed data about level of technical knowledge of the personas, which was supported by already collected user data. Already early in the process, the initial draft persona descriptions were well received and helped a lot to facilitate discussion, even if they had to be significantly modified later on. When the usability team presented the first version of personas, they were perceived as trustworthy with clear traceability to collected user data. All collected user data like notes from interviews and observations were easily accessible for all project members for further reference during the project.

3.4 Constructing Personas

The organization had previous experience of working with personas; the format was already known to the technical teams and therefore well accepted. The usability team took these good practices and refined them for the specific project. Photos were

chosen from an internal photo database providing realistic photos resembling actual people interviewed during field trips, not models. Background, knowledge and skills of personas were described together with attitudes towards, for example, computer usage. Goals, concerns and work practices were also part of the description. The personas were restricted to maximum one A4-page length and the team took care of only adding a few sentences of fictional data about each persona's personality. Eight different persona descriptions were written in this phase. The team took great care to ensure that each persona had a very distinct personality. For example, a one-liner such as *"I speak [the programming language], Finnish and English – in that order."* The one-liners were well understood by project members: "*You get an instant feeling for the persona."* Some of the fictional background was easily memorable and got, for example, the product manager's attention: "*… and Joe's [priority 1 persona] wife complains a lot."* One-liners are part of many descriptions of personas [8], [9] but not part of Nielsen's approach and not part of persona descriptions used earlier in the same organization. The usability team found such one-liners very effective in the daily communication in the project as they gave a quick summary of what each persona's role in the customer organization is as well as their main focus. The one-liner was often used in reference to the persona description instead of its name.

3.5 Globalization (Additional Step)

When iterating the personas, comments from the project team, such as *"too much old fashioned Northern Europe feeling now,"* resulted in changes to names, photos and certain details to align the descriptions better with the vision of a product used in a global market. All other aspects were kept intact in the personas. One additional persona was written in this phase in order to cover more technical aspects of the customers' personnel, which was a response to inquiries made by several members of the technical project team. Impartial user data was supplemented with second-hand data from customer representatives less involved in the project and knowledge coming from project members. Assumptions about possibly missing data in terms of market coverage were discussed. The globalization step was necessary for credibility and important to ensure wider buy-in in the project.

3.6 Validation of Personas among End Users (Additional Step)

Validation of personas among end users which also involved the globalization aspects refined the personas iteratively and added to their trustworthiness. Workshops with some of the customers were organized, and also one workshop with relevant customer representatives not visited during fieldtrips. Comments such as "*in general, the responsibility areas [of the personas] look real*" strengthened the validity. "*Nothing big is missing*" and "*this is a guy we could hire here*" were taken as confirmations about the validity of the personas. Several details were added and some customers complained about age span of the personas. The interviewees chosen by the customers' management were usually the most experienced ones. Therefore, some of the personas did not represent a completely normal organization, which lead to a quick revision of the ages, backgrounds and skills of some of the personas. Validation

among end users is discussed as a possible improvement of the process by Nielsen [1]. In this project the usability team found it necessary to prove validity of the descriptions in order to get full acceptance for them in the project.

3.7 Prioritizing of Personas (Additional Step)

To facilitate the building of a common vision in the project, prioritization of personas was proposed by the usability team. Prioritization was done using an effect map [11] onto which the personas were placed (see Fig.3). The effect map showed the overall expected effect of doing the project, the prioritized personas, their respective main needs, and was later extended by links to solution descriptions described in use cases. Thus, for the first time in the project, the users' needs were presented to the project management and the product manager and discussed with them in a structured way. This resulted in an official prioritization for future situations requiring certain trade-offs. This was an important step towards consensus on the main focus for the product in the product management. "*Joe [priority 1 persona] is the sledgehammer,"* said a sub-project leader to stress the importance of persona *"Joe"* when discussing argumentation for certain technical requirements that might increase the budget.

