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Management of Uncertainty – A Blind Spot in the Promotion of Innovations

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Abstract

In industrial societies the idea has arisen that it is possible to eliminate uncertainty. Science, organization, technology and, linked to this, planning and control are all orientated in this direction – in particular in industrial production. Attempts at planning and control are also increasingly found within the scope of innovation management. However, in the case of innovations, uncertainty is not strictly a shortcoming but an important potential. The endeavor to eliminate uncertainty holds the risk of jeopardizing rather than promoting innovation. A new approach to uncertainty is required in order to promote innovation. It is necessary to recognize uncertainty and at the same time maintain the ability to act. To this end the better term seems to be the *overcoming* of uncertainty instead of elimination or powerlessness. In various academic disciplines there are approaches which relate to this such as the concept of an experience-led, subjectivity-based action or new approaches in project management. However to date they have barely been systematically addressed or linked in the prospect of a new way of dealing with uncertainty. In the article the necessity of a new approach to uncertainty is justified and the prospect of overcoming uncertainty as a basis for further articles on this topic is outlined.

1 Innovations Require a New Approach to Uncertainty

The management of innovations has to date been geared towards planning and controlling innovation processes as much as possible. However, this runs the risk of hindering rather than promoting innovations. This article argues for the thesis that innovations require a productive approach to uncertainty. The concept of coping with uncertainty – as opposed to removing it through planning and control – is presented and substantiated. This approach does not replace planning, but complements it in the sense of *not only, but also*.

In industrial societies, however, uncertainty has up till now been primarily regarded as a deficiency and a threat. A new approach to uncertainty therefore requires profound cultural change and fundamental re-orientation. This applies not only to practical applications, but also to the academic community in particular. Academic research must address phenomena and problems that occur in practice, which until now have lain largely outside the realm of academic thought.

2 Coping with Uncertainty rather than Removing it

In the chapters that follow, the predominant approach to uncertainty in industrial societies is first briefly described (2.1). Uncertainty is then presented as a structural feature of innovations (2.2), and a new perspective defined for managing innovations by coping with uncertainty (2.3).

2.1 Industrial Societies' Program for Removing Uncertainty

Uncertainty is a fundamental experience in human existence. In traditional societies, it results primarily from dependence on nature, and these societies attempt to evade the threats posed by uncertainty by adapting to nature, as well as through religious practices, sacrifices and magic. In modern industrial societies, on the other hand, the idea has grown up that “in principle, all things can be controlled by means of calculation” (Weber 1968, 593; translated by author). Science and an increasingly scientific approach to practical action and, on this basis, planning and the establishment of a planning framework have made it possible to overcome uncertainty (cf. Parsons 1980, 145; Beck et al. 2004, 27). Particularly in the field of industrial production, it seemed possible to completely remove uncertainty, or at least clearly differentiate that which could be planned from that which could not. The latter includes in particular the market, scientific discoveries, technical inventions and social change. These do not easily lend themselves to the goal of removing uncertainty, but are nonetheless central features and forces within industrial societies. On the one hand, they are seen as either a threat or a means to liberate human potential, which is the (only) way to enable social progress. However different these views of uncertainty may be, they nonetheless have one thing in common: uncertainty is regarded as a more or less fate-governed by-product of human and social development which can only be avoided by renouncing change and transformation. From this point of view, human beings remain – even in modern societies – largely powerless in the face of that which cannot be calculated and planned. At the same time, however, these approaches are also based on the assumption that social development overall is subject to an innate developmental logic that can be identified and predicted. The metaphor of the *invisible hand* in the regulation of the market and theories and forecasts of continuous, linear economic growth, technical progress etc. are an example of this. On the other hand, these approaches also try to treat (and recommend treating) the unplannable in a plan-oriented, rational way and to analyze and calculate e.g. developments on the market accordingly. The removal of uncertainty is complemented by transforming uncertainty into risks. The difference between uncertainties and risks is that, although the latter cannot be completely planned and controlled, it nonetheless seems possible to estimate and calculate the probability of them occurring and the concrete form they are likely to take. Accordingly, it also appears possible to plan the handling of risks (cf. Lupton 1999, 7). Furthermore, new organizational techniques are being used which attempt to plan and enable planning of processes on the market and technical and social change.

