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Conceptualising the Causes and Consequences of Uncertainty in IS Development Organisations and Projects

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CONCEPTUALISING THE CAUSES AND CONSEQUENCES OF UNCERTAINTY IN IS DEVELOPMENT ORGANISATIONS AND PROJECTS

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Abstract

This paper is concerned with the situational causes and behavioural consequences of uncertainty in ISD organisations and projects. The paper draws on a social action theory perspective and select contributions from the fields of or about ISD, organisational studies, sociology, and psychology to discuss uncertainty as a concept and in terms of its' causes and influence on individual as well as on social action. The paper defines uncertainty, shows that it is an under-researched phenomenon, and provides a theoretical framework for further conceptual and empirical research into what makes IS developers feel uncertain, how they consequently act and interact, and what might promote the positive and prevent the negative effects of uncertainty in practice.

Keywords: Uncertainty, IS Development, Theoretical framework.

1   INTRODUCTION

> "If we want to deal with uncertainty we have to understand how human beings
> behave in the face of uncertainty" (Mathiassen & Stage, 1992)

ISD research has traditionally been very focused on ISD methods and processes: the prescriptive literature emphasizes how methods should be used, while empirically grounded writings focus on how they are used. The general picture that emerges from the many empirical studies about ISD methods and processes in practice (see e.g. Bansler & Bødker, 1993; Stolterman, 1991, 1992, 1994; Fitzgerald, 1997, 1998; Fitzgerald et al., 2002; Vidgen, 2002; Madsen & Kautz, 2002) and the few integrative frameworks here of (Jayaratna, 1994; Gasson, 1999, 2005; Sambamurthy & Kirsch, 2000; Fitzgerald et al., 2002; Madsen et al., 2006) is: a) that IS developers adapt and apply method elements in a pragmatic way and b) that ISD is best conceptualized as locally situated, historically contingent, and somewhat 'messy' social action that unfolds over time in an only partly predictable way. In other words, practice is miles away from the prescriptive literature's smooth technical process that moves from a clear beginning to a clear end (Wastell & Newman, 1993; Truex et al., 2000; Madsen et al., 2006).

ISD concerns a process of IT-supported organizational change and as such it is subject to: resistance to change; unclear goals; changing system requirements; conflicting stakeholder demands; individual career concerns; difficulties in achieving time with and information from future end users; time- and budget constraints; pressure to deliver results; rapid technological change in the market place; other planned and unplanned organizational changes; and difficult and unexpected technical problems at the project level (e.g. with regard to software design and system integration) (Wastell & Newman, 1993; Gasson, 1999, 2005; Madsen et al., 2006). Thus, the ability to deal effectively with change as an individual and a group of individuals in uncertain situations is among one of the most important skills of ISD.

However, even though change and uncertainty are mentioned as fundamental characteristics of ISD in almost every contribution within the field little attention has been paid to the concept of uncertainty as such, i.e. to its clear definition and the identification of its' major situational causes, its' influence on the involved individuals' way of thinking and acting, and its' influence on social action (including collaborative decision-making and project management) at different stages of the development process. Moreover, the ISD literature's main emphasis on ISD methods and processes means that there is only little knowledge about what it actually feels like to take part in a complex and uncertain ISD endeavour in terms of stress and emotions and how the subjective and inter-subjective experience here of influence action positively and/or negatively. Thus, there is a need for research that addresses *uncertainty* as a concept in its own right which it is highly relevant to theorise about in order to increase researcher and practitioner awareness of situational causes, behavioural consequences, and appropriate ways of coping.

This paper explores uncertainty through conceptual analytical research (Järvinen, 2001). It draws on assumptions and conceptualisations from relevant literature about ISD, organisational change, sociology, and psychology to deductively derive a theoretical framework 1) that constitutes a tentative outline of what uncertainty is as a concept and when optimistic goals are achieved and pessimistic consequences prevented (Järvinen, 2001) and 2) which can serve as a starting point for further research into the phenomenon of uncertainty.

