Trust in ICT-Based New Product Development – Guidelines for Virtual New Product Development Teams

Rainer Haas, Oliver Meixner, Siegfried Pöchtrager
University of Natural Resources and Applied Life Sciences Vienna, Institute of Marketing & Innovation, Feistmantelstr. 4, A-1180 Vienna, Austria,

rainer.haas@boku.ac.at, oliver.meixner@boku.ac.at, siegfried.poechtrager@boku.ac.at

Paper prepared for presentation at the 99th EAAE Seminar 'Trust and Risk in Business Networks', Bonn, Germany, February 8-10, 2006

Trust in ICT-Based New Product Development – Guidelines for Virtual New Product Development Teams

Rainer Haas, Oliver Meixner, Siegfried Pöchtrager
University of Natural Resources and Applied Life Sciences Vienna, Institute of Marketing & Innovation, Feistmantelstr. 4, A-1180 Vienna, Austria,
rainer.haas@boku.ac.at, oliver.meixner@boku.ac.at, siegfried.poechtrager@boku.ac.at

Abstract

The traditional process of new product development is focusing on an intra-organizational workflow, which should – in its ideal form – be done by virtual interdisciplinary teams. Team members should be from several departments like manufacturing, research & development, sales and marketing. But innovation is happening more and more in networks of companies, clusters or so called network companies. The following article delivers a framework of guidelines for virtual team management in order to improve the success of innovation strategies.

Keywords: *e-collaboration, virtual team work, new product development*

1 Introduction

Innovation oriented companies in markets like biotechnology, pharmacy but also food industry are challenged to broaden the traditional paradigm of new product development into the network oriented paradigm. To distinguish the main business processes in network companies it is important to understand the major coordination processes and their differences (table 1).

Table 1. Characteristics of five coordination processes (Fleisch, 2002; Hagel and Singer, 1999)

Coordination process	Aims & culture	Processes	Main forms of coordination	Main coordination technology
Supply chain management	Efficiency via economies of scale, deep integration	Planning, procurement, production, distribution	Stable network	Supply chain (CPFR), e-commerce systems
Relationship management	Efficiency via economies of scope, customer relationship management (CRM)	Marketing, sales, service policy	Market	CRM- and document-oriented EC-systems
Innovation	Time-to-market, dynamic, high interdependency, promotion of creative stars	Idea generation, concept finding, development	Dynamic networks, virtual teams	E-collaboration platforms
Infrastructure	Efficiency via service culture and standardisation; cost reduction, economies of scale	Accounting, human ressource management, assets	Internal, stable network	Distributed efficient ressource planning (ERP)-systems
Organisational development	"Network-compatible" employees and partnerships	Organisational development	All forms of coordination	All forms of coordination

Innovation is characterized through highly dynamic networks, high interdependency of communication and work processes and the crucial success factor "time-to-market". The state-of-the art tool for communication via ICT is a flexible and easy to use e-collaboration platform. The success of inter-organizational innovation as it is done e.g. between the food and pharmaceutical industry in the case of functional food depends among other things on the performance of virtual project teams. Trust between the team members is one of the most important success factors for efficient and reliable project work. Considering time constraints and the culture of fast changing project teams the question is how trust and commitment in virtual teams can be established. Furthermore, are there other important factors and constraints for successful virtual team management?

2 Methodology

Based on the approach of grounded theory by Glaser and Strauss (1998) we deliver a framework of guidelines for virtual team management by the theoretical analysis of research outputs concerning computer supported cooperative work (Olson and Olson, 2000; Dix, 1997; Robertson, 2000), marketing research (Madhavan and Grover, 1998), communication theories (Watzlawick et al., 2003), and organizational science (Cramton, 2001; Cramton, 2002; Maznevski and Chudoba, 2000; Orlikowski, 2002).
A new product development case study was used to investigate and modify these guidelines. For this purpose, a virtual team developed a new milk product using e-collaboration for all communication processes and the exchange of documents and knowledge. Based on these outcomes a guideline for the management of virtual new product development teams will be presented which should guarantee a trustful and efficient product development process. In this respect, the attribute "trustful" is of tremendous importance as R&D-initiatives always contain the risk of a knowledge transfer to unwanted addressees as competitors.

