6

Competency Rallying Processes in Virtual Organizations[1]

Bernard Katzy[1] and Kevin Crowston[2]
1University BW Munich, Center for Technology and Innovation Management, Munich, Germany
bernhard.katzy@cetim.org
2 Syracuse University School of Information Studies
Syracuse, NY 13244 USA
crowston@syr.edu

Abstract. Firms face an environment changing at an increasingly rapid pace. Unfortunately, the speed at which organizations can adapt their strategies and competencies to exploit such opportunities remains limited. In this paper we weave together an external perspective on market-facing with an internal perspective on competency development and marshalling to describe the organizational activities necessary for firms to cooperate within a virtual organization. We argue that firms can address their individual limitations through a systematic process that we call "competence rallying," with which they can access market opportunities and additional needed competencies. Specifically, we present a local process theory of how one network of firms reliably engineers and delivers manufacturing projects using an inter-organizational process that works to meet short-term market opportunities. Our theory is grounded in the experiences of the *Virtuelle Fabrik* project, an organized network for regional cooperation in the manufacturing industry around the Bodensee in Europe. The success of manufacturing projects in a

[1] The Virtuelle Fabrik project was started by the Institute for Technology Management, University of St. Gallen. Financial support was provided by The Swiss Commission for Scientific Research (KwF) and the Virtuelle Fabrik partner companies. The Virtuelle Fabrik project team included Günter Schuh, Bernhard Katzy, Kai Millarg, Thomas Zehnder, Stefan Eisen, and Åsa Göransson, as well as managers from the partner firms. The authors thank all of the participants in the Virtuelle Fabrik for their contributions and in particular, for the many discussions that led to the concepts discussed in this paper. The authors take sole responsibility for the work presented here. This paper has benefited greatly from discussion with Paul van Fenema, Steven Sawyer, Ping Zhang, Robert Heckman, Barbara Kwasnik, and Gisela von Dran.

virtual organization is predicated on specific organizational activities in four phases of the competence rallying process: 1) identification and development of competencies, 2) identification and facing of market opportunities, 3) marshalling of competencies, and 4) a short-term cooperative effort.

1 Introduction

Firms face an environment changing at an increasingly rapid pace. Market opportunities in particular can arise and disappear again in a short time. However, the speed with which organizations can adapt to changes remains limited. We refer to this situation, where the environment changes more rapidly than organizations can adapt, as a "turbulent environment" [1]. Turbulent environments re-pose two central questions addressed by theories of the firm: How does the firm behave in its market, and how is work organized?

In stable environments, the answers provided to these questions distinguish two broad types of theories of the firm. In the first type of theory, markets are assumed to determine the organization of work and it is the role of management to craft deliberate strategies to translate industry realities into appropriate organizational structures and processes. In the second type of theory, existing structures or "core competencies" [2] internal to the firm are used to explain its market behavior. Competencies are valuable, rare, inimitable, and embedded in the organization and thus define a resource barrier that provides a source of sustainable competitive advantage. As a result, strategies emerge from organizational structure and culture as long-term patterns of behavior [3].

While both types of theories deliver fruitful explanations of the nature of a firm in stable environments, the two questions point to opposite ends of a paradox for firms in turbulent environments. On the one hand, the insight of the first type of theory—that deliberate strategy is necessary—remains true even in the face of short-term market opportunities. However, time constraints make it impossible for firms to adopt appropriate organizational structures and routines to ensure performance for each change in the market. On the other hand, the insight of the second type of theory—that competencies inside the firm are a source of competitive advantage—holds true especially for short-term market opportunities. The more valuable a competency is, the longer it takes to develop (often a decade or more [2]), so competing firms cannot readily develop competencies to meet short-term opportunities. However, the unpredictable nature of market opportunities in turbulent environments increases the risk that necessary competencies may be missing and that existing competencies may become irrelevant or outdated. In short, turbulent environments make appropriate strategy and competencies simultaneously more important yet seemingly less attainable.

We suggest that one way for firms to resolve this paradox is by addressing these conflicting theoretical insights as distinct phases in a process that unfolds over time and across a virtual organization of cooperating firms [4]. In particular, we suggest that one way for firms to address their individual limitations in meeting short-term market opportunities is to cooperate with other firms for access to temporarily needed competencies they cannot build themselves. We use the term "rallying,"

meaning, "to rapidly reunite for concentrated effort" [5], to describe *the process of developing and bringing together in temporary cooperation a network of firms with the competencies needed to satisfy a newly-identified market opportunity*. In this paper, we describe the process of competency rallying for successful short-term projects in a particular virtual organization.

Aspects of the competency rallying process have been discussed before, of course, and these prior discussions provide some of the building blocks for our theorizing. For example, the role played by market recognition and competency recombination is evident in the Prato region of Italy [6], where many small textile manufacturing firms specialize in various aspects of textile and apparel production, such as weaving, dying, sewing, etc. These small companies are not able to identify worldwide customers, nor do they offer a complete range of desired services. Instead merchants, *impannatores*, provide access to the highly volatile fashion market opportunities for the entire industrial district [6] and temporarily bring together numerous small companies to fill the requirements for each particular contract. Similarly, Prahalad and Hamel [2] note that to develop competencies, they must be used and re-used in many different markets and contexts, as we suggest happened in our case setting. However, our theory is novel in the way that it weaves together an external perspective on market-facing with an internal perspective on competency development and marshalling to describe the overall process of competency rallying.

