

Improving Innovation Culture by Demonstrator Design

Kjersti Øverbø Schulte¹, Morten Hatling², Silje Helene Aschehoug¹

¹*SINTEF Raufoss Manufacturing*
Kjersti.Schulte@sintef.no, Silje.Aschehoug@sintef.no
²*SINTEF Technology and Society*
Morten.Hatling@sintef.no

Abstracts

In this paper, we present a case study from a high-tech manufacturing company in Norway. The project was a close collaboration between managers and engineers from the R&D department in an industrial tool manufacturer and a cross disciplinary team of researchers from an independent research institute and a university. The overall aim of the project was to revitalize and improve the manufacturer's innovation culture by focusing on real design challenges the R&D department had to solve. Throughout an action research project, new innovation approaches and tools for collaboration and knowledge sharing were introduced to the company. The participants' reflections on their own individual and collective praxis were point of departure for a digital demonstrator of innovation culture. The overall aim of the research project was to a) investigate critical elements of what constitutes innovation culture in a Norwegian manufacturing company and b) to develop and distribute these elements as ICT-based learning histories in a web-based demonstrator. The evaluation of the research project concludes that innovation tools and approaches implemented in the company through the action research project increased the momentum in the development work. Still, disruptive innovation can easily be slowed down by practical challenges and changes in priorities. In addition, developing a digital demonstrator was a resource demanding process. It was evaluated by the company, but could not be implemented. Nevertheless, by developing the demonstrator the researchers analyzed the company's innovation culture from diverse perspectives and discussed a broad range of topics with company representatives.

Keywords: *industry-academia cooperation, cross-disciplinary development project, digitalizing learning histories*

1 Introduction

An industrial tools manufacturer in Norway has a long industrial history, but their transformation from a mass-producing to a high-tech manufacturer started 40 years ago when they were presented with an idea of a totally new product. This truly disruptive innovation (Christensen & Raynor, 2003) eventually made the company abandon their traditional line of

products, dismantle their existing production line and replace it with a totally new one. The change was fundamental and affected all aspects of running the company. The markets and customers changed, new production technology was needed and the role of the operator became highly specialized and “knowledge intensive”. This process is a defining period in the company history and the myths are still alive in the company culture. It also represents a turning point in the role of innovation and product development in the company. This was the start of building a strong culture of innovation and a position as one of the technologically leading companies globally in their field.

Over the years the company has had a steady growth and kept their position as a technological forerunner. One of the key factors for success, in their own words, is the willingness to collaborate with universities and R&D-institutes in a wide range of topics to gain access to external knowledge and perspectives. The challenge of reproducing a potent innovation culture was the company’s main motivation for partnering up with us in this project. Over the years their ability to reinvent themselves had weakened and they were standing before a situation where several of their initial patents would run out. To emphasize the strategic importance of the innovation culture project the company selected the development of a new core technology as the major case. They needed to challenge the “ways they do things” and especially improve how they worked in the early phases of their innovation projects. When asked to characterize their innovation culture they emphasized issues like high degree of willingness to take risks, individual freedom to pursue ideas and the ability to rapidly and flexibly respond to customers' needs for new solutions with unexpected solutions. Their main challenge was to combine this with the ability to prioritize resources and to enroll highly autonomous engineers in fewer, but longer lasting projects.

The company is located in a part of Norway with few manufacturing companies and is not part of an industrial cluster. On the other hand it is situated close to a university and an independent research institute that to some extent function as the company's external research department and a source for recruiting new engineers. The tools manufacturer is also a preferred study object among other because of its location and open attitude towards innovation. The company, the university and the research institute have close cooperation on technology, materials and organizational issues including innovation and through this long term cooperation these partners had been practicing open innovation (Chesbrough, 2003) long before the term was established.