In the development of industrial societies, the handling of innovations is particularly characterized by the approach to uncertainty described.

In the early days of industrialization up till the start of the 20th Century, innovations were predominantly regarded as resulting from the “creative personality” (Schumpeter 1934; translated by author) and general scientific progress. Innovations were assigned to particular occupational groups within and outside the company organization. Company organization and management focused primarily on realizing the results of innovations and were therefore less geared towards innovation and more towards reproduction. On the other hand, in the development following the 2nd World War, primarily large companies increasingly tried to control innovation processes in a targeted manner, and innovation management was developed into a specific management discipline in research and teaching (cf. Hausschild 2004). Innovation management processes are based on classic management tasks i.e. planning, evaluation, control and monitoring (cf. Gärtner 2007, 120 et seq.). In the face of increased competition and the acceleration of innovation, management of innovations has become a new challenge, not just for large companies, but also primarily for small and medium-sized businesses (cf. e.g. Mikael and Weiss 1990; Bullinger 2006). Whether the prevailing methods of innovation management are suitable for this is questionable.

2.2 The Return of Uncertainty – Uncertainty as a Structural Feature of Innovations

Without doubt, industrial societies have achieved considerable success in overcoming uncertainties, and continue to do so. There is much evidence that Germany is particularly strong in this area, particularly in the fields of economics and technology. However, this strength is now threatening to become a key weakness. For despite the incontestable successes, it is increasingly becoming apparent that uncertainties cannot be completely removed or transformed into risks, but keep emerging in new forms – precisely as a result of scientific progress, complex organizations and technical systems. Uncertainties continue to exist and appear in new forms (even) in the very areas where overcoming uncertainties is relatively successful – such as technical production plants (cf. Böhle et al. 2004). In the face of these developments, current social theories, such as the theory of reflexive modernization, diagnose a “return of uncertainty” (Beck and Bonß 2001, 53; translated by author). This is reinforced particularly by the acceleration of innovation and the resulting shift from stability to increased dynamism and flexibility – ranging from changes in company organization and technology to the shaping of individual lives.

The removal of uncertainty aims to increase the scope and opportunity for action. This is the case for machines and production plants in industrial mass production, for example. If their performance can be calculated and planned, they can be used in a targeted way for series production of large quantities of unvarying products. For innovations, however, the opposite is the case. The more uncertainties are removed, the greater the probability that the innovation will be limited in

scope, and an innovation will be replaced by a mere further development or slight modification of something known and existing.

For innovations, uncertainty is a structural feature and source of potential, and without it innovation is not possible. In the available research on this subject, several reasons are given for this:

- The goal of innovations is to replace or complement that which is currently known with that which is currently unknown and therefore uncertain. Innovations are therefore fundamentally characterized by the openness of the result (e.g. Rammert 2008, 294; Erdmann 1993; Wegner 1995, 88; Lazonick 2005). Due to the large number of material, social and cultural influencing factors and interdependencies, it is not possible to precisely comprehend and assess whether an innovation is successful (e.g. Wegner 1995, 189; Mistri 2008, 299 et seq.). The success of innovations can often only be defined subsequently, as it is not possible to identify in advance what problems may be solved by the innovation and what effects may occur (e.g. Siebel et al. 2001, 530 et seq.; Pavitt 2005, 100 et seq.).
- Innovation processes are not sequential linear, but iterative. A step is made in different directions depending on success or failure. As innovation processes must deviate from what is known, neither hindrances and obstacles nor success factors can be predicted in advance (e.g. Pavitt 2005, 106 et seq.). Milestones and interim evaluations (cf. Cooper 2002) are scarcely possible either, as no dependable criteria exist for assessing the success of an innovation reliably during the innovation process (cf. Ibert 2005, 600 et seq.).
- Neither standard models nor best practice models are possible for innovation processes. Innovation processes all take different forms depending on the object, technical organizational and personnel framework, problems, obstacles etc. and must therefore be designed on a customized basis taking these influencing factors into account (cf. Pavitt 2005, 95 et seq.; Nippa 2007; Coopey et al. 1998, 279 et seq.).
- Pre-imposed requirements, rules and checks hinder creativity (cf. Amabile and Gyskiewicz 1989; Schuler et al. 2007; Kanter 2006). However, creative freedom for particular occupational groups, departments, new businesses etc. also restricts innovation. The technical, product-oriented understanding of innovation is increasingly being replaced by an understanding based on comprehensive information that also includes organizational and social innovations (cf. Lazonick 2005; Howaldt 2009). This means that innovations are being seen less as the specific task of particular persons and occupational groups and more as part of the work of every employee in the company and even outside the company (customers, suppliers etc.) (cf. Moldaschl 2007). The employees' knowledge and experience of the operational processes is therefore a key resource for innovations (cf. Kocyba 2000, 50 et seq.; Ortmann 2009, 208 et seq.).