While the potential value of such cooperation is becoming more widely accepted, the details of competency rallying are little understood. The contribution of this paper is the development of a process theory of competency rallying that meets the demands of turbulent environments. The process theory is grounded in a detailed action research study of one successful virtual organization called the *Virtuelle Fabrik*.

2 Methodology

Following a grounded theory approach to theory building [7], we carried out a research project to develop a relatively full description of competency rallying in a specific setting. This description suggests further research that could be carried out in other settings to develop a more general description of competence rallying (as we will discuss in the conclusion of this paper). In this section, we describe the particular research setting, overall research methodology, and data collection and analysis approach. In the subsequent section, we describe the general structure and each phase of our proposed process theory in turn.

2.1 Research Setting: The *Virtuelle Fabrik*

Our study was conducted at the *Virtuelle Fabrik* (the "Virtual Factory"), an organized network for regional cooperation in the manufacturing industry in the Bodensee (or Lake Constance) region of Germany, Switzerland, Liechtenstein and Austria. The virtual organization started in 1996 and still operating today, routinely engineers and manufactures new products by recombining the competencies of its members to meet short-term market opportunities. Members of this virtual

organization (ranging from small and medium enterprises to divisions of large multi-nationals) have cooperatively produced dozens of products, from simple parts to a complex module for a letter-sorting machine.

2.2 Research Approach: Collaborative Action Research

The research project was carried out as a four-year collaborative action research case study [8]. To be able to study the process of cooperation between the project organizations, the core partners assumed the role of active promoters. Researchers acted partly as change agents in the firms and partly as observers of the change processes, "alternating the change agent and researcher roles" [9, p. 420].

Susman and Evered [8] describe a five-phase cyclic process for action research, consisting of 1) diagnosing, 2) action planning, 3) action taking, 4) evaluating, and 5) specifying learning:

1. **Diagnosing** includes identification of the primary problems that underlie the organization's desire to change and leads to the development of working hypotheses about the state of the organization. In this phase, action researchers can use techniques similar to organizational ethnography as a way to develop thick descriptions of the dynamics and processes of the organizations involved in the project (the methods used are described below).
2. In the next phase, **action planning**, researchers and practitioners collaborate in determining organizational activities to address the problems identified. This planning is based on the theories and models brought to bear by the researchers as well as the knowledge of the practitioners. In other words, the research is both theory-driven and theory-building.
3. In the **action-taking** phase, the planned changes are implemented. Being part of the change process requires the researchers to be participant-observers in the processes being studied.
4. After the actions are taken, researchers and practitioners collaborate in **evaluating** the outcomes, including determining whether the actions had the theoretically expected effects and if they were effective in relieving the problems, a form of theory testing.
5. In the final phase, **learnings** from the actions and results are formally specified. This phase distinguishes action research as research rather than simply a type of change effort. Baskerville and Wood-Harper [10] suggest three audiences for the learnings. First, the participant organizations can be restructured to reflect the new knowledge gained in the interaction. Secondly, where the change was not fully successful, the learnings may lead to a new round of diagnosis and action planning. Finally, the test or building of the theoretical framework in practice contributes to the development of scientific knowledge.

In this project, each cycle began with a diagnosis of the current state of the *Virtuelle Fabrik* project inspired by the data and literature. Then to see if this diagnosis could be supported, the project organizers developed an action plan that was cooperatively implemented by the researchers and managers. The results of the

intervention were observed and evaluated to see if the predictions were supported. These evaluations led the researchers to explore complementary perspectives and facets of the process of competency rallying. As the priorities of the project shifted, we modified or maintained each inference about the process. Informal discussions and formal reporting of the project led to specification of the learning and to the next round of action learning. Finally, we wrote up our inferences about the various aspects of the process, adding conceptual arguments, additional examples, and citations to relevant literature.

2.3 Data Collection

There are significant similarities between action research and other kinds of qualitative research in the modes of data collection. The evidence guiding our descriptions of and inferences about the process of competency rallying is divided into seven general categories:

1. **Semi-structured interviews with company managers**. The researchers conducted nearly 100 semi-structured interviews to diagnose a variety of topics with company managers. Interviewees included company directors and managers and employees involved with in- and outsourcing at all levels and departments. Each round of interviews lasted three to four days and resulted in a report describing the situation of the firm.
2. **Project plans**. The project was co-funded by the participating companies and the Swiss Commission for Scientific Research (KTI). The project plans showed the results achieved in the prior year, lessons learned from this work, and the specification of concrete actions for the year to come.
3. **Project meetings with partners**. Regular meetings were held among the partners to plan and take actions. Smaller formal meetings were held for parallel development work. Researchers attended many meetings as change agents or to follow the developments.
4. **Results of interventions**. The action interventions produced both intended and unintended results. Some of these results even appeared in parts of the partner companies remote from the project interventions.
5. **Observations of projects**. Partner companies executed numerous manufacturing projects, about fifteen of which were directly observed by the researchers. The researchers followed the interventions, progress, and difficulties encountered in these manufacturing projects to feed the observation back to the partner companies as lessons learned.
6. **Informal discussions**. As part of the ethnographic data analysis process, researchers were participant-observers in the network for four years and constantly had informal conversations with managers and employees of the participant companies. These ranged from brief interactions to long discussions over group dinners (known among participants as the “virtual dinner”, as discussed below). Researchers talked informally with employees at all hierarchical levels from all participant companies.

