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A new orientation to deal with uncertainty in projects

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1. Introduction

The term of management, according to prevailing interpretations, refers to planning, governance and control. This understanding is linked to the effort to conquer and eliminate uncertainty as far as possible. In this context, uncertainty appears as an obstacle or even as a threat to successful management. This idea usually also applies to project management, at least up to now. The present paper approaches project management from a sociological perspective, considering changes in dealing with uncertainty in projects in the context of overarching social developments. It presents the *thesis* that projects are characterized by a dual uncertainty, the consequences of which are not (completely) foreseeable and can only partially be managed by plan-oriented methods.

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Firstly, this paper argues that changes in dealing with uncertainty in projects touch upon fundamental socio-cultural convictions, deeply rooted in modern societies. So they require equally fundamental cultural and institutional reorientations (Section 2). The changes in dealing with uncertainty in projects are, moreover, embedded in general trends of science, technology, and organization, presenting new challenges for dealing with uncertainty in general. Recent approaches critically discuss the traditional concentration upon preventing or eliminating risks in projects, suggesting instead to consider the positive potentials of uncertainty in projects (Section 3). Against this backdrop, the changes in dealing with uncertainty in projects get an overarching and trend-setting significance for society as a whole. Drawing on the authors' empirical investigations and results, the thesis is put forth that a dual uncertainty is existent in projects (Section 4). Experience-based work action in projects is an important strategy to deal with these uncertainties. The dimensions of this kind of work action are presented using the example of selected empirical situations occurring during the project process (Section 5). The results are summarized in a concluding section (Section 6).

2. Planning and elimination of uncertainty as a guiding principle in the culture of modern societies

In social science, the evolution from the traditional agrarian society to the modern industrial society is often described in terms of a transition from stability and certainty to change and uncertainty. According to this description, a hallmark of modern societies is the "destruction of old certainties" (Bonß, 2010) by dissolving traditional communitization, religious worldviews, and experiences of agricultural and handicraft work (Giddens, 1995; Joas and Knöbl, 2004; Nassehi, 2006; Wehling, 1992). This goes along with the diagnosis of a permanent change of the scientific, technological, social and cultural areas of life. There is no doubt that scientific and technological change is closely interlocked with social and cultural change, but the respective ways on how to deal with uncertainty are very different. The guiding principle of the scientific and technological change in Europe is mastery of nature, accompanied by the conviction that "one can, in principle, master all things by calculation" (Weber, 1919/1988, p. 594). Thus, the "maturity of mankind" advocated in the enlightenment era, the "disenchantment" (Weber) of the world, is mainly directed to the disenchantment of nature by calculation. So the natural sciences become the model of modern science. The idea of autonomy developed by the 17th and 18th century enlightenment finds its first and foremost expression in the mastery of the powers of nature. In central Europe, this perspective increasingly became the guideline for the behavioral demands to individuals in social processes as well. Rationalization of action is considered as a development that not only allows for options of action but also makes individual action understandable and predictable for others (Weber, 1919/1988). This means that both uncertainty (invention of the unknown) and certainty (calculation and calculability) are essential features and requirements of industrial societies, but these two features have met with very different interpretations and value judgments. Whereas the guiding principle of "mastery of nature" and the production of certainty connected to it have been valued as the comprehensive signum for conscious and economically successful human action, uncertainty has received the signum of powerlessness and has been interpreted as the consequence of individual resp. collective failure to control the environment.

Industrial societies have developed a formidable repertoire of strategies and institutions to overcome and remove uncertainty. Among the most important are science, technology, and organization. Especially the natural sciences became the epitome of the ability to progressively decipher and master nature's secrets. Technological progress was seen as proof that it is possible to systematically apply and master the given conditions of nature, and the bureaucratic organization seemed to show that it is also possible to plan, govern, and control social processes. This is evident in technological developments geared to seal themselves off to a large extent from the potential "risk factor man". Upon the organizational level, enterprises follow the guiding principle of Taylorism, which results in an effort to largely eliminate the subjective side of the workforce. This constitutes a twofold task for the management. On one hand, they have to align management action to this principle; on the other hand, they permanently have to produce and reproduce the preconditions for the plannability, governability and controllability of the technical and organizational processes. In this context, uncertainty appears as a deficiency and a disturbing factor that should be eliminated as far as possible. This can best be effected if the technical and organizational processes are stable and steady and if internal as well as external influences are known and can be controlled. However, the strategies to eliminate uncertainty are also applied to events and processes that turn out to be beyond complete control.