The project was part of a larger research programme with the aim to develop next-generation manufacturing in high-cost country. The research programme decided to use industrial demonstrators to communicate results on a small number of topics, one being *innovation culture*. This demonstrator aims to answer the research question: How can innovation culture be described and improved in manufacturing companies? Innovation capabilities was regarded by most of the industrial partners as critical for success in an increasingly competitive market. This particular project had the ambition to contribute with new knowledge about critical aspects of innovation culture at company level. To our knowledge, there are few publications within this field of knowledge. Therefore, this paper aims to make an empirical contribution to the field of innovation culture. At the same time, the ambition of the research project was to further develop the innovation capabilities of the particular manufacturer and in the long run lead to changes in the way they work with R&D.

2 Theoretical background and perspectives

2.1 Innovation culture

Organizational culture can be seen as the deeply seated values and beliefs in an organization (Martins & Terblanche, 2003). In this sense organizational culture fills the gap between what is formally announced and what that actually occurs (Ibid.). The conscious and tacit elements of an organization's culture influences most aspects of the inner life and production. Indeed, research on organization culture is interesting because insight into a company's culture is necessary to change the culture (see e.g. (Goffee & Jones, 2001), (Denison, 2001)). Organizational culture is not static and it is often presented as dimensions of values, as for example flexibility versus stability, and internal versus external focus as critical dimensions (Quinn & Cameron, 1988).

Innovation comprises the commercialization of technology, either as radical and trend-breaking technology or as utilization of cumulated knowledge to optimize technical and economic performance. Over the last years, both during and after the innovation culture project, we have seen an increased research interest in the concept of innovation culture (see (Herzog & Leker, 2010), (Buschgens, Bausch, & Balkin, 2013) and (Jucevicius, 2010)). This is in part a contrast to a rather dominating focus on structured methods for streamlining the innovation process, i.e. stage gate and process models (e.g. (Cooper, 1993), (Ulrich & Eppinger, 1995)). Innovation culture has been described as organizational culture to support innovation, but the term is not well defined. In our experience it is also difficult for managers to grasp the concept and initiate development oriented dialogues on this topic. In this project we attempted to understand organizational characteristics and values that supported and hindered innovation. Further, we attempted to initiate cross departmental reflections and communication to facilitate close collaboration in the early phases of innovation. In this process the framework of Martins and Terblanche (2003) was useful; including strategy, structure, support mechanisms, behavior and communication.

2.2 Learning histories and organizational learning

The Innovation culture project had point of departure in the research area of organizational studies in an environment with a strong tradition for action research. Indeed, the aim of the study was to understand and change the innovation culture in a manufacturing company. Action research can support reflection and learning (see (Greenwood & Levin, 1998) and (Argryis & Schön, 1996)). Moreover, action research can emphasize the participants' voices and own storytelling (Bray, Lee, Smith, & Yorks, 2000). Stories and field notes were introduced to organizational studies in the nineteen seventies with Clark (1972). Concurrently Mitroff and Kilmann (1975) were pioneers to apply stories to problem solving and action research. However the storytelling approach was not accepted by highly ranked organizational journals until the mid nineteeneithies, and thereby legitimized as a topic in organization studies (Røyrvik & Bygdås, 2004).

The learning histories methodology was developed at Massachusetts Institute of Technology (MIT) in the 1990's. Roth and Kleiner, who was central in the development of the methodology defined learning histories as "a formalized approach for capturing and presenting learning processes in organizations" (2004, p. 6). They originally introduced it as a method of organizational learning from very large and complex development projects in the car-industry. Learning histories was introduced for Norwegian industry by SINTEF around 2000 by (Hatling, 2001). Learning histories is first and foremost a tool for reflecting on past

experiences by a broad specter of members of an organization, across divisions and professions to enable organizational learning. In its most basic way they are a form of organizational memory about important events or critical aspects of the inner life of the company. Typically events that involves a broad set of actors with an equally diverse opinion on “what happened because of what”. Through a selection of narratives, produced in a collective effort by “insiders” from the organization with deep knowledge of the “critical episodes” and the researchers with analytical skills to comment and question the original narrative. This jointly-told tale forms the basis of a learning process within the company. The variety of voices and perspectives in a learning history is the main characteristic of the method. Many perspectives makes the stories more trustworthy, a better tool for broad discussions and a facilitator of organizational learning. Particularly for “difficult” topics it is important to present many experiences and voices in the reflection on what really happened (Kleiner & Roth, 1997). Learning histories has also proved to be very effective learning tools across organizations which was a main overall motivation for using the method in the research project. Both an action research process and the development of learning histories can support reflections, organizational learning and development.