7. **Formal reports**. The researchers and managers regularly wrote up project results, which were defined as sub-projects from teams and work-packages. In 1998 a book was published in German reporting the project results in general [11], though not including the model presented in this paper.

2.4 Data Analysis

Action research uses much the same data analysis techniques as other kinds of qualitative research. Because our goal was developing theory, we followed the general approach of grounded theory [7, 12]. A variety of more specific data analysis techniques were used for different data and at different points in the action research cycle and in the project lifecycle. A primary approach was content analysis of the text for example, from interviews or observation) to develop insights on the development of manufacturing projects among the partner firms. By comparing the process of multiple manufacturing projects, regularities in the development processes could be induced. By using multiple sources of evidence, findings could be triangulated to improve our confidence in their reliability. The validity of the findings could be tested by checking with project participants and by using them as the basis for designing, implementing and testing helpful interventions.

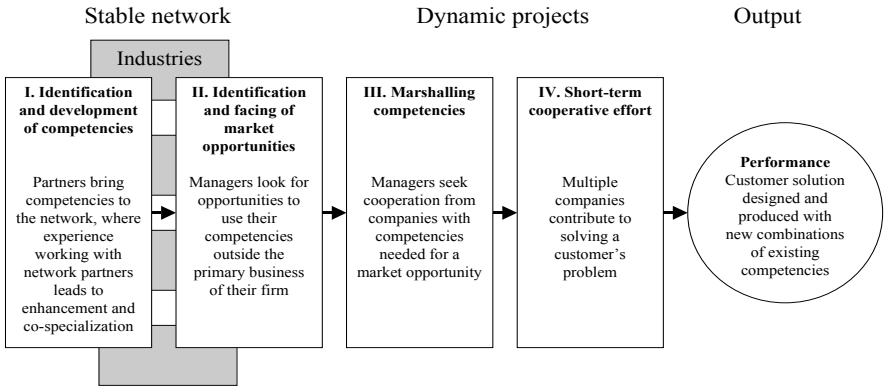

Figure 1. A process model of competency rallying. The first two phases are carried out in all member firms across multiple industries; the final two phases are carried out for the specific projects identified in Phase II.

3 A Process Theory of Competency Rallying

In this section, we present the process theory of competency rallying induced from the analysis of the collected data described above. Our analysis suggests that successful competency rallying involves four related sets of organizational activities, specifically: 1) identification and development of distinctive competencies in network members, 2) identification and facing of short-term market opportunities, 3) marshalling competencies from network partners for a particular market opportunity, and 4) a short-term cooperative effort. These stages of the process

theory are shown graphically in Figure 1. The first two phases are performed on an on-going basis within the relatively stable network of firms taking part in the *Virtuelle Fabrik* project. These phases draw on competencies and market opportunities from a variety of industries, as indicated symbolically by the grey boxes. The final two phases are performed dynamically for each individual product developed by the *Virtuelle Fabrik*.

3.1 A Process Model of Competency Rallying

The data from our case study suggests that successful design and manufacture of products by the *Virtuelle Fabrik* required the successful performance of four sets of activities: competency creation, market facing, competency marshalling and cooperative effort. For example, consider the development of the electric retraction device for a steering wheel, a product engineered and built within the *Virtuelle Fabrik*. The manufacturing project started when one of the network members, Wiftech, was approached by a customer and asked if they could provide the part. Wiftech itself did not have the capacity to build the part but offered instead to take the project to the network, an example of **facing a market opportunity**, which would have been impossible without the project. Wiftech passed the project on to a project leader from another firm, with whom they were acquainted from various project meetings. The project leader evaluated ten different technologies from ten independent firms in the network for technological feasibility and for their cost in the effort to design the part, an example of **marshalling competencies** ("to arrange things in an appropriate order so that they can be used effectively"). While ten companies were involved in the search for a technical solution, only three were involved in designing and manufacturing the first prototypes. The joint work of these companies at this stage is an example of a **short-term cooperative effort**. Final production required different partners, as the order quantities did not fit the one-of-a-kind manufacturing philosophy of the prototype manufacturers. Unstated in this example, but clearly necessary, were the on-going processes for **developing and maintaining the competencies** necessary to design and manufacture such a part in the first place. In the remainder of this section, we present the four phases of our process theory and the evidence for each phase.

Phase 1: Identification and development of competencies. The network rallies competencies that are provided by independent partner firms in the *Virtuelle Fabrik* project. These firms can provide competencies from their various industries (as indicated symbolically by the grey boxes in Figure 1) that are potentially valuable yet not exploited in other industries. This view corresponds with the stream of literature on the resource-based view of the firm, which describes firms as collections of resources that can be deployed to establish competitive positions in multiple markets with heterogeneous products [13].