The concept of risk is a manifestation of this tendency. It refers to the effort to describe events and processes that are not completely predictable and controllable as precisely as possible, calculating the probability of their occurrence. Upon this basis, it appears possible to plan how to deal with risks, with reference to the probability of their concrete occurrence, and to develop an appropriate risk management in order to estimate and calculate their concrete forms of occurrence. By this operation, uncertainty is being differentiated into two forms: risk (known unknowns) and uncertainty proper (unknown unknowns). An important task of risk management is to transform uncertainty into risk as far as possible in order to make it plannable and controllable. So it seems possible to plan how to deal with risks (Lupton, 1999).

Against this backdrop, it has seemed only natural to transfer the general principles of business management to the organization of projects. This means that if unforeseen incidents or disturbances occur in the course of a project, the cause is seen in insufficient project planning, management, and control, individual misconduct of the project participants, or "extraordinary events" that cannot be expected or calculated under normal circumstances. The basic assumption is that limits of planning and control met in actual practice will be overcome in the future and that they are conquerable in principle. It is doubtlessly necessary to plan projects and to guide and control their implementation. It is also true that a respective project management is indispensable and that the development of suitable procedures and tools to guarantee project quality and efficiency is an important task. However, the question arises whether these traditional concepts and procedures are sufficient for successful project management and project work. This is the subject of the following section about new challenges in dealing with uncertainty.

3. New challenges in dealing with uncertainty—from elimination to utilization

Since the 1980s, a change in dealing with uncertainty has been taking shape in the highly industrialized societies. This development is not without brisance, as uncertainty is now emerging in a new form precisely in the areas where the strategy of elimination of uncertainty had been eminently successful in the past.

Within this evolution, science turns out to be not only an institution producing reliable knowledge and certainty but also

a procedure to challenge certainty, both of a traditional, religious or experience-based nature and of a scientific nature. Science thus also gives rise to new areas of un-knowing and produces different knowledges and "certainties" in plural form (Wehling, 2006) referring to identical issues, dependent on perspective and scientific discipline. Increasingly complex and interconnected technological systems give rise to new imponderabilities due to a great number of internal and external influence factors that are not completely predictable and controllable (Böhle and Rose, 1992; Pfeiffer, 2007; Weyer and Grote, 2012). New models of organization, particularly the decentralization of enterprises, not only lead to a heightened flexibility but also boost the internal dynamics and self-organization. Moreover, with the expansion of services the interface between organization and market becomes fluent, there is a blurring of boundaries, and imponderabilities originating from market and customer relations are imported into the organization (Heidling, 2011). Particularly service work with contact to customers and clients implies fundamental uncertainties, much more so than production and administration work inside the enterprise (Böhle, 2011; Dunkel and Weihrich, 2012).

These trends are increasingly apparent also in the area of project implementation and project management. Notwithstanding the development and expansion of sophisticated methods and tools of project management, deviations from planning and even total failure are anything but exceptions or rare occasions. For instance, a survey conducted in 2013 examined 5400 software projects. Almost half of them exceeded their cost budgets before the project was finished, more than half of them could only produce a reduced scope of delivery (as compared to the contract), and nearly one fifth of them even put the existence of the enterprise conducting them at risk because of their underperformance. IT project problems are particularly dicey because IT components are often integrated into larger product, process, and system contexts. This can cause a cumulation of problems as soon as the IT components are combined with other components in the course of product assembly (Dalcher, 2014, p. 179; see also Williams and Samset, 2010; Liu et al., 2011). Other surveys in the area of big industrial projects on a global scale yielded similar results. 65% of 318 projects that had been included in the survey failed to fulfill the planned project targets. The planned costs were 40% overdrawn on average, the time delay in the course of the project amounted to 28% on average. Finally completed, the production facilities only delivered 60% of the planned product quantity (Merrow, 2011, p. 48). These results are giving rise to the question whether limits of planning as they obviously occur in practice are really only due to inadequate development and application of planning, management and control. These limits of planning might rather be in the nature of things.

Projects are essentially limited in time. The targets they pursue and the conditions they have to cope with are variable or even totally unprecedented. Projects have to cope with far greater difficulties to create certainty about targets, resources, procedures, conditions of application and environment than stable and continuous processes. In projects, elimination of uncertainty may often resemble the struggle against Hydra who for each head cut off grew two more.