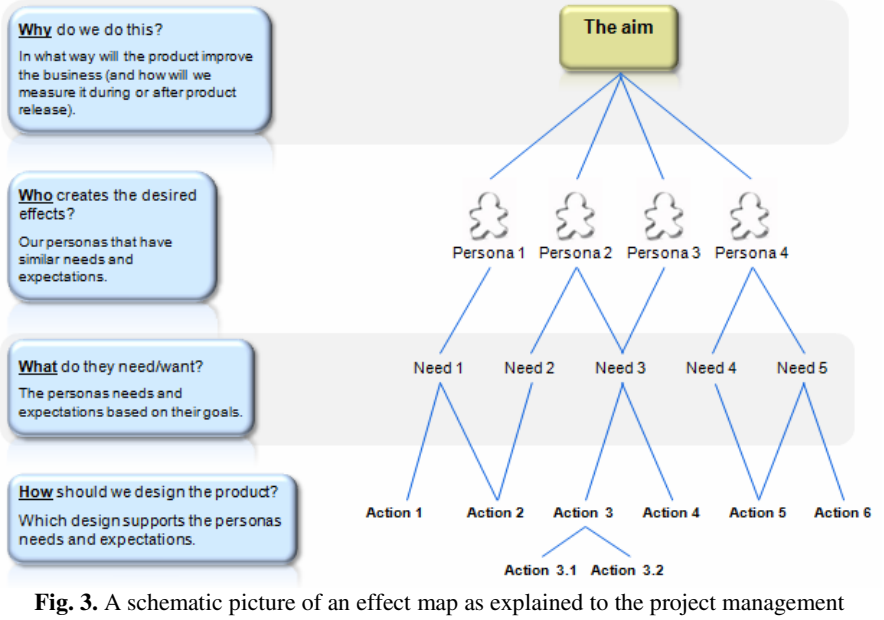

Fig. 3. A schematic picture of an effect map as explained to the project management

3.8 Defining Situations

The persona set, their tasks, goals, motivations, and general context were the basis to find interesting topics for scenarios. The definition of scope of work to support in the

future was discussed in the project. The usability team was responsible for defining the scenarios, but also dependent on inputs from project members on certain technical issues.

3.9 Validation and Buy-in

The usability team hosted a series of workshops to discuss, present and prioritize persona descriptions and scenarios with the aim to involve stakeholders and to communicate results and insights. A good overview presentation of persona and scenario material played an important role in getting involvement from the technical sub-projects and to be able to facilitate the ongoing discussions among stakeholders. A brief process description of the work enhanced understanding and gave an overview of the work.

3.10 Dissemination of Knowledge

As a part of the workshops, project members were informed on how to use personas and scenarios and also on how to link this material to use cases - the next step in the development process. All data from interview notes to presentations were accessible for the project member through the project server.

3.11 Creating Common Vocabulary (Additional Step)

Before starting the scenario writing process, the usability team compiled fundamental concepts and naming conventions together with project members. It was necessary to form a common language to be able to write meaningful, credible scenarios without serious misinterpretations. The common terminology formed a “project language” and thus contributed considerably to building a common vision in the project. The concepts were based on basic assumptions about the robot such as the viewer’s reflection angle that determines, for example, which side is meant by “left” and “right” of the robot. This information was not written down in any other documentation common for the whole project and therefore necessary before writing scenarios.

3.12 Creating Scenarios

Topics for scenarios were found in collaboration with other project members and based on earlier discussed outlines of personas using the new robot. Known problematic situations were also documented. The necessity to identify and describe only the most business-critical scenarios was recognized, due to the complexity of the project.

3.13 Identification of Business Critical Scenarios (Additional Step)

The 23 most critical scenarios were selected together with stakeholders to be the basis for the major requirements. The usability team was responsible for writing the

scenarios with support from other parts of the project. The scenario approach challenged the different visions in the project and scenario descriptions unveiled missing functionality. The holistic approach of the scenarios and the possibility to add earlier collected field data created detailed stories with a lot of context information. All scenarios were descriptions of one or several personas in a specific context with specific goals. Not only straightforward cases were described, but also problem situations like a technically demanding troubleshooting scenario, authored by one of the sub-project leaders.

3.14 Identification of Safety Critical Situations (Additional Step)

The goal of the project, to develop a robot with reduced need for safety equipment, put special importance on the topic of safety. The team quickly realized that the overall view provided by the UCSD process facilitates the identification of safety critical situations. Working on safety aspects was originally not planned for the usability team, but became necessary later when the team had more information about customers' work practices and everyday working situations. In this way, the user-centered way of thinking supplemented existing technical expertise and helped to identify and fill gaps between the risk assessments done in different sub-projects For instance, the frequency of occurrence of each situation in the formal risk assessment was based on input from the task analysis and persona descriptions.

3.15 Ongoing Development

The responsibility for persona descriptions and scenarios, including any changes to them, was kept with the usability team when the project entered the phase of writing use case descriptions. Personas and scenarios played a key role to provide context to use cases and also affected other discussions during later phases of the project.