3 Research design and demonstrator development

The study was carried out by a transdisciplinary team of researchers consisting of a sociologists, engineers, an industrial designer as well as visual and social anthropologists. In addition a journalist with expertise on web design and photography had main responsibility for implementing the digital demonstrator. The objective was to achieve an operational understanding of a particular project in order to suggest actions to support the team's innovation practices and thus improve the company's overall innovation culture. The innovation culture project started mid-2009. The technology development project at the tools manufacturer started early fall 2009 with an expected deadline 3 years later. The R&D team was followed closely from summer 2009 until the end of 2010. The development of the digital demonstrator started February 2010 and it was evaluated by the company late fall 2010. A broad range of data were obtained. Weekly project coordination meetings were observed among other to record periods of stagnation and progress. Innovation tools and approaches were suggested and implemented. Finally both informal discussions and formal interviews were carried out regularly. Particular action research events were followed up by interviews which allowed the participants to reflect on their experiences. Finally, the evaluation of the digital demonstrator facilitated reflection and learning.

The transdisciplinary group of researchers worked closely to develop content and design of the digital demonstrator. The demonstrator was planned simultaneously as the action research event Peer Resist. The transcribed material from the case study was analyzed with perspectives of visual anthropology and learning histories attempting to unfold the story told by the manufacturer's representatives. The researchers selected *direct quotes* that were interesting and visually pleasing to watch. Additionally the transcribed material was coded and categorized applying a grounded theory approach (Charmaz, 2006). Applying two perspectives on the empiric material increased the understanding and triangulated the findings, see Figure 1. As a result the empiric material was concentrated from 16 rather concrete and descriptive topics into four learning histories. As a result the research team experimented with two different styles of narrator's text for the learning histories: The narrator's voice was poetic and to some degree provocative. Another set of text was based on categories derived and references to theory.