The inevitability of uncertainty in projects can be founded both on ontological and pragmatical reasons. The ontological argument refers to fundamental structural features of projects and the qualities of relevant influences. The pragmatical argument primarily focuses upon the discrepancies between theoretical and practical possibilities: even if it were theoretically possible to eliminate uncertainty in projects, this possibility does not apply to practice because the necessary temporal, material, personal and financial resources are invariably limited in availability. Notwithstanding which argument is preferred, however, the challenge ensues to regard uncertainty in projects as a normal and inevitable phenomenon.

This point of view has gained a certain degree of relevance in the project management debate in recent time. Still the concentration upon risk management is predominating, but increasingly fundamental objections to the efficiency of traditional methods of risk management are being raised. An important point of departure is the statement that the terms of risk and uncertainty are often insufficiently distinguished. "The problem is that few of these texts give full consideration to the vital prior questions of whether, and if so how, risk differs from uncertainty. Instead, there is a tendency to conflate these terms and to use them interchangeably, which in effect means that uncertainty is either treated in the same way as risk or ignored" (Sanderson, 2012, p. 434; see also Hartono et al., 2014). In particular, the question remains open as to how project actors should handle uncertainty in practice. "More important, it is not clear how to manage these unknown-unknowns" (Lechler et al., 2012, p. 60). From this starting point, the critical appraisal of the risk discourse extends to a number of issues.

The potentials of uncertainty are insufficiently exploited for future developments in order to improve the value of projects. Within the discussions about dealing with uncertainties, the insight is being emphasized that such situations should not be considered as purely negative. Rather, they also permit to strike new paths in the course of the project in order to develop new potentials hitherto unnoticed. "We call this potential possibility to improve the value of a project 'opportunity'. The management of opportunities is different from the management of risks. The exploitation of an opportunity requires significant changes that go beyond modifications of a baseline" (Lechler et al., 2013, p. 18; see also Lehtiranta, 2014; Sanderson, 2012; Perminova et al., 2008; De Meyer et al., 2002). This idea is linked to the postulation that the target system of projects should be altered in general: "[…] from a generic normative view of determining project success with a general set of criteria and toward a value-oriented perspective" (Lechler et al., 2013, p. 10).

If project management is strictly oriented to planning, it might yield negative effects for the project as a whole since the scenarios are too much bound to states of the past. Too much preoccupation with planning will lead to a strong tendency to formalized procedures (as risk identification, risk analysis, monitoring, and control). The implicit idea is that a more detailed planning allows for a tighter control of every single

project step and that this is to be seen as an asset. "However, a preoccupation with planning has been linked to project failure […]. Highly detailed or rigid plans have been identified as limiting freedom to make decisions […] and encouraging an attitude where low level products become ends in themselves, instead of contributing to a greater goal" (Pollack, 2007, p. 271; see also Eschenbruch, 2013; Grösser, 2011). Moreover, a strict orientation to planning procedures is apt to reduce the prognostic value of risk scenarios, treating "[…] future outcomes as statistical shadows of the past" (Sanderson, 2012, p. 435; see also Scheurer and Ribeiro, 2012a). Thus, future developments tend to be seen from the perspective of past events. Since uncertainties often arise in the course of the project, it may be impossible to define them at the outset of the project. "The selected project portfolios evolve over time due to a number of external and internal reasons, which means that uncertainty exists and has an impact also during project portfolio deployment" (Martinsuo et al., 2014, p. 732; see also Thamhain, 2013; Pollack, 2007). There is also the problem that flexible re-orientation required by permanently changing situations during the implementation of the project may be impeded and slowed down by a strict orientation to the specifications of advance planning. "The traditional approach to project management still puts a lot of emphasis on assuring conformance to time, budget and scope constraints. Considerations, such as continuous improvement, customer-centric thinking, and reflective learning are often left behind. This leads to the fact that project companies become less flexible, unable to accumulate knowledge and experience necessary for coping with uncertainty" (Perminova et al., 2008, p. 74).