Through the course of the project, the conception of "resources" gradually evolved and expanded. Initially, the view was quite limited: the original goal of the project was to increase machine utilization, so resources were machines. Descriptions of these machines across the industries were based on the generally accepted classification scheme and terminology from the DIN 8580 standard, which

defines all machining operations. Defining resources makes direct comparison across business or industry boundaries possible. It also led, in some cases, to a rethinking of the meaning of resources. For example, two member companies considered themselves experts in grinding in their respective industries, but when one contracted work to the other, they discovered that one was much cheaper than the other, a fact the companies could not have discovered through benchmarking only within their own industry. This discovery led to a revision in thinking about resources. Rather than viewing them as undifferentiated commodities (for example, tool machines), the view shifted instead to competencies: something one firm was better at doing than others. The second, more expensive company was forced to reconsider its competencies and determined that they lay in grinding smaller-sized parts and to more precise tolerances, which made them more expensive, in the particular case, but able to do work that the other firm could not. As this example shows, in order to participate in the network, firms had to clearly identify what competencies they could contribute. A second important benefit of the project was that experiences with the *Virtuelle Fabrik* contributed to the further development of competencies within the partner firms. This development occurred because workers within the companies faced requirements from a range of different industries and customer projects, which stretched their existing skills. Managers began to refer to this stretch as the "jogging effect," meaning that the little time they spent manufacturing for the network led to an increase in the fitness of the firm.

Experiences of cooperative manufacturing also revealed capabilities that were not linked to machine tools but which were needed to design and engineer complete customer solutions and thus equally important for successful projects. Examples included assembly, quality inspection and testing, project management and certification for ISO conformity. Unlike simple machining operations, the competencies discovered in this way were to a great extent intangible. There were no generally accepted definitions (such as DIN 8580) that could be used to describe the distinctive competencies the network could bring to bear on customer problems.

As well as within the individual member companies, competencies were developed at the level of the *Virtuelle Fabrik* as a whole. From experiences with joint manufacturing projects, stable sub-networks of partners emerged, which as a group proved to have competencies for applications in medical technology or precision machinery (for example). In building these sub-networks, the *Virtuelle Fabrik* project contributed to a trend of co-specialization of the partners. Some firms decided to give up certain technologies, for which they found reliable partners in the network, and to concentrate on other competencies, which proved to be competitive over a wider range of industries.

In summary, the *Virtuelle Fabrik* relied upon member firms' competencies, which were conceptualized as something one firm can do better than others. In order to contribute to the virtual organization, companies had to first clearly identify and further develop their competencies.

Phase II: Identification and facing of market opportunities. The *Virtuelle Fabrik* provided member firms with market opportunities beyond their core businesses and industries, again as indicated symbolically by the grey boxes in Figure 1. The conception of identifying and facing market opportunities evolved through the course of the project. Initially, the understanding was simply market access, an

important element in other networks where companies are not equally situated in terms of access to profitable opportunities. However, market opportunities do not present themselves neatly labeled as such. Instead, accommodating short-term market opportunities requires active entrepreneurial creation of business on the level of the partner firms as well as on the level of the network. We refer to these activities together as "market facing" (based on the concept of market orientation, [14]).

Penrose [15] argues that the market opportunity of a firm "comprises all productive possibilities that its 'entrepreneurs' see and can take advantage of." Her central argument is that the growth of the firm is limited by the managerial services (for example, "fundraising ingenuity," "ambition," or "entrepreneurial judgment") available for creating market opportunities. Such managerial services were particularly limited for the partners in the *Virtuelle Fabrik*, who were either internally-oriented production departments or small and medium-sized firms, where highly specialized management resources are particularly scarce.

Explicit market facing activities took time to develop. The majority of manufacturing projects in the first two years of the project were carried out for customers from inside the network. Some manufacturing projects had served external customers, but these usually occurred by chance or were initiated by the customer. The research project worked nearly exclusively on how to organize work in the network, so market-facing activities were a matter for the individual partner firms. However, experience and early success in manufacturing projects showed that the *Virtuelle Fabrik* was also successful with products that were not fully specified and for which the firms could use their engineering capabilities. To take advantage of these competencies, the project leaders promoted facing markets outside the network. Advances from the inward orientation to outside marketing were made in the third year of the action research project.

Organizational routines for facing market opportunities on the level of the network were initially developed as an adoption of existing product marketing techniques for the marketing of production competencies. For example, purchasing criteria were identified that could be used to signal the uniqueness and the buyer value of competencies from the virtual organization. Mapping these purchasing criteria on market segments and customers resulted in a number of target segments for which sub-networks of firms developed marketing plans. Exposure to new business opportunities raised awareness of market facing among the managers involved. A saying became common among them: "Market opportunities are like trains that run again and again through the station. To catch the train, you have to practice jumping on trains, not construct new stations."

In summary, identification of market opportunities provided member companies with access to applications for their manufacturing competencies in businesses beyond their traditional industry boundaries. Membership in the network exposed the firms to ideas and demands they would otherwise not have seen, with beneficial effects for the development of their competencies. Selecting business opportunities, as we have seen from the action interventions, requires more than simply picking them off the shelf. Instead, it is necessary for managers to be able and willing to perceive opportunities to stretch competencies beyond their primary business.