To promote innovation, it is therefore necessary to acknowledge uncertainty as an aspect of innovations. It should not be seen as a deficiency that needs to be

removed, but as potential to be harnessed. However, this does not mean that innovation today should (again) be left up to *creative personalities* or based on reliance on general scientific progress. To promote innovation, *management* of innovations is essential. However, a *different* approach to uncertainty is required, one which does not aim to remove it altogether, but rather to cope with it, i.e. to deliberately design innovations *with* uncertainties.

2.3 Coping with Uncertainty – A New Perspective

The fact that it is not possible to remove uncertainty completely in the field of economics is not a new discovery. This was established at the end of the 1950s in research on decision-making in businesses. The concept of “bounded rationality” became very prominent in this field (Simon 1957). This theory assumes that in practice, the information required for a rational decision, i.e. information regarding influencing factors, possible alternatives and consequences of decisions, is not normally fully available. Similarly to the concept of risk, uncertainty is acknowledged, but ways are sought to plan and establish a planning framework nonetheless.¹ There are also research strategies that acknowledge uncertainty, but which infer from this that deliberate control and structuring of company organization is therefore not possible (any more). Consequences of uncertainty are therefore loss of control, anarchy and/ or uncontrollable self-management according to a set of private rules.² An example of this is the Garbage Can Model (cf. Cohen et al. 1972). While acknowledging uncertainty, these research strategies nonetheless retain the assumption that processes within businesses can only be deliberately controlled and structured when uncertainties have been removed as far as possible.

Other more recent research strategies deduce that, since removing uncertainty is impossible, decisions and planning need to be *politicized*. In these theories, the interests of those directly and indirectly affected by decisions and plans take the place of the trusted knowledge of experts (cf. Beck and Holzer 2007).³ These approaches focus primarily on assessing the consequences of decisions (cf. Stadelbacher 2010, 25). The diagnosis of politicization instead of orientation towards trusted knowledge is on the one hand comparatively radical, but on the other hand, this approach also remains rooted in the concept of planning as a basis for deliberate and goal-oriented action.

In relation to these research strategies, the concept of *coping with uncertainty* is not based solely on acknowledging the limitations of removing uncertainty. Rather, it is significant to realize and acknowledge that deliberate and goal-oriented action

¹ For more details on this and similarly oriented research strategies, cf. Neumer (2009, 12 et seq.).

² For more details on these research strategies for handling uncertainty, cf. Neumer (2009, 31 et seq.).

³ For more details on this in relation to decision-making in organisations, see the articles by Robert T. Gephart, John Van Maanen and Thomas Oberlechner *Organisation and Risk in late modernity*, the article by Kent D. Miller *Organizational Risk after Modernism* in the special edition of the journal *Organization Studies*, 30/ 2-3, 157-180, 2009, and Stadelbacher (2010).

is also possible without planning and rational decision-making.⁴ This approach to uncertainty lies between the strategy of removal on the one hand and powerlessness on the other. Research strategies exist for this too. They have been developed in various academic disciplines to address different problems. Currently, however, they are (still) barely connected to each other and are not being utilized or further developed for a *different* approach to uncertainty with regard to innovations – either in research or in practice. Nonetheless, they show that a new productive approach to uncertainty in the handling of innovations is definitely not just wishful thinking or a utopian ideal.