3 Theoretical Background

By studying literature about success factors of virtual teams a wide variety of conceptual models can be found. Due to the dynamic and complex environment of virtual teams (often also international and/or cross-departmental teams) none of these papers offer empirical tests of the proposed models. Based on the various backgrounds of researchers (organizational management, computer-supported cooperative work, marketing, etc.) the approaches and factors differ one from another. To describe all models in detail would excess the available space of this paper, but to illustrate the diversity of the models some examples of them are discussed briefly. For example, Olson and Olson (2000, p. 164) mention four factors, which are *common ground* of team members, *collaboration-readiness* and *technology-readiness* of team members and *loose coupling*. The latter refers to the need to choose the right communication medium based on the complexity of the coordination task. For example, face-to-face meetings are highly preferable to conduct difficult and complex negotiations. Maznevski and Chudoba (2000) propose a success factor model where complexity and interdependency of tasks, team factors, technology factors, the kind of decision process and the complexity of the communication process have an influence on the team performance (figure 1).

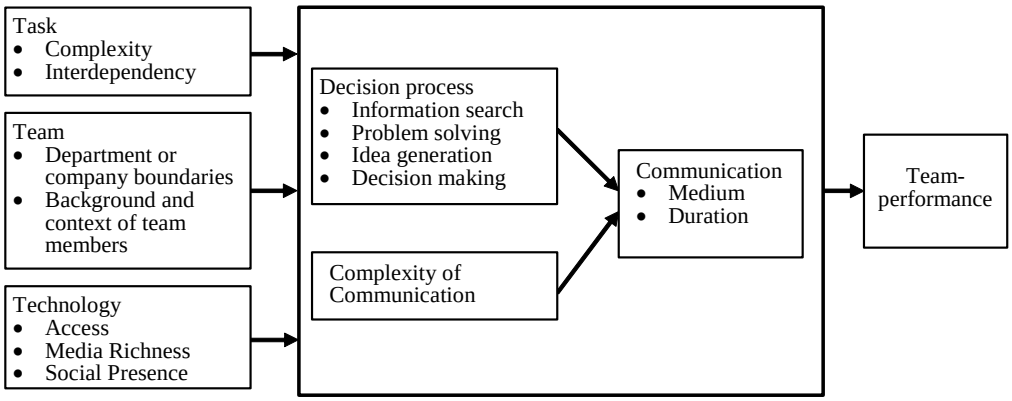

Figure 1. Success factors of global virtual teams based on Maznevski and Chudoba (2000)

Concerning trust Madhavan and Grover (1998, 6) distinguish between two forms of trust (figure 2). One is “trust in team members’ technical competence”, the other one is “trust in team members’ team orientation”. They emphasize the importance of “information redundancy” and of “rich personal interaction” on trust: “Rich personal interaction, consisting of direct, frequent, and informal interaction among members, will influence the trust in team orientation of other members positively …” (Madhavan and Grover, 1998, 6). This statement is in line with Watzlawick’s second communication axiom, noticing that personal trust can only be established over personal, direct, face-to-face communication (i.e. analogue communication; Watzlawick et al., 2003, 63). The factor *information redundancy* means “sharing of information over and above the minimal amount required by each person to do the job” (Madhavan and Grover, 1998, 8). Again, the importance of the communication style is emphasized. Compared to the success factors of Olson and Olson (2000) it is obvious that similar constructs with slightly different names like *common ground* and *shared mental models*

were used. A lack of trust in team members' team orientation would result in retention of information and an investment of resources in other projects.