The paper is structured as follows. First, the underlying theoretical foundation adopted for understanding uncertainty is explicated. Second, the concept of uncertainty is defined. Based on this definition the next sections discuss the relationship between uncertainty and 1) its situational causes, 2) its influence on the individual IS developer's way of thinking and acting, and 3) its influence on the involved IS developers' actions. Subsequently, a theoretical framework is developed. The concluding section provides a summary of the research.

2 THEORETICAL FOUNDATION

The theoretical foundation of this paper is a social action theory perspective (Hirschheim et al., 1996). Giddens' structuration theory (1984) is an example of a theory based on such a perspective (Hirschheim et al., 1996). The social action view has been selected: a) because it recognises and aims to explicate the emergent, locally situated, historically contingent, and politically loaded nature of ISD, b) and because it focuses on understanding social actors and their dynamic behavior from the viewpoint of the involved actor(s) (Hirschheim et al., 1996) and c) as such, it is in line with the ISD literature's main empirical findings about the characteristics of ISD, the pragmatic use of ISD methods, and the emerging nature of ISD processes. Moreover, the research is based on the assumption that to understand the complexity of ISD in general and uncertainty in ISD in particular the phenomenon has to be viewed from as many angles as possible.

The concept of uncertainty is assumed as the object of study that has to be clearly defined and viewed from a number of relevant perspectives, namely *the structuralist*, *the individualist*, and *the interactive process perspectives*. The three perspectives were originally delineated and used by Slappendel (1996) to analyse research on innovations in organizations. Markus & Robey (1988) apply similar perspectives in their work on causal structure in theory and practice, and the three views have also previously and successfully been advanced and used as a framework for understanding: the actual use of a method in a systems development project (Kautz, 2004), Software Process Improvement in practice (Kautz & Nielsen, 2004), and what influences and shapes ISD processes in practice and how they consequently emerge over time (Madsen et al., 2006). The three perspectives provide a frame for focusing on situational/structural characteristics, individual perception and action, and the complex and dynamic interplay between socially constructed structure and purposeful social action over time (Slappendel, 1996; Kautz, 2004; Kautz & Nielsen, 2004; Madsen et al., 2006). Addressing one of the major discussions in the social sciences and IS, namely that of structure and agency (see e.g. Rose et al., 2005), Slappendel's framework has a general relevance for and has already shown its suitability for ISD and ISD research.

The three perspectives will be used to combine and integrate existing contributions from the fields of or about ISD, organizational studies, sociology, and psychology into a coherent theoretical framework for understanding uncertainty in ISD organizations and projects. *The structural perspective* will address the question of what the major situational causes of uncertainty are. *The individualist perspective* aims to understand how uncertainty shapes the individual IS developer's way of perceiving and acting, while *the interactive process perspective* turns attention towards how uncertainty influences and is influenced by the complex interplay between situational causes and the social action of all the involved IS developers over time. An important assumption underlying the argument presented in this paper is that much, if not all of what actors in organisations do can be understood as 'meaning making conversation' (Streatfield, 2001). Human actors engage in reflective conversations with themselves and each other to make sense of the situations in which they find themselves (Schön, 1983; Streatfield, 2001). In line with this, Madsen et al. (2006) and Kautz et al. (2007) show that IS developers engage in constant verbal communication and negotiation to reconceive the development process and the IS under development and from a social action theory perspective it is generally assumed that the quality of social interaction is one of the factors that bear most directly on ISD success or failure (Wastell & Newman, 1993). In this paper, conversation is broadly defined to include in-the-moment verbal discourse, e.g. informal dialogue and gossip, as well as deep thought, writing, and discussion (Streatfield, 2001).

The developed theoretical framework will be based on a definition of uncertainty, it will consist of three inter-related perspectives, or focus areas (i.e. situational characteristics, individual action, social action over time) with clearly explicated assumptions rooted in social action theory, and each perspective will provide a number of relevant theoretical insights and key concepts for conceptual understanding and empirical exploration of uncertainty in practice.