Frequently, projects are viewed as isolated processes, without taking into consideration their environment. Therefore, important influence factors producing uncertainty are dismissed. Projects are often conceptualized as an isolated sequence of certain activities, without considering their embedding in organizational or networked contexts. "Contemporary thinking on project management is thus grounded in a lonely project perspective. Both textbooks and research literature primarily discuss individual projects. The perspective is from the inside […]. The historical and organizational contexts of the project are taken for granted, or simply not included in the analysis" (Engwall, 2003, p. 793). External causes for uncertainty generating disturbances of the project flow may be triggered by different factors. These include not only technological and market-related uncertainties but also changes in legal regulations and industrial standards. Moreover, uncertainties may also be caused by problems in cooperation relationships with suppliers (Martinsuo et al., 2014; see also Petit, 2012). Coping with "contextual uncertainties" of this kind is considered very important for project management, and according to some authors, the application of formal instruments will only cover a limited scope regarding this task. "That is why identifying relevant […] contextual uncertainty by means of environmental scanning or other analytical methods is an important part of project management" (Perminova et al., 2008, p. 77; see also Petit and Hobbs, 2010). This is especially true in large-scale projects. "[…] megaprojects are typically characterized by multiple and diverse discourses, cultures and rationalities rather than by a singular, shared rationality as is assumed by more orthodox, technicist perspectives. This means that different actors within a project understand inputs to and outputs from the project in very different, incomplete and often competing ways" (Sanderson, 2012, p. 437; see also Conforto and Capaldo Amaral, 2010). The interconnection of enterprises, processes, institutional and individual actors in project networks is another important issue. "Unchecked contingencies tend to cascade and penetrate wider project areas. Contingencies occurring anywhere in a project have the tendency to penetrate into multiple subsystems (domino effect) and eventually affect overall project performance" (Thamhain, 2013, p. 31; see also Scheurer and Ribeiro, 2012a,b). This kind of cumulative effect is not restricted to striking events with very conspicuous and serious consequences; it also appears in the course of "business as usual." "Unforeseen uncertainty is not always caused by spectacular out-of-the-blue events, however. It also can arise from the unanticipated interaction of many events, each of which might, in principle, be foreseeable" (De Meyer et al., 2002, p. 62; see also Sanderson, 2012).

All of these critical remarks do not intend to fundamentally deny or query the performance of formal project management methods in dealing with uncertainty. However, they point to their limitations. "Although analytical methods provide the backbone for most risk management approaches, and have the benefit of producing an assessment of a known risk situation relatively quickly, including economic measures of gains or losses, they also have many limitations" (Thamhain, 2013, p. 30). These limitations are said to have systematic causes, since "the theory might have bounded validity, i.e. there might be factors influencing project execution that are not included in established theory" (Engwall, 2003, p. 798). In order to achieve a more comprehensive view upon the practices and processes of projects, it could be necessary "to bring these microstructures [as a conglomerate of procedures and practices with different origins and of different age] into the analysis" (Engwall, 2003, p. 798; see also Williams et al., 2012). Focusing more upon uncertainties "might function as a lens through which one can gain new and important insights" (Munthe et al., 2014, p. 214) into concrete project procedures. In the following section, we shall draw on these insights.

4. Dual uncertainty in projects

The empirical findings come from several research projects about the work action of project leaders and project employees (Böhle, 2013; Heidling, 2012; Meil et al., 2004). These surveys are based upon qualitative social science research and particularly case study research, methods that have been well-established, tried and tested in the sociology of work and industry since the middle of the 1950s. The specific strength of this methodological approach is its capability to integrate structural, organizational, and subject-oriented empirical issues (Pongratz and Trinczek, 2010). For the investigation of preconditions of emergence and contexts of effects of uncertainties within projects, expert interviews with project employees and project managers are

particularly suitable. This methodological approach permits to establish a discursive process between the interviewee and the researcher, which in turn enables the researchers to bring to light preconditions and effect contexts that are not openly visible and not easily accessible. On the one hand, this applies to the project processes in networks inside the enterprise or overarching different enterprises, processes that are influenced by very diverse factors. On the other hand, it applies to the subjective perspective of the employees toward coping with, experiencing, and evaluating these complex requirements.

The statements of project participants quoted in Sections 4 and 5 were gathered in two research projects conducted between 2008 and 2015 and were funded by the German Federal Ministry for Education and Research and the European Social Fund. Among others, the research projects also covered two small and medium-sized enterprises (SME). These SME are producing technological goods and services in joint projects with big companies from plant engineering, iron and steel industry, automotive industry and aerospace industry. The empirical results were gained by methods of qualitative social research, with the concept of experience-based action as a heuristic instrument (see also Section 5). 35 guideline-based qualitative interviews were conducted in these enterprises, in addition feedback workshops and group discussions were organized. This material is the basis for our empirical findings presented in this paper.