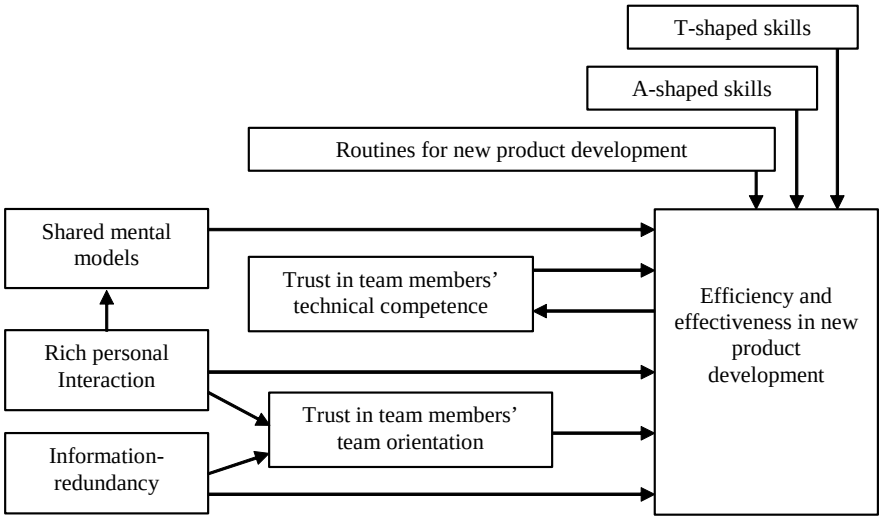

Figure 2. Success factors for cross-departmental teams (Madhavan and Grover, 1998)

Concerning "T-shaped skills" (i.e. expert knowledge in a certain field) and "A-shaped skills" (i.e. generalist knowledge necessary to bridge the knowledge of the different experts), it is sufficient to keep in mind that this distinction represents factors reflecting the importance of the required skills of the team members. In the model of Maznevski and Chudoba (2000) these factors are called "context and background of team members". Other researchers support the importance of team member skills: "… strong efforts needs to be given to the determination of the necessary task and work structure and ***required skills*** for concurrent engineering teams and team members" (Duffy et al., 1995, p. 443).
Because of the diversity of terms, variables and constructs mentioned in scientific publications about success factors for virtual teams it is necessary to search for underlying basic theories which could be used to group these factors in a traceable and comprehensible way. Two theories were used:

(1) The theory about *coordination* with respect to work flow (Thompson, 1967; Van de Ven et al., 1976): Coordination theory argues that increasing task interdependence leads to more complex coordination mechanisms; in other words, task characteristics influence coordination mechanisms.
(2) The theory about *integration* (Lawrence and Lorsch, 1967), i.e. the assumption that specialization in complex organizations brings negative side effects such as conflicting objectives or conflicts between departments. Other side effects are different cognitive styles, different cultures and different technical terminologies. Integrative measures like incentive systems or job rotation are necessary to reduce theses negative outcomes with respect to team work.

Table 2 summarizes the success factors for virtual teams found in literature with respect to their coordination and integration function.

Table 2. Factors of virtual teamwork

	Boutellier et al. (1998)	Cramton (2001), Cramton (2002)	Maznevski and Chudoba (2000)	Olson and Olson (2000)	Orlikowski (2002)	Watzlawick et al. (2003)
Coordination Thompson (1967) Van de Ven (1976)	ICT, project plan, clear process instructions, meeting protocols, to-	Common ground, "ambassador" online database, alternating visits, ICT	Tasks, boundary objects, alternation co-located and dislocated	Linking of work tasks, readiness for technology, common ground	Interacting face-to-face, learning by doing, supporting participation	Digital communication, operational level of communication
Integration Lawrence and Lorsch (1967)	Incentive systems	Common ground	Boundary objects, alternation between co-located and dislocated work	Common ground, collaboration willingness	Sharing identity, interacting face-to-face	analogue communication, emotional level of communication

This heuristic classification possesses obviously some overlaps. For example, it can be assumed that boundary objects have a coordinative function by visualizing project progress and an integrative function by supporting a team spirit. For a detailed description of the whole theoretical analysis see Haas (2004).