3   THE CONCEPT OF UNCERTAINTY

In the literature, the concepts of complexity and uncertainty are often used, and used interchangeably, to describe a systems development situation, but the two terms are often not clearly defined. However, for the purpose of this paper a clarification of what uncertainty means is important as the concept constitutes the core of the theoretical framework.

Mathiassen & Stage (1992) provide definitions of and distinguish between complexity and uncertainty by focusing on: degree, information, and situation. They (1992) suggest that "the degree of complexity represents the amount of relevant information that is available in a given situation" and that "the degree of uncertainty represents the availability and reliability of the information that is relevant in a given situation". Both definitions are based on what could be coined 'an information perspective'.
The Oxford dictionary (see e.g. AskOxford.com) provides more general, i.e. non information oriented, definitions of complexity and uncertainty:
- Complexity, when something is complex it means that it consists of many different and connected parts and/or that it is difficult to understand.
- Uncertainty, refers to the state of being uncertain or to something that is uncertain (e.g. a situation) or causes one to feel uncertain. To feel uncertain means not to know for sure.

According to the Oxford dictionary uncertainty is about 'a state of being' or (not) knowing. This is in line with Streatfield (2001), who argues that decision makers are always only working with part of the picture, that there is always information missing, and that there therefore are lots of things that practitioners do not and could not know when they make judgements and decisions about the appropriate course of action and its outcome. Decision makers have to live with the exciting and anxiety provoking paradox of being simultaneously 'in control' and 'not in control' of emerging processes. To live with this paradox requires courage and attention; courage to keep participating creatively in the continual struggle and on-going conversations to make sense of the situations one find oneself in despite 'not knowing' and 'not being in control' and attention to how uncertainty makes the individual and/or the group feel with regard to anxiety, energy, and control, and how the perceptions here of affect the quality of human action and interaction (Streatfield, 2001).

For the purpose of this paper and the developed theoretical framework (Table 1), the concept of uncertainty is defined as: 'the individual's and/or group of individuals' perceived level of *not knowing* the appropriate course of action and/or its outcome at a given point in time'. However, uncertainty is considered a multifaceted term that needs operationalisation through a focus on anxiety, energy, control, as well as an assessment of the level of perceived uncertainty itself.

4   THE STRUCTURALIST PERSPECTIVE: THE CAUSES OF UNCERTAINTY

Much research attention has been paid to the uncertainties of ISD projects and situations (Mathiassen & Stage, 1992). In the introduction section of this paper a long list of often mentioned causes of uncertainty was for example outlined. Davis (1982) suggests that in a given ISD project uncertainty can be analysed in terms of: the organisational and technical context, the future information system, the experience and skills of the users, and the experience and skills of the IS developers. For each of these elements, there are characteristics that reduce or increase the expected uncertainty of the development process (Davis, 1982), as illustrated in table 1.

Elements	Examples of characteristics that:	
	Reduce uncertainty *(well-understood situation)*	*Increase uncertainty* *(ill-understood situation)*
Context	Stable, well-defined context not in process of change; well-defined activities and decisions	Unstable, ill-defined context in process of change; ill-defined activities and decisions
IS	Simple, well-understood set of requirements; automation of tasks	Complex, ill-understood set of requirements; decision support
Users	One or few users; high experience with context; high experience with similar IS	Many users; low experience with context; low experience with similar IS
Developers	Trained and experienced with similar IS	Little prior training or experience with similar IS

Table 1: Characteristics that reduce/increase uncertainty in ISD (adapted from Davis, 1982, pp. 22)

Davis (1982) views uncertainty as a stable characteristic to be assessed in the beginning of the project. However, unexpected events during development might make the IS developers temporarily unable to make sense of the situation and cause them to feel that the uncertainty has increased, and perhaps become too high (Sabherwal, 1999; Streatfield, 2001). Sabherwal (1999) puts forward that all projects need a balance of trust-based collaboration and structural mechanisms, such as reporting arrangements, deliverables, division of work, training programs etc., to cope with change and ensure good performance (i.e. good quality, timely progress), while Streatfield argues that meaning making is both the problem and the coping mechanism of uncertainty (2001). Streatfield (2001, pp. 128) explains "[i]n the accounts of my experience…there are a few examples of temporary resignation and even despair. But the next morning we were always back to work, actively trying to make sense of our situations and form intentions about what to do next".