Phase III: Marshalling competencies. In the structure of the process theory, developing competencies and facing market opportunities represent two necessary

preconditions in the network of firms. However, they are not in themselves sufficient to address a customer's need. Central to the success of projects in turbulent environments is the quick combination and recombination of the competencies necessary for a particular market opportunity. In order to meet this need, members of the *Virtuelle Fabrik* developed routines for marshalling competencies, that is, for determining what competencies from which partner companies are required to satisfy a specific customer's need. Development of these marshalling capabilities was necessary to permit companies to address opportunities that could not be handled by any single firm.

Again, the conception of marshalling evolved over the course of the project. Initial activities were based on literature suggesting that markets would be an efficient means of allocating resources to evolving market opportunities without hierarchical overhead or central management [16]. For example, Miles and Snow [17] suggest that market mechanisms will become more important for marshalling competencies with the use of information systems that reveal the status of potential trading partner (a so-called full-disclosure system). A shift towards market coordination through computer systems also fits predictions based on transaction cost economic analyses [18]. In accordance with these suggestions, a full-disclosure information system, called the "Technology Capacity Bourse," was developed in the early stages of the project. This database provided descriptions of the machine tools available in each of the member companies. The goal of the system was to reduce the cost of searching for partners and specifying competencies.

The system served its purpose until the partners attempted to include real-time capacity information to automate competencies marshalling. At that point, action reflection revealed that managers of the partner companies were not prepared to make sourcing decisions solely based on information from the database. This was especially true for many of the intangible competencies developed in the network that could not be described as succinctly and unambiguously as the physical resources (for example, engineering or integration competencies). Because of the difficulty of describing such competencies, a simple database was out of the question in any case.

Instead of relying on technology, organizational routines for marshalling competencies were developed. The researchers analyzed early experiences of manufacturing projects to identify problematic situations. Small teams of managers and researchers then developed what the project partners called the "rules of the game." Each rule was presented to all *Virtuelle Fabrik* project partners and a formal vote taken on adding it to the set of guidelines for collaboration. These guidelines eventually covered the entire lifecycle of a co-operative manufacturing project, for example, how partners are selected, how prices are calculated co-operatively, a checklist of how to specify customer products, and a standard contract. In addition, the researchers drew on literature to describe the complementary roles and positions of cooperating partners. Consideration of these functions led to the specification of a set of roles to ensure that the competencies needed for a successful manufacturing project were available. One firm might fill different roles (or even multiple roles) for different manufacturing projects, as long as it was clear who was responsible for a role and all were filled.

Apart from those explicit guidelines, mutual site visits and experiences from joint production projects contributed to shared knowledge about the competencies and priorities of individual partner firms in the network. Frequent informal social contacts, such as the "virtual dinner," provided the relationships needed for marshalling competencies on a self-organized, ad hoc basis. This body of shared knowledge formed what some have called a knowledge market [19]. Based on the mutual knowledge of partners' competencies acquired during the project meetings and site visits, managers chose to use personal contact to directly settle technical issues. Other authors have documented similar networks that seem to operate without a central design agency, such as industrial districts in Italy [20] and the film industry in Hollywood [21]. These cases are similarly reported to have culturally embedded restructuring mechanisms independent of any central institution.

In the end, the database in the Technology Capacity Bourse was regarded more as a means to establish a first contact (yellow pages), while placing orders was based on personal contact. Kumar et al. [20] similarly report the failure of an information system for transaction management in the Prato region, which they attribute to a mismatch between the economic rationality of the system and the need of the managers to build trust and a relationship with the companies with whom they interacted.

Phase IV: Short-term cooperative effort. Rallying competencies requires that multiple partners temporarily unite to combine their forces in a concentrated effort to create a new solution for a customer. The fourth set of organizational activities in the process addresses the question of how management can facilitate and elicit "the willingness of individuals to contribute force to the cooperative system" [22, p. 83]. There were several issues that had to be addressed.

First, the project leaders had to address the development of cooperative processes to allow companies to give and take business at a reasonable cost. Evaluation of initial projects showed that the additional coordination among independent firms led to roughly 30% higher cost than would have been the case for a manufacturing project performed within a single firm. Clearly such a cost disadvantage could not be tolerated. Firms therefore engaged in the reengineering of firm-boundary-spanning processes to make cooperation within the network as efficient as in-company processes. Duplicate activities—such as repeated quality inspection each time a part crossed a firm's boundary, filling out a full set of shipping papers and purchase orders, or work preparation and entering the workload in the next firm's electronic planning systems—were traced and eliminated. Of course, elimination of these activities also removed an important set of safeguards against mistakes and opportunism by partners. For this type of cooperation to work, expectations for the performance of the work moved from control at the transaction level to controls at the level of the network. Companies had to agree to follow the procedural guidelines that the project leaders derived from experiences with earlier manufacturing projects.