Table 3. Factors of cross-departmental teamwork

	Duffy et al. (1995)	Duffy and Salvendy (1998)	Duffy and Salvendy (1999)	Hauptmann and Hirji (1999)	Madhavan and Grover (1998)
Coordination Thompson (1967) Van de Ven (1976)	Skills and knowledge of team members, implementation of IT and structuring of tasks and work processes	Design for manufacturing / design for assembling, IT, knowledge of the production department	cross-departmental communication, top management promotes cross-departmental communcation	IT, authority and leadership of project leader	T-shaped skills and A-shaped skills, routines in new product development, common mental models
Integration Lawrence and Lorsch (1967)		Top management promotes cross-departmental communcation, incentive systems	Top management promotes cross-departmental communication, individual and team related incentive systems	Incentives for the team, job roation, leadership of the project leader	A-shaped skills, common mental models, trust in team members and technical competence, information redundancy

In addition, some of the most im portant factors of cross-departmental product development can be taken from **table 3**. Some of these factors, e.g. “design for manufacturing / design for assembling”, are specifically valid in the area of concurrent engineering. Therefore, it is not possible to apply them one-to-one with virtual teamwork (e-collaboration). The outcomes of the theoretical analysis are the basis for the following new product development case study. As a result, the case study will contribute to theoretical advancements confirming grounded theory by Glaser and Strauss (1998).

4 Case Study

The main aim of the case study was to develop a variety of product concepts for an innovative milk dessert with functional food attributes. The virtual new product development team consisted of 10 people: 2 employees of the Austrian diary “Gmundner Milch”, 6 students from the University of Natural Ressources and Applied Life Sciences, Vienna, and the authors of this paper. The whole project required about six months. The team members were situated in Vienna, Gmunden (distance 228 km away from Vienna), Klagenfurt (311 km) and Bolzano/ Italy (586 km). For communication purposes it was agreed to use an e-collaboration platform. Other communication media were telephone, e-mail and face-to-face meetings. During the whole project only three face-to-face meetings were held. Because of the importance of a dedicated relationship and interdependency management of virtual teamwork the project leader planned the following measures:

- Explicit project management, well defined milestones (Boutellier et al., 1998)
- A standardized scheme for product development (Madhavan and Grover, 1998)
- Definition of processes with high interdependences; foreseen for face-to-face meetings (Van de Ven et al., 1976, p. 324; Thompson, 1967, pp. 54)
- Workload-dependent usage of the e-collaboration platform for low and medium grade interdependencies (Boutellier et al., 1998)
- Explicit initiating of a positive emotional climate between all team members in order to promote trust (kick-off meeting, informal pre- and post-meeting periods etc.; Orlikowski, 2002; Watzlawick et al., 2003)
- Development of a project-specific mind map serving as a boundary object; developed at kick-off meeting (Henderson, 1991)
- Creation of templates provided via the e-collaboration-platform for documentation requirements (Sobek et al., 1998, p. 38)

The standardized scheme for all new product development purposes was the Stage-Gate-Process by Cooper (2002) and the decision based new product development process by Meixner (2003). On the basis of these schemes, it was possible to develop several product concepts in cooperation with the diary mentioned above. One of these concepts finally led to a marketable product, which is available in a specific Austrian supermarket chain since 1 January, 2004. By using e-collaboration tools and a virtual new product development team the creation and definition of the relevant product concepts were executed within the proposed time line without the necessity to make a lot of face-to-face meetings. A more detailed insight into the concrete new product development procedure can be taken from Meixner (2003, p. 247).

5 Management Guidelines

Based on the theoretical and empirical exploration the following guidelines could be derived. These guidelines represent hypotheses which should be empirically tested and evaluated in future research.