Which situational characteristics and events make IS developers feel that the level of uncertainty is *too high*? When the organisational context and IS under development is complex and poorly understood by the developers, when there is a lack of relevant and reliable information to remedy this situation, when unexpected changes occur, and when the appropriate organisational structures are not in place to deal with complexity, information scarcity, and unexpected changes IS developers are likely to feel that the level of uncertainty is too high and to fear for their own and as well as the project's ability to stay in control and on track.

Which situational characteristics and events make IS developers feel that the level of uncertainty is *appropriate*? Drawing on Sabherwal (1999) and Streatfield (2001) I propose that the situation does by no means have to well-understood by the developers at all times for the level of uncertainty to be appropriate, but the structural mechanisms in a project have to fit the level of uncertainty as it changes over time and to facilitate sense making in order to avoid long-term loss of meaning, what Sabherwal (1999) refers to as a 'vicious cycle' of poor performance and distrust in one self, others, and the project in general.

5 THE INDIVIDUALIST PERSPECTIVE: INDIVIDUAL ACTION

It is widely recognised in the literature that ISD projects are prone to limited availability and reliability of all the relevant information, social and technical complexity, and unexpected changes to e.g. goals, requirements, and IT. For these reasons, uncertainty is ever present, reflecting the continual threat of collapsing into meaninglessness, disorder and chaos both at the personal and project level (Streatfield, 2001). However, at the same time some uncertainty is normal, healthy and a source of energy that drives the IS developer to search for new and different meanings (Streatfield, 2001). Thus, too much uncertainty is counterproductive, while some uncertainty is essential for the emergence of novelty and change.

How does the individual IS developer act when the level of uncertainty is *too high*? It varies from individual to individual how much is too much, but a high level of uncertainty, anxiety, and stress may

lead to a general reduction in job and cognitive performance as well as to reality distortion (Wastell & Newman, 1993). Reduction in overall job performance may show as a general resistance to change, confrontational behaviour or over-cautioness, resignation, and social withdrawal. Reduction in cognitive performance may show as an inability to concentrate in the moment and on all the available and relevant information. Janis (1982) proposes that in uncertain and stressful situations decision makers often become "hypervigilant", scanning information and alternatives in a hasty, disorganised, and incomplete way, or they become "hypoviligant", a defensive-avoidance response characterised by under-reaction and denial, by lack of vigilant search, distortions of meaning, selective inattention and forgetting, and wishful rationalisation (Janis, 1982; Wastell & Newman, 1993). Similar coping strategies are proposed by Dorner who coins them "thematic vagabonding" and "encystment" (Dorner, 1987; Wastell & Newman, 1993). In very critical situations when events are getting more-and-more out of control, thinking tends to become more-and-more rigid and reflexive, less time is spent reviewing and critically evaluating previous actions, future plans degrade into disconnected and increasingly stereotyped reactions, and fortification tendencies may also develop in which actors only look for evidence that confirm their already established and perhaps erroneous views. Thus, in critical, high uncertainty situations actors may create a distorted perception of reality as they become unable to concentrate, develop a tendency to over-generalise and in general lose their objectivity and sense of proportion.