Our empirical findings show that situations of uncertainty are widespread in work processes of project actors. In practice, they are often referred to as "critical situations" which means situations requiring action under limited information and time pressure, thus action under and with uncertainty. Employees will typically express it like that: "Critical situations are principally the rule; it is basically typical to have critical situations." The most frequent occurrences of uncertainty are linked to technological problems. As a consequence, dealing with uncertainties caused by technological issues is a part of everyday project business. Moreover, technology projects are often characterized by uncertainties due to material properties and material changes under different environment conditions. This will become apparent in the form of problems in the project processes due to divergent product qualities delivered by globally distributed production sites that are parts of a global division of work. Another kind of problem is caused by deviations between the functioning of a machine in a test run and its subsequent operation under normal conditions within a production process. "The material may be totally different if it has been cast down there in AC.[1] […] On acceptance testing the machine works fine, it is delivered. As soon as it is integrated into the line, problems arise" (project manager, mechanical engineering). The growing degree of organizational networking in the production of goods and services is an additional source of uncertainty during project implementation. The advantages of networks, as improved knowledge exchange and learning potentials, integration of new perspectives, and increased flexibility, are accompanied by correspondent challenges, as growing requirements for coordination and integration of diverse cultures and interests, and increased investment into implementation of adequate communication structures. These challenges have to be coped with on project level. For instance, uncertainties arise when deliveries of network partners are delayed which frequently will greatly affect the whole supply chain. Similar effects for project partners may be caused by quality defects of certain products. "You got delay in delivery, […] everything has to be calibrated anew all the time because of the interaction with the previous machine, it might not fit in as the case may be […]. Since we always do large-scale lines, there are always several manufacturers involved, and sometimes you simply ain't got it down pat" (project manager, mechanical engineering).

Therefore, the project actors have to fulfill a great diversity of tasks to find adequate solutions for these different requirements. The priority is to find conflict resolutions while at the same time making sure that the project targets are not at risk. Since project leaders, particularly in projects with diverse and frequently international enterprises, often cannot resort to hierarchy and command, or at least only to a limited degree (as distinguished to line managers in internal processes), project work is characterized by permanent negotiation procedures. They are confronted with conflicting requirements. On the one hand, they have to protect the interests of their company, making sure that the company is not burdened with additional tasks and costs. On the other hand, they are bound to prevent risks for the project and its targets, the planning and timely completion and delivery of products and services. For coping with these conflicting requirements, it is vital to generate action in mutual consent and agreement, since only consent can guarantee a successful implementation of the project. For this reason, both project management and interaction between the project participants are essentially characterized by negotiation and trade-off.

These findings can be summarized in two statements:

(1) In projects, uncertainty occurs in a dual form. First, in the form of limits of planning because of the occurrence of unexpected events; second, in the actual process of coping with such events.
(2) This means that coping with unexpected events is neither amenable to calculation nor manageable by plan-oriented action.

5. Coping with uncertainty through experience-based action in project work

A widespread idea is that rational and well-considered decision-making and action is particularly necessary in difficult and novel situations (Giddens, 1987; Volpert, 2003). However, it is just the critical situations described above where information and time are insufficiently available to rationally assess, ponder and evaluate information. In scientific literature about decision-making, the concept of "bounded rationality" (Simon, 1982) has been developed for this kind of situation. The core intention of this concept is to permit a rational

[1] The abbreviation "AC" means "Asian country".

decision as far as possible, in spite of lack of information.[2] Another idea that is often emphasized in studies about "high risk situations" is the necessity of routines (Dietrich, 2003). According to this idea, in situations where there is no time for rational reflection, practiced routines are bound to warrant reliable action, as what is usually the case in disaster management or fire service.