Second, direct communication was established between the involved operators in the *Virtuelle Fabrik,* avoiding chain-of-command communication. For example, partner companies created dedicated liaison positions with the ability to by-pass normal business processes for network business or allowed an outsourcing firm to contact machine operators directly. Consequently, expectations of what individual employees would do changed. For many machine operators, work for the *Virtuelle*

Fabrik included external contact for the first time, forcing them to build skills in communication or conflict resolution. Of course, empowering production staff to accept work for the firm has the potential for conflict between their decisions and the traditional hierarchical control of the company and work processes, and these conflicts had to be resolved.

Third, in the course of the project, short-term cooperation increasingly shifted towards substantial arrangements. The established guidelines, for example, covered the context of cooperation, for example, the process of acceptance of new partners by the network, the process of specifying customer products, the process of calculation of cost, reward systems, and the communication processes in the network. On the other hand, direct procedural arrangements to control transaction were declined by the partner firms. For example, after the discussion of several proposals, it was decided that a guideline for the allocation of resources within partner firms was not required. Instead, the managers agreed that work could be delegated within the network, but not the responsibility for its quality, timeliness and cost. In other words, rather than having a rule for how to allocate resources, it was the explicit agreement of the managers to leave open how commitments were met, as long as they were.

This focus on substantial rather than procedural cooperation resembles the particularities of the craft industrial mode. As Piore and Sabel [6] explain with the example of the construction industry, manufacturing projects are too short-lived, firms too unstable and employment too ephemeral for time-consuming process of grievance arbitration. Moreover, individual customer-defined projects vary too much to justify the establishment of arbitration systems that are unlikely to have any bearing on the facts of future conflict. Unlike mass production, this mode of working requires the collaboration between workers and managers. Since the work is always based on a unique design, problem solving is a trial and error process based on the craftsman's experience. It is therefore not surprising that organizational units are small and supported by personal leadership. Improvements are based on the ingenuity and creativity of the individual and his technical excellence, which is challenged by the customer's desire.

In summary, our data suggest that competency rallying involved four related sets of organizational activities, specifically: 1) identification and development of distinctive competencies in network members, 2) identification and facing of short-term market opportunities, 3) marshalling competencies from network partners for a particular market opportunity, and 4) a short-term cooperative effort. Our data suggest that the successful performance of these activities in the *Virtuelle Fabrik* was necessary (though not sufficient) for the design and development of manufacturing projects that met emerging customer demand in a turbulent environment.

4 Discussion

Two characteristics strike us as key to understanding the success of the *Virtuelle Fabrik*, although further research would be valuable. A first characteristic is the nature of the manufacturing projects carried out in the *Virtuelle Fabrik*. The project started with the goal of trading commodity manufacturing, but it turned out that it performed best for products requiring intensive engineering for which intensive

interaction between customer and designers and among designers is necessary. In short, the process summarized in Figure 1 worked best for cases where marshalling of competencies and cooperation mattered. On the other hand, for standard, off-the-shelf products, the degree of customized effort represented in this process is probably inappropriate. Instead, for these products an electronic market might be useful to lower transaction costs and enable customers to locate low-cost suppliers. A possible research question then is how companies can develop procurement processes and criteria to decide when to purchase from an electronic market and when to seek the specialized services of a virtual organization.

Second, the partners in the *Virtuelle Fabrik* operated in turbulent environments, meaning that the environment, and in particular the demands of the market, changed more rapidly than the strategies and competencies of the companies could change. In part these changes were endemic, due to increased competition and the companies' strategies of innovation, and in part they were due to participation in the *Virtuelle Fabrik*. Because of the turbulence of the market, it was necessary for these companies to search for new market opportunities where they could apply their competencies and to be able to marshal collections of competencies, including competencies from other firms, in order to satisfy rapidly-emerging market opportunities. Turbulence is characteristic of industries where market demand is uncertain or where technologies are rapidly evolving. Jones et al. [23] have identified demand uncertainty, task complexity, human asset specificity and frequency as factors leading to the need for network governance. Describing Silicon Valley, Saxenian [24] showed how production networks among computer systems companies spread the risks of developing new technologies. Similarly, in the Hollywood film industry, agents provide access for actors to new films [21].

In a more stable environment, where innovation is less critical, some of the activities we have described may well be unnecessary. For example, in Prato, where the production processes are well understood, explicit marshalling of competencies seems to be less necessary. *Impannatore* reportedly do not need to know the details of the production chain; instead, they pick an initial firm, which can in turn place further work. However, we speculate that even in stable environments the processes we have described may be useful. Miles and Snow [25] point out that dynamic networks—likely arenas for competencies rallying—offer firms additional strategic options. Competency rallying makes firms more agile and able to respond quickly to customer requests. Organizations that are practiced at the process we have described should be able to change very rapidly since they are constantly changing anyway. In other words, competency rallying seems to be an important "dynamic capability" [26]. An important research question here is to identify and describe appropriate control mechanisms for firms that are constantly on the edge of instability.