(1) **Trust:** To establish trust between team members analogue communication cannot be replaced by ICT-based communication. E-collaboration is a useful and efficient tool to support communication and data management but cannot replace face-to-face communication. It cannot be supposed that team members have enough trust in other team members in case of cross-departmental or cross-company e-collaboration teams. Therefore, it is absolutely necessary to establish personal relationship via informal face-to-face meetings prior to project start (e.g. kick-off meeting).

(2) **Skills**: The team should consist of generalists (A-shaped skills) and specialists (T-shaped skills). Team members should dispose of shared mental models for new product development purposes.

(3) **Rules for communication:** During the project most of the coordination is done by written communication. Therefore, team members should dispose of a clear and precise common language. Provide templates for executive summaries, minutes, protocols etc. In this respect it is of enormous importance to agree upon a convention for communication. For example, it is not acceptable not to response to e-mails ("netiquette"). Even the briefest comment is better than a non-response.

(4) **Project management:** The structuring of tasks and processes is even more important than in traditional project management. The difference lies in the choice of adequate communication media depending on different levels of interdependencies. This refers to identification of work packages, analysis of task characteristics, clear assignment of responsibilities, and the choice of relevant communication tools.

(5) **Milestones:** It is important to predefine milestones and objectives which can be reached *easily* at an early stage of the project. This promotes the creation of trust in the technological competence of the team members. In its ideal form the progress of the project will be consequently visualised in the e-collaboration platform.

(6) **Boundary objects** like mind maps, project plans, construction plans, time schedules provide a basis for the identification with the project, if they were developed and supported by all team members at the beginning of the project.

(7) **Privacy:** An e-collaboration platform is an important tool for knowledge and data management and the communication between team members. Privacy must be guaranteed. It is not advisable to grant the top management access to the documentation and the written communication. Only results should be transferred to superior management levels.

(8) **Misunderstandings and conflicts**: Using e-collaboration presumably leads to a higher potential for conflicts and misunderstandings. Therefore, all team members must be aware of in-group/out-group thinking and of negative attribution. Sometimes only face-to-face meetings can solve problems arising from dislocated communication. Another tool for preventing negative impacts of conflicts and misunderstandings are so called "cultural online databases" (Haas, 2004).

(9) **Collaboration readiness:** The existence of adequate incentive systems should be installed to assure collaboration readiness: transparent rules for the evaluation of teams and team members, rewards and benefits based on work performance etc.

(10) **Technology readiness:** Existing technologies have to be evaluated in view of their usability. In case of need software/system adaptations might be necessary. Furthermore, the use of an ICT technology for e-collaboration purposes usually requires guaranteed privacy. If it is not possible to keep information and communication within a system it cannot be supposed that the team members will be willing to play an important part in the project.

These guidelines reflect a knowledge creating cycle (or flowchart; see figure 3) which has to be initiated from project to project. To achieve a continuous increase of organizational memory, project results (i.e. explicit knowledge) have to be transferred to the company database (organizational memory). The tacit knowledge of the team members should be distributed within an organization through job rotation, communities of practice and mentors.