Beyond doubt, the ability to master routine action is necessary in critical situations in order to warrant reliability of action. However, it is not sufficient. Critical situations require that the actors are able not only to apply routines in a flexible way, but also to use non-routinizable modes of action, depending on the given situation. The concept of experience-based subjectifying action refers to the observation that in critical situations an intelligent and flexible kind of action is necessary which, however, does not work according to the model of planned rational action. This concept has been developed on the basis of a number of empirical studies (Böhle, 2016; Böhle et al., 2014) and draws on diverse research approaches and traditions. Especially in the context of technicization and informatization, several research approaches have emerged that focus upon the ability of human beings to obtain goals and solve problems without previous planning. These include the concepts of situated action (Suchman, 1987), of professional-intuitive action (Dreyfuß and Dreyfuß, 1986) and of intuitive-improvisational action (Volpert, 2003). The model of rational planning has been further relativized by the concept of an embodied "implicit knowledge" or "tacit knowing" which is linked to a person (Polanyi, 1985), the idea of a difference between "knowing that" and "knowing how" (Ryle, 1992) and the notion of a special "mastership" of experts (Neuweg, 1999) that draws on the before-mentioned concepts. Specific research into expert action calls attention to a broad spectrum of mental processes beyond rational analysis, like reflection-in-action, heuristics, chunks, analogous, metaphorical, and associative thinking (Schön, 1983; Sternberg and Wagner, 1986). Finally, new insights concerning the relevance of sensory perception for practical action arise out of phenomenological theories that posit an embodied relationship to the world (Merleau-Ponty, 1966; Schmitz, 1978). These theories seek not only to overcome the purported mind–body distinction but also, more importantly, to overcome the separation, rooted in modern thinking, between the objective, rational acknowledgment of the 'external world' and (exclusively) inward-directed experiences and perceptions associated with feelings and sensations. According to these approaches, feeling and 'sensing' is also capable of providing information about properties of the environment and can be utilized for this task.

The concept of subjectifying action draws on these research approaches, focusing upon the mutual interrelationships between those different extensions of the model of rational action. It systematically defines a distinct mode of practical action. As opposed to the model of planned rational action, the mode of subjectifying experience-based action is characterized by specific features in four dimensions: proceeding, thinking, sensory perception, and relationship to the environment. These specific features are: an explorative, discovery-oriented, dialogical proceeding, an associative-pictorial thinking, a sensual perception based on feeling, and a relationship to the environment characterized by closeness, affinity, and unity (Böhle, 2009, 2013). Subsequently, empirical findings are presented that verify and illustrate the existence and relevance of experience-based subjectifying action in project work.

Dialogical-explorative *proceeding* relies on a method of action that is characterized by "feeling one's way" and discovering things within the process of work. Employees find themselves, as it were, in a dialogue with their work situation, deciding how to proceed within the ongoing work process. This kind of work action, which is applied upon the basis and on top of established methods and tools, is essentially characterized by pragmatic modes of action. The interim results that are important for the work process are primarily obtained by experimental steps within the actual project work. "Things most often start on the computer, meaning you sit down and see roughly what you would like, then things take shape, circuit diagrams, layouts are made, assembled and then you see if it works the way you imagined. Then I worked it up to a certain point […] and then I started building it, experimenting and improving it […] it simply grows over time" (project team member, measurement systems). This procedure is also applied in project management. Thus, the process of planning as a whole is not primarily defined by detailed and premeditated specifications, as in classical project management. This does not mean that one does without planning altogether. Rather, elements of planning are developed and implemented within the working context and are adapted to the incremental procedure. "You can set milestones at best […]. As in our case, certain physical boundary conditions have to be attained; otherwise it doesn't work at all. You can stop things then. But there is always a large number of small secondary conditions which you can't foresee, that's impossible" (project manager, measurement systems). A basic requisite for this dialogical-interactive work procedure is an intensive communication between all actors about the project status and the project developments. Their comprehensive participation in these communication processes creates the connection between the projects. Thus, a continuous flow of shared experiences and mutual suggestions emerges. "Most of the time, conversations are not private talks between two persons, but […] wherever we are at the moment, that's where the conversations take place. […]. So that means you get an incredible amount of impulses from the experiences of others […] which you would not have got without this kind of colleague network. Many have already made certain experiences and you need not make the same experiences for yourself" (project team member, measurement systems). These intensive processes of communication and cooperation will not be initiated, shaped and institutionalized automatically—there are a number of specific preconditions for them. One important requirement in the management of project work is to allow sufficient leeway to the employees and their work actions, while at the same time the specific limits of the

[2] See also the discussion in Neumer, 2012 which refers to dealing with uncertainty.

project have to be observed. In order to manage such processes, moderation seems to be a better tool to keep this fragile balance than traditional instruments of leadership: "It has a lot in common with a moderation process, so if it is to be helpful, you can't run things in the way of tight control […], you have to play moderator. […] Controlling […] means that whoever is actually moderating things basically already knows where things are headed. […] That sort of thing kills innovation. […] control should be understood as something that only has the function to […] prevent digressions into arbitrariness […], into too many details " (project manager, measurement systems).