Finally, consideration of the case suggests some important preconditions for its success. For example, the project leaders spent considerable time discussing and refining reward mechanisms for participation in the *Virtuelle Fabrik*. Other factors are not yet fully understood and or under the control of the project leadership. Some of these were implicit in the industrial district and created and reinforced by other means, such as common training, past interactions, etc. Other researchers have documented empirical evidence for such processes in industrial districts such as Prato [20] or the watch industry in Switzerland. In these areas, extensive

socialization mechanisms have been developed, for example, professional schools, professional associations, institutions, governance structures and traditions [6]. In other words, while the manufacturing projects undertaken by the *Virtuelle Fabrik* are only short-term, commitment to the *Virtuelle Fabrik* and the industry is long-term. The failure of other networks may be attributable in part to an absence of these factors, which led to suspicion and mistrust among the partners, disinterest and eventual disintegration of the network [27]. Further research might consider what factors are necessary for the success of a cooperative venture such as the *Virtuelle Fabrik*, and how these factors are realized. Many of these factors seem to be regional and specific. Given that information technology makes cooperation possible on a global scale, future research might consider how (or indeed, if) absence of local factors can be overcome and cooperation extended globally.

5 Conclusion

In this paper, we developed a process theory of competency rallying, that is, of *the process of developing and bringing together in temporary cooperation a network of firms with the competencies needed to satisfy a newly identified market opportunity*. Our process theory hypothesizes that competency rallying consists of four related sets of organizational activities, specifically: 1) identification and development of distinctive competencies, 2) identification and facing of short-term market opportunities, 3) marshalling competencies from network partners and 4) a short-term cooperative effort. Some of the basic building blocks of our process theory have been discussed before, but our process theory is novel in the way that it weaves together an external perspective on market-facing with an internal perspective on competency development and marshalling to describe the overall process of competency rallying. The purpose of an action research study such as the one reported here is to guide and inspire new ideas and practices rather than systematically testing existing theories. Our process theory of competency rallying suggests that performance of firms in turbulent environments should be studied by considering both how these firms face the novel market opportunities and how they marshal competencies to attack these opportunities. In doing so we build on research on entrepreneurial behavior of individuals [28] but shift the level of analysis to the organization.

The study of rallying processes advances another existing but so far distinct research stream by generalizing the concept of agility [29] of virtual organizations beyond its origins in the reallocation (or switching) of mainly physical resources [30-32]. While reallocation or switching has been accepted as an important mechanism to achieve agility, our process theory offers a richer description of how it is undertaken. Competency rallying offers an organizational perspective on the reallocation process within a network of firms. As such, it also contributes to research on the concept of dynamic capabilities [26, 33] that sustainable firm performance can be based on the mastering of organizational routines of resource reconfiguration. More specifically our local explanation of competency rallying in turbulent environments, summarized in Figure 1, contributes empiric evidence “that dynamic capabilities are not tautological, vague, and endlessly recursive” [26, p.1116]. It is our hypothesis that

competency rallying provides a structured set of common and specific dynamic capabilities that can be observed in other settings, despite the high degree of idiosyncrasy of dynamic capabilities and path-dependency in their emergence.

The extent to which our local explanation of competency rallying in turbulent environments, summarized in Figure 1, develops into a more general theory depends on how well it works in other settings. For example, Crowston and Scozzi [34] successfully used the process theory to analyze cooperation in Open Source Software development projects. One of the first questions for future research is whether or not the process of competency rallying in other settings resembles our model, or whether the model is unique to the *Virtuelle Fabrik*. A possible approach to answering this question is to apply well-known theory-testing techniques. For example, a large-scale survey of networks could be attempted to statistically replicate this model. A problem with this approach is the difficulty of identifying functioning networks, since unlike firms they do not appear in directories with contact addresses, ready to be sampled. Another approach would be a meta-analysis of existing case descriptions of networks, although there are obvious difficulties with this approach also.

For an action research project, it may be more meaningful to ask how the experiences of this project can influence further action. In this sense, replication of the *Virtuelle Fabrik* project is already underway, as other groups are building similar networks in their own regions and industries. One such example can be found in the construction industry in Switzerland. Four other networks in precision machining are operating or planned in the regions around Bern and Basel, Switzerland and Augsburg and Aachen, Germany. One of these groups has already informally reported a significant backlog of orders for the network. These groups have adopted the *Virtuelle Fabrik* processes and, though independent, are working with the *Virtuelle Fabrik* project research team. Clearly, the interest of these groups in replicating the *Virtuelle Fabrik* is an indication of its success in changing peoples' mindsets about the value of such cooperative networks. Their experiences will be a valuable replication of our results.

References

1. S. L. Brown and K. M. Eisenhardt, The Art of Continuous Change: Linking Complexity Theory and Time-paced Evolution in Relentlessly Shifting Organizations, *Administrative Sciences Quarterly* 42(1), 1 (1997).
2. C. K. Prahalad and G. Hamel, The Core Competence of the Corporation, *Harvard Business Review* 68(3), 79 (1990).
3. H. Mintzberg, Patterns in Strategy Formulation, *International Studies of Management and Organization* 9(3), 67 (1979).
4. M. S. Poole and A. van de Ven, Using Paradox to Build Management and Organization Theories, *Academy of Management Review* 14(4), 562 (1989).
5. British Academy, The Oxford English Dictionary (Oxford University Press, Oxford, 1971).
6. M. J. Piore and C. F. Sabel, *The Second Industrial Divide - Possibilities for Prosperity* (Basic Books, USA, 1984).