In research into representing human action using information technology, the concept of plan-oriented, rational action was replaced by the concept of situated action (cf. Suchman 1987). According to this theory, humans do not act on the basis of *decide first then act* – particularly when resolving technical problems – but in a process- and situation-related manner based on a practical approach to concrete requirements and conditions for action.

Research on artificial intelligence focused originally on the model of deliberate, rational information processing and action control. In the face of the difficulties and failures of programming human action in this way, a new orientation towards concepts of *embodied intelligence* or *embodied mind* was developed (cf. Mainzer 2003; Lenzen 2002). In the field of robotics, the focus has shifted away from anticipating as fully as possible the action situations that can occur in practice. Technical design now concentrates instead on situation-based interaction with the environment and processing this.

Organizational theory explored the question of how organizations that are particularly exposed to uncontrollable environmental influences (emergency medicine, fire brigade, aircraft carriers etc.) provide reliable services (cf. Weick and Sutcliffe 2003). In this case, *attentiveness* is singled out as a particular form of *managerial practice*. The focus among other things is on anticipating the unexpected through particular sensitivity and a feel for situations. Rather than viewing unpredictability only as a danger for the organization, it is seen in a positive light – as an opportunity to improve performance. Learning from mistakes also plays a key role.⁵

Within the framework of knowledge management, the tacit knowledge acquired through practical action was identified as an important knowledge resource in businesses (cf. Nonaka and Takeuchi 1997). The term tacit knowledge goes back to Polanyi's philosophy of science and refers primarily to physical corporeal knowledge that is essential for practical action, but almost impossible to describe in words (cf. Polanyi 1985).

Research into work in the service industry shows that handling uncertainty is a key requirement in this sector, much more so than in industrial production and administration. When looking at the question of how to cope with this uncertainty

⁴ On the discussion regarding modification of fundamental additions to and expansion of the prevailing concepts for rational decision-making and action, see also in particular the articles in Böhle and Wehrich (2009).

⁵ For more details, see also Neumer (2009, 50 et seq.) and Stadelbacher (2010, 27 et seq.).

in practice, parallels are drawn with artistic activity. This approach stresses that a key element of artistic activity is the ability to be unreservedly open to the new, along with a situation- and process-oriented procedure (cf. Brater et al. 1989).

Investigations into how work changes with technological advances in industrial production and administration show that human work is in no way limited to just residual functions, but rather that it is becoming important to iron out imponderabilities in technical and organizational processes in order to prevent malfunctions (cf. Böhle et al. 2004). Specific experience-based knowledge and work practices are required, rather than the prevailing concept of a scientifically managed, plan-based, rational approach to work. More in-depth investigations in this field have developed the concept of an experience-led, subjectivity-based approach to work. These demonstrate that sensory, physical experiences, subjective sensations and experiences, associative thinking, an interactive, dialogue-based approach to objects and a personal, emotional relationship with them are key vocational skills (cf. Böhle 2009; Böhle 2008; Pfeiffer 2007). Linked to this, investigations into cooperation draw a distinction between the formally organized, plan-led cooperation in committees and meetings on the one hand and the informal, experience-led cooperation that takes place in routine work processes on the other (cf. Böhle and Bolte 2002; Bolte and Porschen 2006). Possibilities for exchanging tacit knowledge are also demonstrated in this context (cf. Porschen 2008).