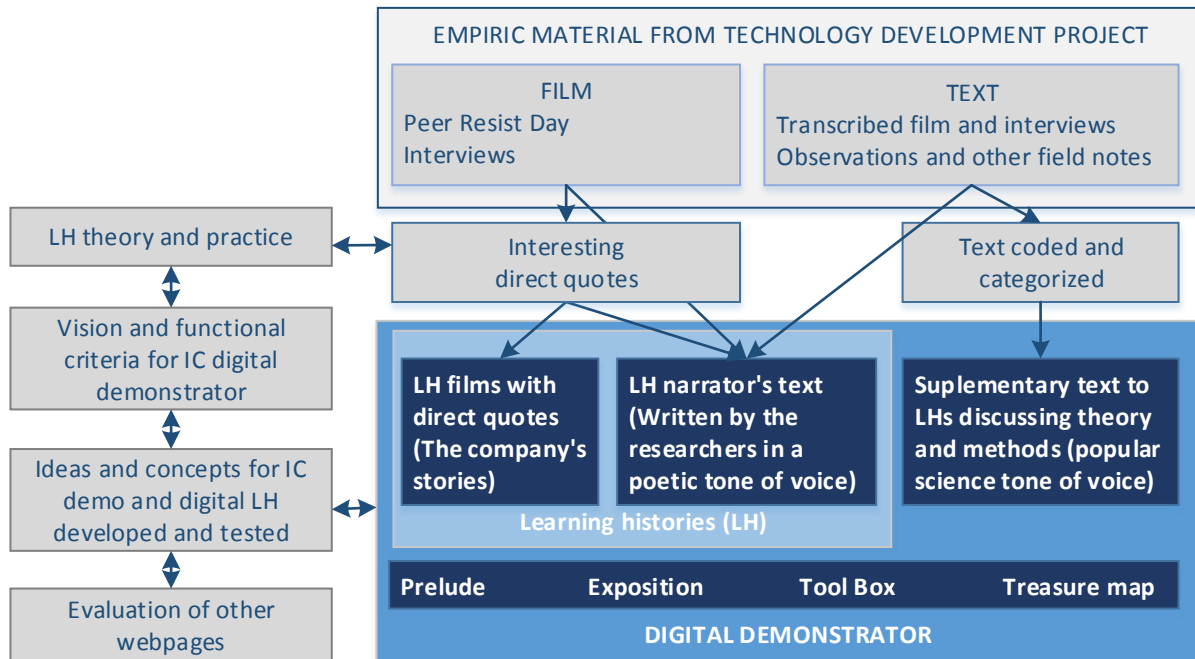


Figure 1. Developing the learning histories and the digital demonstrator.

4 Cooperation between the manufacturer and the researchers

The project was organized in two main phases; in the first phase we focused on mapping and describing the key characteristics of the current innovation culture in company. In the second phase we worked with the R&D-unit in a particular technology development project to establish new practices and alternative approaches to innovation. The lessons learned and productive dilemmas were documented and published on the digital demonstrator.

Through interviews, observations and document studies we developed a profile of the company's innovation work. We presented and reworked this profile in a workshop, where managers and key personnel from all business areas participated. The main purposes of this workshop was to create a common platform for dialogue about what constituted their particular way to think, plan, talk about and collaborate on innovations. Through the workshop the company was given tools and a physical space to openly discuss roles, values and practices in innovation and product development. The process uncovered some keywords describing the organization culture; a very open culture with a flat organizational structure based on autonomous production teams. Further, the engineers were free to immerse themselves into problems they found interesting, and to pursue their own ideas and manage their own time-table. Finally the pride of being real experts was very widespread. Indeed, the tools manufacturer has developed a world leading technology that at the time gave them an extremely strong market position worldwide. These characteristics were elaborated and refined throughout the research project and were central in the learning histories.

The close collaboration between the engineers and production was a cornerstone in the organization and enabled the company to develop customized variations of their products rapidly to keep their customers satisfied. In other words, time was spent on incremental innovation and customer adaptation, rather than developing strategic important and more disruptive technology. Long term innovation projects were fragmented, sequential and not resource efficiently driven, and the engineers sometimes found it difficult to focus on more radical ideas. Therefore the management saw a need for improving the innovation process,

how they worked, how they communicated and shared knowledge and in particular how they challenged each other across fields of specialties and departments. An innovation project to develop a new core technology was chosen as the focus in the research project. This innovation project was prestigious within the company, with a fairly large pressure of succeeding because a crucial patent was expiring. In addition, the innovation project took place at a critical time as the manufacturer was acquired by a larger international tools manufacturer. The development team in the manufacturer consisted of engineering designers, a process engineer and toolmakers.

At the start of the innovation project, the researchers suggested front-loading where a large group of development resources worked closely together for a limited time period. In addition the project manager and the researcher developed a project structure with among other weekly project meetings where tasks were delegated according to milestones and the individual engineer's motivation. Some discussions on solutions took place at these meetings, but generally, solutions were discussed in small groups of engineers working on the actual problem. Overall, the project had good progress or momentum throughout the first fall. Yet, towards the end of the year the project stagnated. To regain momentum the project introduced a collaborative and interventionist process called "peer resist" – to function as something more than just a contrived milestone.

In preparing for the Peer Resist Day, the development team had selected three areas of the technology development project that they found particularly challenging or interesting. The team presented their ideas, solutions and challenges for a jury consisting of four company external experts. The team received concrete feedback on the technological solutions and achieved a benchmark on the teams knowledge on their own solutions. Finally, the team of experts and the team discussed how to proceed with the project. In preparing for the Peer Resist day the innovation team had an intensive working period, making progress on the three selected areas and making concise presentations for the external panel. Moreover, the team cleaned and organized the project room next to the production area and started using it among other for their weekly meetings. Overall Peer Resist was considered a very useful tool for the engineering team. Leading up to and following the Peer Resist day the project gained momentum.

