Event-Driven Product Development: Collaboration and Learning

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Ph.D. Dissertation

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To Caroline

Foreword

This dissertation is the result of the research project “Event-Driven Product Development: Collaboration and Learning”. It is an industrial Ph.D. project carried out in collaboration between the company Danfoss A/S, and the Institute of Technology and Social Sciences at the Technical University of Denmark; now the Department of Manufacturing Engineering and Management. The research was funded partly by Danfoss A/S and partly by the Danish Academy of Technical Sciences (ATV), who have named the project EF 609. The research project began in February 1996. I have had three supervisors: Thomas Binder and Jacob Buur both of whom represent Danfoss, and Lauge Baungaard Rasmussen from the Institute of Technology and Social Sciences at the Technical University of Denmark.

My interest in industrial research arose from my studies at the Technical University of Denmark. I hold a master’s degree in mechanical engineering, specialising in engineering design and operations in organisations. During my studies I have attended several courses where we worked on projects in collaboration with the industry. I have always considered it very interesting to take part in projects based on real life and which, if implemented, would be of benefit to the companies involved. The research project I will describe in the following deals with user-driven product development.

My interest in user-driven product development stems from the Department of Control and Engineering Design where I took a special design course in Man-Machine-Interaction. During the course we (the students) conducted projects together with industry where we had to explore users’ needs, design a prototype and evaluate it by involving users in the design process. I learned that it can be hard for users to define or describe what they want and that usability issues are very hard to describe in terms that fit into traditional product specifications. Later I conducted my master thesis project at the Department of Control and Engineering Design. Together with Jan Pojezney I developed a bag for cooling and rotating arterial blood samples at hospitals. We did this by collaborating with potential users and found that this process does appear to be the ideal when aiming at the development of products of high value to users.

During the first three years of this research project I was employed by Danfoss. Danfoss is the largest manufacturing company in Denmark with 17,000 employees on a world-wide basis. Danfoss produces components like compressors for refrigerators and freezers, valves, sensors and controllers for refrigeration and heating systems, and industrial hydraulic components. Common to these products is that they are built into larger systems by original equipment manufacturers (OEM customers). The products are mechanical, electronic or mechatronic, usually installed by OEM customers and operated by professional end-users such as electricians, refrigeration mechanics, and plumbers. Just as in other companies, the departments in Danfoss now experience greater demands for

shorter 'Time to Market', increased customer orientation, and lower production costs. Because user-friendliness became a vital competition parameter, Danfoss decided in 1992 to establish a department aimed at building up competences which would increase the usability of products and disseminate the concept throughout the Danfoss organisation. The name of the department at present is the User Centred Design Group. It was within this department that I was employed during my research. Today the User Centred Design Group pursues user-driven product development by maintaining close contact with present or potential customers and users throughout the product development process. The goal is to assist product development teams at Danfoss in developing very user-friendly products of high value to users.

Prior to the commencement of this research project, the experience gained by (relatively few) researchers in examining different ways of staging collaboration between product developers and users was good but limited. Their experiences indicated that a large potential for improvement lay in focusing on collaboration across different competencies in product development. The leader of the User Centred Design Group, Jacob Buur, therefore initiated this research project. His interest was in conducting research that included the development and testing of forms of collaboration where developers together with other interest groups would be able to sketch out and evaluate proposals during the product development process.

In 1992, this was not the area of focus of the User Centred Design Group. Since its establishment, however, the group has gained inspiration from different fields; inspiration that has influenced the ways in which the group works. Examples of this progression can be seen in the two previous Ph.D. projects carried out within the group. Initial focus was on cognitive engineering with the underlying assumption that it is possible to describe how users think and act. The group conducted task analysis and were inspired by research on human computer interaction (HCI), a subject being explored at Risø. Claus Sehsted Hansen's research objectives included the creation of theoretical preconditions and design tools for the development and application of computer-based simulators for simulating man-machine interaction (Hansen, 1995).

The User Centred Design Group then learned about empathy-driven design and aimed at familiarising themselves with users by, for example, making up character descriptions of different user types and by creating scenarios. The group was inspired by companies like IDEO and Interval. Pi Nielsen's research objectives were to create concepts and suggest a procedure for design for usability with the focus on the physical handling of products. She based her research on the product development tradition, cognitive psychology and literature from the human computer interaction area (Nielsen, 1999).

The third field the User Centered Design Group found inspiration from was the participatory design tradition with its focus on involving users directly in the design process. Here they drew inspiration from the Department of Computer Science at Århus University and the SPORG

group at MIT. Today, the User Centred Design Group uses a mixture of empathy-driven design and participatory design methods. The title of the paper 'Turning usability testing into user dialogue' indicates how the focus and ways of working have changed since the User Centred Design Group was established (Buur et al., 1997). This research is about the collaboration and dialogue inside the design team and especially with stakeholders outside it.

The research project was comprehensive and took a long time. Many people contributed to the work. Above all I would like to thank my supervisors for their interest and faith in my ability to complete the project. Thank you for the many rewarding discussions we have had and which gave me much inspiration. There is no doubt that if you had not given me so much backup and encouragement it would have been impossible to complete the project. Thank you to Danfoss and the Danish Academy of Technical Sciences for financing the project and thank you to Professor Börge Obel, who under the auspices of ATV became my "father" during the project.

I must also thank my colleagues from Danfoss, especially those in the User Centred Design Group, and those who at various times hosted the group when it took part in different product development projects. Being a member of the User Centred Design Group was a very inspiring and educational experience. Thank you to the project groups and the individuals from the different product divisions of Danfoss who became involved in the research project. Thank you to all those people from outside Danfoss who also took part in the product development projects.

I must express gratitude to my colleagues from the Institute of Technology and Social Sciences for an interesting research environment and for their backup, in spite of the fact that the project did take such a long time. Thank you for support from my present colleagues at the Space and Virtuality Research Studio at the Interactive Institute. A special thank you to William Porter and Turid Horgen for a very fruitful and inspiring research period with the SPORG group at MIT in the autumn of 1997. Thanks to Larry Bucciarelli and Jeanne Bamberger (both at MIT) for some very useful discussions and research inputs.

Last but not least I must thank my family and friends who have stood by me and given me space in which to complete the project. Thanks to friends from the Norwegian organisation Acem who gave much mental support. Special thanks to my parents, Ulla and Sigurd Brandt and my brother, Peter, who have done quite a lot and who always have been ready to help. Especially thank you to my daughter Caroline whose never-failing love gave me the energy and strength I needed to continue.

Eva Brandt
Kgs. Lyngby, March 2001

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