The following articles on the subject of managing uncertainty present further research strategies and perspectives geared to individual skills and forms of learning and to forms of organizational structuring for a new approach to uncertainty. The research strategies outlined above and the complementary articles that follow show that coping with uncertainty requires procedures and organizational forms – particularly in the field of economic activity – to which modern societies have until now paid little attention and which have for the most part even been discriminated against. Situated action, the search for and definition of goals (only) during and through practical activities, sensory perception based on feelings and sensations, tacit knowledge etc. are all too easily regarded as *unprofessional* and as a sign of *human weakness*. This has been the case until now not only in practice, but above all in the academic community, and this approach is particularly promoted by the tendency towards academically focused training and practical use of scientific findings and procedures. A new productive approach to uncertainty requires a revision of ideas and reorientation not only in practice, but also primarily in the academic community. The research trends presented above and in the articles that follow are important approaches to a new orientation of this kind, but are still predominantly on the fringes of the various disciplines within which they originated, and targeted promotion is necessary in order to develop them further and anchor them in the academic canon. This is the only way that scientific research can succeed in promoting innovations using phenomena and problem situations in practice which to date have been largely outside the realm of academic thought and which have been disregarded up till now, mainly due to the predominance of the scientific approach to work.

3 Summary

In modern, industrial societies, unlike traditional societies, the idea has arisen that it is possible to transform uncertainty into certainty and thus eliminate it. Science, organization, technology and, linked to this, planning and control are all oriented in this direction. This is particularly the case in industrial production. Planning and control (innovation management) are also increasingly geared to innovation. There is much evidence to suggest that one of Germany's particular strengths is based on such an approach to uncertainty. However, this strength is now threatening to become a key weakness.

Despite considerable successes in overcoming uncertainty, it has become clear that uncertainties can never be completely removed, but keep emerging in new forms – precisely as a result of scientific progress, complex organizations and technical systems. This is particularly the case for innovations. Where innovation is concerned, uncertainty is not a deficiency, but rather a structural feature. The striving to remove uncertainty therefore carries with it the risk of hindering or even completely impeding innovations rather than promoting them.

A new approach to uncertainty is required in order to promote innovation. Uncertainty needs to be acknowledged and used productively. This approach to uncertainty lies between the strategy of removal on the one hand and powerlessness on the other. An appropriate concept for this is *coping with uncertainty*, according to which the striving to overcome uncertainty should not be replaced, but should rather be complemented. This approach is a complementary one in the sense of *not only, but also*.

In various academic disciplines, research strategies for a reorientation vis-à-vis the approach to uncertainty have recently been developed. These are based on expanding the concept of rational, plan-based action that has prevailed up till now and focus on situated action, tacit knowledge, sensory, physical perception, subjective feelings and associative thought as key elements of professional activity (in the articles that follow on the subject of managing uncertainty, these approaches and research trends are further elucidated with regard to learning, individual skills and organizational structuring).

Against this backdrop, the demand for a new approach to uncertainty in innovation processes is not just a utopian ideal or wishful thinking. Up till now, however, the various research strategies and trends in the new approach to uncertainty have not (yet) been systematically linked to each other or utilized and further developed for systematic promotion of innovation processes. They are largely (still) on the fringes of the various disciplines within which they originated. To develop them further and anchor them requires targeted promotion, since a revision of ideas is required not just in practice, but also in the academic community in particular.

4 Future Research Requirements

Research to promote innovations has so far been mainly oriented to management of innovations with regard to planning, control and monitoring. The German Federal Ministry of Education and Research (BMBF) has set up new initiatives to expand and complement innovation management with its research and development program “Arbeiten – Lernen – Kompetenzen entwickeln. Innovationsfähigkeit in einer modernen Arbeitswelt” (Working – Learning – Developing Skills. Potential for Innovation in a Modern Working Environment) focusing on “promoting innovation above and beyond traditional management”. An approach to managing uncertainty in the context of innovations that extends beyond the prevailing strategies for planning and removing uncertainty is not yet a priority, but is nonetheless being explored by three research associations.⁶ Linked to this is an urgent need for research in the following areas:

- Identifying and systematizing the concrete forms that uncertainties take in innovation processes based on a broad understanding of innovation. A system is to be developed to enable distinction in innovation processes between uncertainty as a structural feature offering potential and uncertainty as an obstacle and limitation that can be overcome.
- Analysis and development of procedures that enable acceptance and productive use of uncertainties (coping with uncertainties) in innovation processes. To do this, existing research strategies for expanding the plan-oriented, rational action model are to be utilized and related to the handling of innovation processes, linked together and further developed.
- Investigations must be undertaken to define the particular characteristics of innovation work, which exhibits special features in contrast to production, administration and service-industry work. This requires both theoretical conceptual basic research and empirical analyses of different forms of innovation work.
- Identification of the individual resources (physical, mental strength, skills etc.) required to cope with uncertainty, possible new handicaps to coping with uncertainty and possibilities for preventing it (for more details, see also the article by Martin Elbe).