7. B. G. Glaser and A. L. Strauss, *The Discovery of Grounded Theory: Strategies for Qualitative Research* (Aldine Publishing, Chicago, 1967).
8. G. I. Susman and R. D. Evered, An Assessment of the Scientific Merits of Action Research, *Administrative Science Quarterly* 23582 (1978).
9. H. Aguinis, Action Research and Scientific Method: Presumed Discrepancies and Actual Similarities, *Journal of Applied Behavioural Science* 29(4), 416 (1993).
10. R. L. Baskerville and A. T. Wood-Harper, A Critical Perspective on Action Research as a Method for Information Systems Research, *Journal of Information Technology* 11235 (1996).
11. G. Schuh, K. Millarg, and A. Göransson, *Die Virtuelle Fabrik* (Hanser Verlag, Stuttgart, 1998).
12. K. M. Eisenhardt, Better Stories and Better Constructs: The Case for Rigor and Comparative Logic, *Academy of Management Review* 16(3), 620 (1991).
13. M. H. Meyer, The Product Family and the Dynamics of Core Capabilities, *Sloan Management Review* 34(2), 29 (1993).
14. A. K. Kohli and B. J. Jaworski, Market Orientation: The Construct, Research Propositions, and Managerial Implications, *Journal of Marketing* 54(2), 1 (1990).
15. E. Penrose, *The Growth of the Firm* (Basil Blackwell, Oxford, 1968).
16. L. S. Flaig, The "Virtual Enterprise": Your New Model for Success, *Electronic Business* (3), 153 (1993).
17. R. E. Miles and C. C. Snow, Network Organizations: New Concepts for New Forms, *The McKinsey Quarterly* (4), 53 (1986).
18. T. W. Malone, J. Yates, and R. I. Benjamin, Electronic Markets and Electronic Hierarchies, *Communications of the ACM* 30484 (1987).
19. T. H. Davenport and L. Prusak, *Working Knowledge: How Organizations Manage What They Know* (Harvard Business School Press, Boston, 1997).
20. K. Kumar, H. G. van Dissel, and P. Bielli, The Merchant of Prato Revisited: Towards a Third Rationality of Information Systems, *Management Information Systems Quarterly* 22(2), 199 (1998).
21. H. T. Goranson, *The Agile Virtual Enterprise* (Quorum Books, Westport, CT, 1999).
22. C. I. Barnard, *The Functions of the Executive* (Harvard University, Cambridge, MA, 1938).
23. C. Jones, W. S. Hesterly, and S. P. Borgatti, A General Theory of Network Governance: Exchange Conditions and Social Mechanisms, *Academy of Management Review* 22(3), 911 (1997).
24. A. Saxenian, The Origins and Dynamics of Production Networks in Silicon Valley, *Research Policy* 20423 (1991).
25. R. E. Miles and C. C. Snow, Causes of Failure in Network Organizations, *California Management Review* 34(3), 53 (1992).
26. K. M. Eisenhardt and J. A. Martin, Dynamic Capabilities: What Are They?, *Strategic Management Journal* 211105 (2000).
27. S. E. Human and K. G. Provan, An Emerging Theory of Structure and Outcomes in Small-firm Strategic Manufacturing Networks, *Academy of Management Journal* 40(2), 368 (1997).
28. R. G. McGrath and I. C. MacMillan, *The Entrepreneurial Mindset* (Harvard Business School Press, Boston, MA, 2000).

29. S. L. Goldman, R. N. Nagel, and K. Preiss, *Agile Competitors and Virtual Organizations—Strategies for Enriching the Customer* (Van Nostrand Reinhold, New York, 1995).
30. W. H. Davidow and M. S. Malone, *The Virtual Corporation* (Harper Business, New York, 1992).
31. A. de Meyer, *Creating the Virtual Factory* (Insead, 1992).
32. A. Mowshowitz, Virtual Organization, *Communications of the ACM* 40(9), 30 (1997).
33. D. J. Teece, G. Pisano, and A. Shuen, Dynamic Capabilities and Strategic Management, *Strategic Management Journal* 20509 (1997).
34. K. Crowston and B. Scozzi, Open Source Software Projects as Virtual Organizations: Competency Rallying for Software Development, *IEE Proceedings Software* 149(1), 3 (2002).

About the Authors

Bernhard R. Katzy started his professional career with an apprenticeship as car mechanic and later earned master degrees in electrical engineering and business management. He holds a PhD in industrial management from University of Technology (RWTH) Aachen in Germany and a second Ph.D. (habilitation) in general management and technology management from University of St. Gallen, Switzerland. He currently is professor at the University BW Munich (D) and Leiden University (NL) and director of CeTIM–Center for Technology and Innovation Management. His research interest is about entrepreneurial management of fast growing high-tech firms and the management of strategic change in the transition to the information age.

Kevin Crowston is a Professor in the School of Information Studies at Syracuse University. His research focuses on new ways of organizing made possible by the use of information and communications technology, including in particular virtual teams and organizations. He approaches this issue in several ways: empirical studies of coordination-intensive processes inhuman organizations; theoretical characterizations of coordination problems and alternative methods for managing them; and design and empirical evaluation of new kinds of computer systems to support people working together.