This kind of proceeding is accompanied by an associative-pictorial way of *thinking* where an event triggers certain associations, images and ideas that may lead to new solutions. The project tasks that extend beyond the frame of the company are often centered around the cooperation with the customer. In this context, an important skill of a project leader is to "visualize" the project process and results, to "see a picture" and "foresee what will happen". Typical expressions of project leaders in practice are: "I see it as if it were in a movie", or: "I don't play this through in my mind but I literally put myself into the situation." This kind of prospective perception is important for a strategical consideration of the effects and repercussions of decisions and actions in a process chain. The end result of a development process may still be months or years away when a certain process step in a project has to be done, so it is important to be able to anticipate future consequences of one's own decisions and actions. This is especially relevant for potentially negative developments in the future of the project, which have to be assessed and counteracted at an early stage. "You also need much experience and capability to estimate and evaluate things. That helps very much. And the ability to look ahead and to […] address future events and trends a little bit, to exert a kind of control on it. Will it come, won't it happen? Whoever has got this skill has got a real asset for project management. Rather than closing the stable door after the horse has bolted, he knows in advance: this will work but that will make us problems, so we should allocate more resources to that area now" (project team member, mechanical engineering). It is also very useful to adapt certain pictures and associations to new situations in order to solve difficult situations. "And then you think about it, about what is this and what was that. You look at the situation, you collect your pictures as the situation emerges. […] And then somewhere a way appears in the picture. This is almost like intuition […] but also coupled with a clear and consistent way of action. You string the beads together, you sort out the components from the heap of rubble" (project manager, mechanical engineering).

The third dimension is a *sensual perception* based on feeling, which integrates sensual impressions like moods or noises into information processing. This kind of perception makes use of all senses and also includes body perception. Project leaders have to meet complex requirements to the processes of planning and development, and they do this most notably by evaluations of the given situation in cooperation with the customer. In the first stage of the project which covers the analysis of the given situation in the customer enterprise, the kind of perception described above is apparent in the project manager's work action. Besides using check-lists and tools for data collection, work action in this stage is strongly characterized by situational evaluations based on feelings and perceptions of atmosphere and mood. One side of this specific perception and interpretation refers to the technological situation in the customer enterprise. "You got your idea how the production is bound to work. To be sure, the business processes are roughly alike in all companies and in all industries, but each company has a life of its own. You have to see that. You have to smell how the processes are like in a given company" (project manager, mechanical engineering). Another side refers to the social relationships in the company. "There I see where the alpha leaders are, where the bellwethers are […] It doesn't matter if they are called project leaders or plant managers or what you like. […] Real information you will only get at the bottom, at the shop floor, not from the people at the top. […] For this reason, you talk with people, which will tell you very much about the company. Usually just as a sideline […] not so much in conversations about the project or the specific task, but as an aside" (project manager, plant engineering). By this kind of interpretation of situations, project managers succeed in promptly grasping the given situation in the customer enterprise. And on the basis of such interpretations, they can develop first ideas of a re-structuration concept. "With me, the first impression is always confirmed. […] You can see it even in a day. […] This is sufficient to form a rough picture. […] Usually you have three or four days for your assessment, so the picture will usually become more consolidated and more concrete" (project manager, mechanical engineering). This quotation shows that experience-based work action is both efficient and effective also from an economical point of view.

The particular *relationship to environment* in experience-based action is characterized by closeness, affinity, and unity. At the heart of it is the "communal action" that also includes a cooperation with objects. An important element in project groups consisting of representants of different companies is to establish cooperative and trust-based structures within the group. For instance, in the coordination of a project group of international composition, work action proved to be predominantly situational and object-related. "Members come from company A, suppliers, and customers, together we are about 100 persons. Every day at 9 o'clock a meeting is held. We haven't got any tools. Several points are addressed: What has been done the other day? Did new problems emerge? Some things do not match the drawings that had been authorized. A technological discussion occurs. […] There is no fixed pattern. The discussion simply goes by the things that happened the previous day. What was good, what was bad, where do we have to touch up? […] for me at any rate it works out fine because I get things done this way. But there is not a paper where you have to make your cross or tick an item off. It simply goes by the situation, one tries to manage what comes up" (project manager, plant engineering).