4 Impact on Design Discussions

The main impact of personas and scenarios was their role as communication catalyst which enabled building a common vision from the different sub-system-oriented visions (Fig.4). The process to put personas and scenarios on paper created important discussions and the descriptions made complex relations easier to talk about – in a language common for all stakeholders, from end user representatives to the product management. As a result, knowledge about the needs and goals of the targeted users were well known and influenced the project work on a day to day basis. Everyone talked about *"Joe"* and his needs for the most challenging technical solutions. As a consequence, the requirements for the robot were for the first time discussed in a structured way in relation to valid user data, which helped technical experts clarifying the vision and then breaking it down into practice. As discussions got more structured, the complexity of the product became evident, missing functionality was identified and requirements were reprioritized.

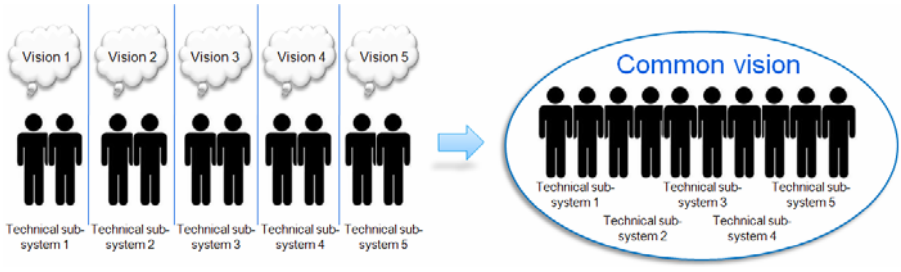

Fig. 4. Result: Common vision enabled by discussion about personas and scenarios. Requirements specification became easier

5 Conclusion

Because development and productization of complex technology for new markets is challenging, it is very crucial to get valid information about the intended future users early and to represent that information in a proper way to the technical project team and the management responsible for the new product. In this project we followed the "engaging personas and narrative scenarios" process [2] for developing next-generation industrial robots and found it necessary to extend existing 10 steps with 6 new ones, driven by real-world requirements and constraints.

- *Globalization* to align persona descriptions to a global market when only part of the markets were properly covered by field trips and user studies,
- *Validation among End Users* to enhance the credibility of the descriptions and facilitate buy-in from technical experts,
- *Prioritizing of Personas* to ensure user-centeredness in the minds of project management,
- *Creating Common Vocabulary* to avoid misinterpretations,
- *Identification of Business Critical Scenarios* to keep focus on the most important scenarios to the customers and to the developers, and
- *Identification of Safety Critical Situations* to facilitate formal safety risk assessment.

Future research will study if these steps have wider applicability in UCSD of technically complex products.

Acknowledgments. We thank Magnus Larsson, Martin Naedele, Mats Källman, Henrik Jerregård and Björn Matthias from ABB Corporate Research for their support.

References

1. Nielsen, L.: Engaging Personas and Narrative Scenarios – a study on how a user-centered approach influenced the perception of the design process in the e-business group at AstraZeneca. PhD Dissertation. Department of Informatics, Copenhagen Business School, Denmark (2004)

2. Nielsen, L. (Guest Author): Ten Steps to Personas, http://www.hceye.org/HCInsight-Nielsen.htm
3. Gulliksen, J., Göransson, B., Boivie, I., Blomkvist, S., Persson, J., Cajander, Å.: Key Principles for User-Centered Systems Design. Behavior and Information Technology 22(6) (2003)
4. Adams, J.A.: Critical Considerations for Human-Robot Interface Development. AAAI Technical Report FS-02-03 (2002)
5. Law, E.L.-C., Roto, V., Hassenzahl, M., Vermeeren, A., Kort, J.: Understanding, Scoping and Defining User eXperience: A Survey Approach. In: CHI 2009 (2009)
6. ISO 9241-210:2010(E) Ergonomics of human–system interaction — Part 210: Human-centered design for interactive systems, page 9. International Organization for Standardization (ISO), Switzerland (2010)
7. Long, F.: Real or Imaginary; The effectiveness of using personas in product design. In: Proceedings of the Irish Ergonomics Society Annual Conference, Dublin, pp.1-10 (2009)
8. Pruitt, J., Adlin, T.: The Persona Lifecycle: Keeping People in Mind Throughout Product Design. Morgan Kaufmann, San Francisco (2006)
9. Cooper, A.: The Inmates are Running the Asylum. Macmillan, New York (1999)
10. Hoffman, R.R., Crandall, B., Klein, G.: Protocols for Cognitive Task Analysis. In: Working Minds: A Practitioner's Guide to Cognitive Task Analysis, MIT Press, Cambridge (2005)
11. Ottersten, I., Balic, M.: Effect managing IT. Copenhagen Business School Press, Copenhagen (2007)