Towards the summer of 2010 the project experienced yet another period of stagnation. A supplier was delayed in providing equipment for vital prototype testing. Production of prototypes for testing were also delayed because of limited access to production facilities. Despite the strategic importance of the technology development project and the measures of the research project, the technology project suffered from being absorbed in incremental, customer focused activities. The last action in the research project was to evaluate the innovation culture demonstrator together with company representatives to improve the demonstrator and the learning histories, to gain permission to use it on other companies, and to evaluate the idea of digital learning histories. The engineers appearing in the learning histories and two managers participated in an evaluation of the digital demonstrator. By then the research programme was reorganized and the industrial demonstrators were terminated. As a result only one evaluation of the demonstrator was completed. Changes for a demonstrator version 2 was documented but never implemented.

The Front Loading and the Peer Resist Day were considered very useful to increase a positive sense of urgency in the project. However the technology development project went through periods with momentum and stagnation corresponding to high and low priority given by the

management and allocated resources. Today the company still has effort on more radical innovation and process, and has recently built an innovation room. On the other hand they are still balancing urgent customer requests with more disruptive innovation projects.

4.1 Design and evaluation of the digital demonstrator

The main content in the digital demonstrator was four learning histories. “How come nobody is intervening?” reflects on the intention and objective for innovation projects, how innovation should be different from everyday life and questions who should take responsibility and leadership in an organization with a very flat structure. The topic in “To see is to believe” is sketching and prototyping. The R&D team frequently drew quick sketches “unplugged”, still prototyping were necessary to prove ideas; for sensing the solution and supporting decisions. Prototyping and testing were also considered a great source of motivation. “I can do it myself” discusses freedom and autonomous teams. One representative expressed the strong feeling of freedom in the company as “nobody should cut off my wings”. On the other hand, to what degree does an organization need somebody with formal management and responsibility? The final learning history “Combined rational gut feeling” reflects upon decision-making. The title is a direct quote expression the ideal decision making situation in the company. Additionally, the demonstrator contained: an introduction to learning histories, an instruction on how to “read” and utilize the histories, an innovation tool box and a “treasure map” with inspiration from practice and academic papers.



Figure 2. The digital demonstrator. Right: The four learning histories. Titles are translated for this article. Left: A learning history with native direct quotes on film and the narrator's (researchers') voice in text.

Some of the engineers expresses skepticism towards the demonstrator project before the evaluation. During the evaluation, however, they changed their mind and became mostly positive and concluded that the demonstrator could be very useful in explaining challenges in an innovation team to external persons. Context and setting for using the demonstrator was considered crucial. The demonstrator should not be used in general assembly meetings. Further, the participants requested a clear framing of the stories for the reader/watcher including background information and an introduction to set the mood and right expectations before watching the films and reading the texts. In parts of the films the engineers very honestly discussed weaknesses in their innovation process. Therefore one engineer questioned whether the lasting impression of external viewers would be an incompetent company. All the same, the team only demanded a few changes before the demonstrator could be used on other companies in the research programme consortium.

The demonstrator was intended to facilitate reflections both for individuals and in groups. Before the evaluation meeting we encouraged each company representative to study the demonstrator alone. The quotes used in the films are rather short and for each topic the film is

crosscut from one engineer to the next. One representative wondered what particular question he was answering at a specific time in the film. Another participant saw great meaning in the films when you really listened to each word that is included. The films were only 2-4 minutes long and could be watched again and again.

For the demonstrator design a variety of webpages were studied to find a format that was useful for presenting text and films in parallel. Crucial for choice of layout and digital solution was the ability for the reader to scroll the text at the same time as she was watching the film. This functionality worked best for individual viewers. For the group session a print of the texts were handed out to each representative. Further, two sets of texts were included in the demonstrator: the learning histories narrative text in a poetic tone of voice and texts discussing the topics based on empirically derived categories and theory. The company representatives did not fully agree on which set of texts they preferred. The text written in a poetic tone of voice and very different from other texts used in the manufacturing company.