The results of our empirical research show that uncertainty in projects is due to the instability and indeterminacy of the properties and modes of operation of technological-material and socio-cultural conditions. Even tasks that appear to be simple often prove to be very complicated in the concrete

course of the project, for instance because the necessary resources are not available in the quantity needed and at the time when they are required. At the stage of (ex ante) planning, it is often not (yet) completely foreseeable which concrete technological tasks will emerge during the course of the project and how the correspondent problems can or will be solved. Further essential imponderabilities and uncertainties will arise from the respective context of application, implementation, and environment. This is most notable in projects that take place in an international context with several partners. Our results show that external customers or else the people directly or indirectly concerned with projects inside the enterprises do not simply classify deviations from the original targets as signs of unreliability or lack of planning. Rather they consider the effects of those deviations: do they also yield positive effects besides the negative ones? This may refer to both contents and time, and last but not least also to the budget. This fact should not be misunderstood as a license for arbitrariness and haphazardness. The relation of costs and gains resp. the benefits of the project results still remain as the criteria of evaluation. However, these criteria are not always to be achieved solely by traditional methods of plan-oriented action, demanding other procedures and skills (Heidling, 2012; Meil et al., 2004; Pander, 2010; Pommeranz, 2011). In general, the findings prove that experience-based action has to be seen as an important strategy to deal with uncertainties in projects. This does not mean that the traditional concepts and tools for planning and control should be replaced by experience-based action, rather experience-based action is an extension of the traditional arsenal of strategies. Both plan-oriented action *and* experience-based action are necessary and should be used.

Because of the qualitative methodological approach, there are certain limitations in the scope and generalization of the statements made above. However, the empirical findings about project work are confirmed by a great number of other surveys into the empirical ways of dealing with uncertainty in diverse technological and organizational contexts (Böhle, 2016). Nevertheless, further research is required to consolidate these insights. Such research should especially focus on differentiations of experience-based subjectifying action of project participators, depending on the different project constellations in which this mode of action is applied.

6. Conclusions and prospects

Uncertainties are a vital part of everyday project business. They emerge in small-scale and in large-scale projects, in simple and in complex projects, in highly interconnected networks and in less complicated settings, in different stages of the project life cycle. Uncertainty in projects essentially manifests in a dual form: unpredictable events play an important role both at the stage of planning and in the course of the project itself when they have to be coped with in the respective situations. An important cause for the emergence of uncertainties is that projects are not only technological systems but also social systems; however, given technological-material and organizational conditions are also a very frequent cause for uncertainties. Thus, the widespread differentiation between technological and material influences seen as predictable and controllable issues and human and social influences seen as uncertain and uncontrollable issues does not hold in project reality. Rather, uncertainty proves to imply important potentials for innovation and economic benefit. So it is necessary to take a fresh look at uncertainty, beyond the discourses of risk management, and to develop a concept of action and capability to act *with* uncertainty. This is the precondition for a productive handling of uncertainty which allows for an extension of action possibilities and opportunities. A productive handling of uncertainty can substantially contribute to increase the innovation capacity and the economic benefit of projects.

In the light of "dual uncertainty", the paradigm of cognitive rational action and decision is stretched to its limits. However, this is by no means equivalent to an inability to act and decide. On the contrary, recent research approaches open up ways on how action and decision-making can be integrated into practical work action. Taking the experiential knowledge of project participants and employees into account and making use of it implies a new kind of requirement with respect to project management. Since experience-based action is hardly amenable to formalization and objectivation, it cannot be reproduced, regulated, and controlled "from the outside" in traditional fashion (Böhle et al., 2012). Experience-based action will not emerge automatically but needs a special kind of organizational and personal support, just like planning-oriented cognitive rational action. It is a new challenge both to research and practice of project work and project management to investigate this requirement and to develop practical models for it. However, since the paradigm of plan-oriented action is deeply rooted not only in project management but also in enterprises and society as a whole (Böhle et al., 2014), fundamental re-orientations are necessary concerning the understanding of successful action and efficient organization.

Conflict of interest

The authors declare that they have no conflicts of interest.

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