⁶ In the KES-MI research association (Artistic, Experience-led, Playful – Management of the informal to promote innovative work, www.kes-mi.de), the MICC research association (Music – Innovation – Corporate culture, www.micc-projekt.org) and the THINK research association (Theatrical Interventions in Innovation and Cooperation Management, www.forschungsprojekt-think.de). Also oriented towards a new approach to uncertainty are the KUN-DIN research association *Service as Art – Pathways for innovative and professional work in the service industry* (www.dienstleistungskunst.de) focusing on *Professionalising services* and the HELD research association (Innovation dramaturgy according to the hero principle, www.udk-berlin.de/sites/innovation-heldenprinzip/content/index_ger.html; www.heldenprinzip.de/html/extra.html) focusing on “Balance of flexibility and stability in a changing work environment”.

- Development of a form of learning suitable for coping with uncertainty. In particular, the role of self-managed informal learning in the work process and its targeted support and promotion is to be investigated (for more details, see also the article by Johannes Sauer).
- Identification and development of forms of work and company organization that allow and promote coping with uncertainty. This also includes principles of leadership and performance assessment. To be investigated in particular is the way in which organizational forms that relate to coping with uncertainty are compatible with organizational forms oriented to overcoming uncertainties and establishing a planning framework, and what new tensions arise from this (for more details cf. Wolf and Peters in this volume).
- Identification and further development of technical concepts geared to coping with uncertainty rather than eliminating it. This is linked to concepts of the *embodied mind* and robotics within the framework of developing artificial intelligence. The technical concepts suitable for supporting employees in coping with uncertainties are also to be investigated. These are linked to the concept of technology as a *tool* and action-oriented structuring of human-technology interaction.

To deal with these issues requires not only theoretical conceptual research, but also empirical investigations and experimental design projects. In particular, innovation processes in companies are to be investigated to determine in what way practically developed approaches to a productive use of uncertainties already exist in this domain. A particular focus of investigation is to determine what potential exists in SMBs that can be harnessed and further developed.

5 Prospects for Germany

According to international experts, a specific culture of planning developed in Germany in the past, above all in large companies. In an international comparison, this can certainly be seen as one of Germany's strengths. However, this strength can only be further harnessed and developed in future through openness to acknowledging the limitations of planning and by providing and systematically promoting opportunities for coping with uncertainties. If this succeeds, Germany in particular could develop a highly productive new innovation culture by combining planning (removal of uncertainty) with productive use of uncertainties (coping with uncertainty) in innovation processes. The comparatively highly developed culture of planning means that research and practice can focus on coping with uncertainties. This also leads to new ways of boosting the innovation potential of SMBs in particular. Small and medium-sized businesses (SMBs) play an important role in economic development in Germany. In the past, SMBs had particularly high potential for innovation, which leads to the assumption that future development in Germany depends largely on whether it can succeed in maintaining and expanding

this potential. In the face of accelerating innovation everywhere and international competition, SMBs are also under increasing pressure, however, to systematically organize and structure their innovation processes more intensively than before. It makes sense to do this using plan-oriented innovation-management and project-management methods developed to date. An example of this is the introduction of the stage-gate model (cf. Wühr et al. 2010; Pfeiffer et al. 2010). Unilateral concentration on such methods of innovation management and project management, however, runs the risk of impeding rather than promoting the innovation potential of SMBs. There is much evidence to suggest that the innovation potential of SMBs in the past lay in the very fact that they unconsciously and almost naturally allowed and coped with uncertainties in innovation processes (cf. Böhle and Kalkert 2010). The concept of *coping with uncertainty* opens up a new way to utilize SMBs' existing approaches to coping with uncertainties, and to systematically support and develop these further.

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