4.2 Demonstrator evaluation from researchers' perspective

Initially, the aim of the industrial demonstrator was to develop short stories from a world class innovative company that would trigger reflections. The demonstrator was developed and design with the intention of being used on several companies, to facilitate learning and act as a source of inspiration. Typical characteristics from the manufactures innovation process were highlighted, both in text but by film. It presents a snapshot of the innovation process following the technology development project. Unfortunately, by the time of the evaluation meeting, the research programme was reorganized and the industrial demonstrators were abandoned. In retrospect, the evaluation of the demonstrator in the company should have taken place at a much earlier time to allow for a more iterative development process. However, skill levels and resources in the research team did not allow a faster development of the demonstrator.

The researchers developed a digital demonstrator because of flexibility. Someone could watch the learning histories alone or in a team setting. The researchers also wanted to include learning histories from several manufacturing companies to facilitate cross-organizational learning. Learning-wise, this demonstrator was never presented to other companies, as it needed re-work. However, the demonstrator was presented to other researchers who found it exciting in the new way it highlighted and presented innovation culture. The demonstrator does not include a "how-to-list" but rather presents "how we do things here", which probably could have worked well as inspiration for other companies wishing to improve their innovation culture.

The digital demonstrator was very expensive to develop, involving an independent journalist/designer, a post doc scholarship holder and the team of researchers at the independent research institute. Finally, the digital learning histories required interesting quotes that looked good on film. Because of poor lighting and back ground noise the number of useful quotes was very limited, indeed for each quote hours of film were abounded. The Innovation Culture demonstrator was created in 2010. Then no digital learning histories existed, thus a digital format was interesting from a research perspective. Meanwhile, there has been a massive development in social media, gamification of learning, and new digital platforms to support these tools. The new platforms could potentially have reduced development costs of the digital demonstrator. Further some of the new platforms also

encourages reflections and a comparison between learning histories and newer digital learning platforms would be interesting. No doubt, the digital demonstrator would have looked different if it was developed in 2016.

5 Conclusion

The ability to organize and stimulate innovations on all levels are probably one of the most critical challenges to leaders throughout all industries. This is particularly true in a high cost economy like the Norwegian where industrial production has been moved to low-cost countries in a steady pace for many decades. The objective of this paper has been to discuss how companies can engage their personnel in reflecting on their practice alongside actually doing a project to further develop their innovation culture in a sustainable way. The framework developed for this project had the ambition of describing and enabling innovation practices in organizations and use the digital demonstrator as a main tool for sharing knowledge and stimulating reflection. We have also showed how learning histories can be a valuable tool for reenergizing innovation culture in an organization.

To a large extent are reports from innovation and product development presented as linear processes, despite the fact that most design researchers emphasize the iterative aspect. Learning histories might provide richer and a more realistic (and messier) narratives that give the reader multiple perspectives and a better platform for reflection. Learning histories, in its original form, is text-based and relatively long, and to be used to initiate organizational change through processes facilitated by experts from outside the company. A major goal of this project was to experiment with the design of the learning history itself by making it shorter and more episodically. "Critical events" were presented by texts in various tone of voice and films. It was all presented within a web-based platform designed to inspire users to customize their own way of reading the stories. Through this design the project wanted to study how learning from complex innovation projects could be shared across company-lines and to instrument a more operational, common understanding of the ambiguous concept of innovation culture. However, producing learning histories and editing them to fit a web-based platform proved to be very costly and to demand a lot of resources on all levels. The effects was positive in the sense that the company participators found the project to have given them new insight in how they organize and cooperate in their innovation processes.