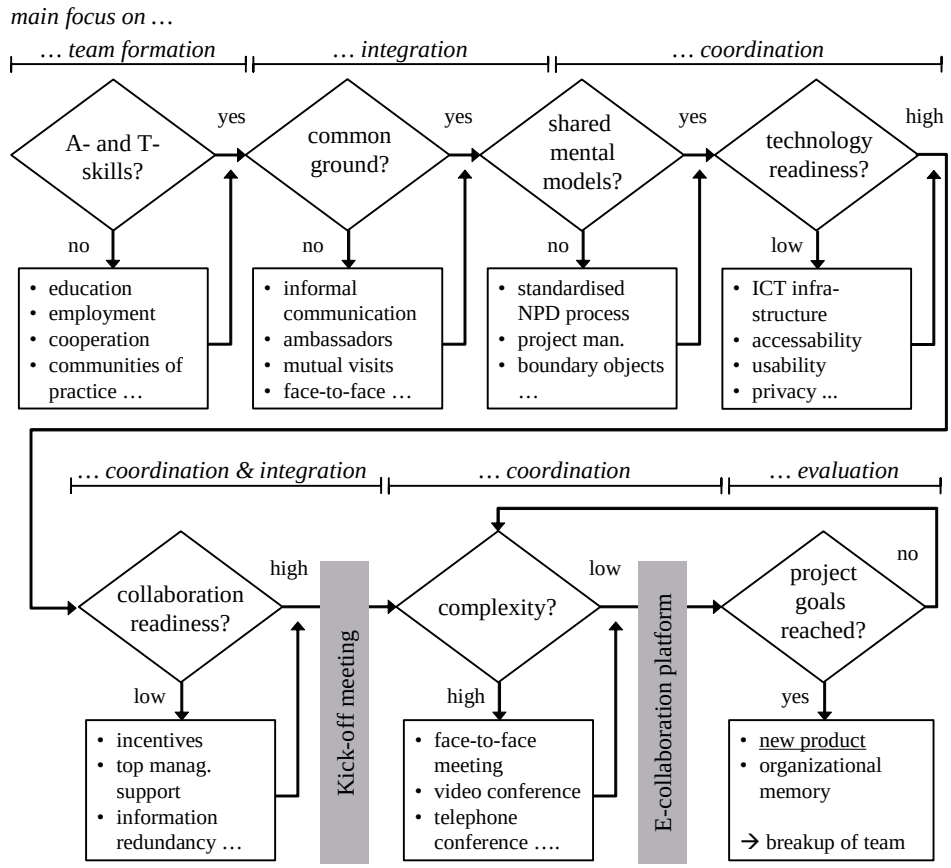

Figure 3. Management guidelines flowchart

6 Conclusion

In contradiction to the technological euphoria of the 1990ies we had to realize that the “death of distance” (Cairncross, 1997) through ICT-tools did not occur to the expected extent: The greater the distance, the higher the importance of the “human factor”. Efficient long distance

communication requires trust; trust is primarily established through informal face-to-face communication. Emotional aspects still dominate our perceptions and behavior; this is true for everyday life and especially for virtual teams. It seems that we still have to cope with a heritage of archaic behavior patterns to gain an efficient cognitive based information flow. In other words: “You can take the person out of the stone age, evolutionary psychologists content, but you can’t take the stone age out of the person” (Nicholson, 1998, p. 135). Nevertheless, a successful management of virtual teams and projects should be achievable if we consider this framework. The management guidelines presented above are a first step into further understanding of the complex and dynamic requirements of the management of virtual teams. In a second step, a thorough empirical evaluation has to be conducted in order to gain further insights.

7 References

Boutellier, R., Gassmann, O., Macho, H. and Roux, M. (1998): Management of dispersed product development teams: the role of information technologies. R&D Management, vol. 28, 1, pp. 13-25.

Cairncross, F. (1997): The Death of Distance: How the Communications Revolution will Change our Lives. Boston, MA: Harvard Business School Press.

Cooper, R. G. (2002): Top oder Flop in der Produktentwicklung. Erfolgsstrategien von der Idee zum Launch. 1. Aufl., Weinheim: Wiley-VCH.

Cramton, C. D. (2001): The Mutual Knowledge Problem and Its Consequences for Dispersed Collaboration. Organization Science, vol. 12, 3, pp. 346-371.

Cramton, C. D. (2002): Finding Common Ground in Dispersed Collaboration. Organizational Dynamics, vol. 30, 4, pp. 356-367.

Dix, A. (1997): Challenges for Cooperative Work on the Web: An Analytical Approach. Computer Supported Cooperative Work: The Journal of Collaborative Computing, 6, pp. 135-156.