The team of researchers achieved in-depth and operational understanding of the company through a close cooperation over an extended time period. Throughout the action research project particular tools and approaches were successfully introduced and the R&D team experienced increased momentum and progress in the project. Nevertheless, the researchers experienced that efforts to improve on the innovation culture in favor of more disruptive innovation had limited effect when short term, customer focused tasks are prioritized or the project experienced delays caused by unforeseen or external issues. To conclude, the long lasting relationship and trust between the manufacturer and team of researchers was vital to gain intimate insight into the manufacturer's innovation culture and be allowed to propose actions that were implemented. The group of researcher feels privileged of the close cooperation with the manufacturer at the time of the study.

Acknowledgement

This research was funded by the Research Council of Norway.

References

- Argyris, C., & Schön, D. (1996). *Organizational learning II : theory, method, and practice*. Reading, MA Addison-Wesley.
- Bray, J. N., Lee, J., Smith, L. L., & Yorks, L. (2000). *Collaborative Inquiry in Practice*. Thousand Oaks: Sage Publications, Inc.
- Buschgens, T., Bausch, A., & Balkin, D. (2013). Organizational Culture and Innovation: A Meta-Analytic Review. *Journal of Product Innovation Management*, 30(4), 763-781.
- Charmaz, K. (2006). *Constructing Grounded Theory. A Practical Guide Through Qualitative Analysis*. London: Sage Publications.
- Chesbrough, H. W. (2003). *Open Innovation: The new imperative for creating and profiting from technology*. Boston: Harvard Business School Press.
- Christensen, C. M., & Raynor, M. E. (2003). *The Innovator's Solution: Creating and Sustaining Growth*. Boston: Harvard Business School Press.
- Clark, B. R. (1972). The organizational saga in higher education. *Administrative Science Quarterly*, 17, 178-184.
- Cooper, R. (1993). Winning at New Products. Accelerating the Process from Idea to Launch.
- Denison, D. (2001). Organizational Culture: Can it be a Key Lever for Driving Organizational Change. In G. Cooper, S. Cartwright, & P. Earley (Eds.), *The International Handbook of Organizational Culture and Climate*: John Wiley & Sons.
- Goffee, R., & Jones, G. (2001). Organizational Culture: a Sociological Perspective. In G. Cooper, S. Cartwright, & P. Earley (Eds.), *The International Handbook of Organizational Culture and Climate*: John Wiley & Sons.
- Greenwood, D. J., & Levin, M. (1998). *Introduction to Action Research*. SAGE Publications. Thousand Oaks, CA SAGE Publications.
- Hatling, M. (Ed.) (2001). *Fortellingens Fortrylling*. ("The enchantments of storytelling"). Norway: Fortuna Forlag.
- Herzog, P., & Leker, J. (2010). Open and closed innovation—different innovation cultures for different strategies. *International Journal of Technology Management*, 52(3/4), 322-343.
- Jucevicius, G. (2010). *Culture vs. Cultures of Innovation: Conceptual Framework and Parameters for Assessment*. Paper presented at the The 7th International Conference On Intellectual Capital, Knowledge Management and Organizational Learning.
- Kleiner, A., & Roth, G. (1997). How to Make Experience your Company's Best Teacher. *Harvard Business Review*, September-October, 172-177.
- Martins, E. C., & Terblanche, F. (2003). Building organisational culture that stimulates creativity and innovation. *European Journal of Innovation Management*, 6(1), 64-74.
- Mitroff, I., & Kilmann, R. (1975). Stories managers tell: A new tool for organizational problem solving. *Management Review*, 64, 13-28.
- Quinn, R. E., & Cameron, K. S. (Eds.). (1988). *Paradox and Transformation: Toward a Theory of Change in Organization and Management*. Cambridge, MA: Ballinger.
- Roth, G., & Kleiner, A. (2004). *Car launch*. Boston: Oxford University Press.
- Røyrvik, E. A., & Bygdås, A. L. (2004). Knowledge Hyperstories. The use of ICT enhanced storytelling in organizations. In A. Carlsen, R. Klev, & G. von Krogh (Eds.), *Living knowledge. The dynamics of professional service work* (pp. 184-204): Macmillan Publishers Ltd.
- Ulrich, K., & Eppinger, S. (1995). *Product Design and Development*: McGraw Hill.