Duffy, V. G., Danek, A. and Salvendy, G. (1995): A Predictive Model for the Successful Integration of Concurrent Engineering with People and Organizational Factors: Based on Data of 25 Companies. The International Journal of Human Factors in Manufacturing, vol. 5, 4, pp. 429-445.

Duffy, V. G. and Salvendy, G. (1998): Concurrent engineering diagnostic model integrating people, organization and technology, vol. 11, 5, pp. 461-474.

Duffy, V. G. and Salvendy, G. (1999): The impact of organizational ergonomics on work effectiveness: with special reference to concurrent engineering in manufacturing industries. Ergonomics, vol. 42, 4, pp. 614-637.

Fleisch, E. (2002): Das Netzwerkunternehmen. Österle, H., Fleisch, E. and Alt, R. (Eds.): Business Networking in der Praxis: Beispiele und Strategien zur Vernetzung mit Kunden und Lieferanten. Berlin (a.o.): Springer, pp. 40-73.

Glaser, B. G. and Strauss, A. L. (1998): Grounded theory: Strategien qualitativer Forschung. Bern: Huber.

Haas, R. (2004): Usability Engineering in der E-collaboration. Ein managementorientierter Ansatz für virtuelle Teams. Wiesbaden: DUV.

Hagel, J. and Singer, M. (1999): Unbundling the Corporation. Harvard Business Review, March-April, pp. 133-141.

Hauptmann, O. and Hirji, K. K. (1999): Managing integration and coordination in cross-functional teams: an international study of Concurrent Engineering product development. R&D Management, vol. 29, 2, pp. 179-191.

Henderson, K. (1991): Flexible Sketches and inflexible databases: Visual communication, conscription devices, and boundary objects in design engineering. Science, Technology, and Human Values, 16, 448-473.

Lawrence, P. R. and Lorsch, J. W. (1967): Differentiation and Integration in Complex Organizations. Administrative Science Quarterly, 12, pp. 1-47.

Madhavan, R. and Grover, R. (1998): From Embedded Knowledge to Embodied Knowledge: New Product Development as Knowledge Management. Journal of Marketing, vol. 62, October, pp. 1-12.

Maznevski, M. L. and Chudoba, K. M. (2000): Bridging Space over Time: Global Virtual Team Dynamics and Effectiveness. Organization Science. 11, 5: pp. 473-492.

Nicholson, N. (1998): How Hardwired is Human Behavior? Harvard Business Review, July-August, 135-147.

Olson, G. M. and Olson, J. S. (2000): Distance Matters. Human-Computer Interaction, vol. 15, pp. 139-178

Meixner, O. (2003): Entscheidungsunterstützung und Wissensmanagement in der Neuproduktentwicklung. NPD-X: Ein Expertensystem zum betrieblichen Innovationsverhalten. Stuttgart, Berlin: WiKu-Verlag.

Orlikowski, W. J. (2002): Knowing in Practice: Enacting a Collective Capability in Distributed Organizing. Organization Science, vol. 13, 3, pp. 249-273.

Robertson, T. (2000): Building Bridges: Negotiating the Gap between Work Practice and Technology Design. International Journal of Human-Computer Studies, 52, pp. 121-146.

Sobek, D. K., Liker, J. K. und Ward, A. C. (1998): Another Look at how Toyota Integrates Product Development. Harvard Business Review, July-August, 36-49.

Thompson, J. D. (1967): Organizations in Action: Social Science Bases of Administrative Theory. New York: McGraw-Hill.

Van de Ven, A. H. Delbecq, A. L. and Koenig, R. (1976): Determinants of Coordination Modes within Organizations. American Sociological Review, vol. 41, April, pp. 322-338.

Watzlawick, P., Beavin, J. H. and Jackson, D. D. (2003): Menschliche Kommunikation. Formen, Störungen, Paradoxien. 10. unveränderte Aufl., Bern, Stuttgart, Wien: Verlag Hans Huber.