How does the individual IS developer act when the level of uncertainty is *appropriate*? And what is the appropriate level? Working under pressure is enjoyable to a degree and, as Csikszentmihalyi (1990) puts it, the best work life moments usually occur when a person's body and mind is stretched in an effort to accomplish something difficult and worthwhile. The concept of "working on the edge" (Austin & Devin, 2003) captures the essence of what it means to stretch and expand one's capabilities and accept the inevitable uncertainty and discomfort here of, without feeling unable to cope and in danger of being overwhelmed (Wastell & Newman, 1993; Austin & Devin, 2003). Achieving the 'right' level of uncertainty, i.e. the edge, in practice is off course difficult, but when it happens, at least more or less, IS developers are able to concentrate in the moment and on all the available and relevant information and to pay attention to and engage in reflective and participative conversations to make sense of the situation and (re)gain a feeling of being in (some) control through the creation of meaning and formulation of intentions for future action.

6   THE INTERACTIVE PROCESS PERSPECTIVE: SITUATIONAL CAUSES AND SOCIAL ACTION OVER TIME

The interactive process perspective builds on and supplements the structuralist and individualist perspectives as the focus is on the relationship between uncertainty, situational causes, and the actions of the involved IS developers over time. However, uncertainty has not yet been studied in this way, i.e. as a complex situational, behavioural, and temporal phenomenon rather than a static characteristic used to describe ISD projects and situations in general. In line with this, Wastell & Newman (1993) state that ISD is an inherently social and stressful activity and that the behaviour of the ISD group, in particularly in uncertain situations, therefore is a matter of supreme concern, but also that this topic is surprisingly under-researched. Generally speaking research about uncertainty and social action seems: to focus on 'the ISD group' as a unit (of analysis) and not on 'the (different) actions of the (different) involved IS developers', to only create weak links between situational causes and behavioural consequences if at all, and to overlook the issue of (change over) time. What, then, is known about the interplay between uncertainty and group action?

How does the ISD group act when the level of uncertainty is *too high*? Wastell & Newman (1993) suggest that the ISD group is likely to engage in groupthink, competitive rivalry, and/or basic assumption behaviour. Groupthink refers to the anxiety and stress-reducing "psychological drive for consensus at any cost that suppresses dissent and appraisal of alternatives in cohesive decision-making groups" (Janis, 1982; quoted from Wastell & Newman, 1993, pp. 132). When the level of uncertainty

is high well-integrated groups are likely to unite and they are therefore more prone to groupthink, while inchoate groups typically will disintegrate and engage in competitive rivalry within the group and with other social groups. Bion (1961) also suggests that the group may engage in basic assumption behaviour, where they direct their energy inward and become more concerned with the preservation of the group as a source of support and security rather than with effective action. Keil's (1995) empirical study of the problem of project escalation offers an interesting example of groupthink, where senior managers and IS developers continued to decide on and make major revisions to a particular information system even though the feedback information they received showed that the project concept was flawed and that the information system would never be fully accepted and put to use.

How does the ISD group act when the level of uncertainty is *appropriate*? Wastell & Newman (1993) suggest that the group engages in collaborative critical inquiry and evaluation of alternatives, what Bion (1961) also refers to as work activity behaviour, where the group co-operates in the pursuit of task goals. Socially constructed structures, such as formal decision-making procedures and organisational forums (e.g. steering committees and review boards) as well as ISD methods, might counteract the tendencies to and effects of groupthink, as they in themselves reduce some of the uncertainty about what to do next. Such structures act as social defences that contain anxiety, and some containment of decision-making and responsibility-taking anxiety *is* necessary, but the structures can also become rituals that are mindlessly enacted to provide a feeling of security and efficiency at the expense of real engagement with the task and each other (Menzies-Lyth, 1988; Wastell & Newman, 1993; Wastell, 1996).

The knowledge that can be found about the positive and negative consequences of uncertainty at the individual (previous section) and group level (this section) seems rather similar: at the individual level, it cover tendencies to engage in reflective inquiry or disregard relevant information, while the group level concerns coping with uncertainty through participative conversations and appropriate defence mechanisms or via development of distorted perceptions of reality. The similarities of the individual and group level conceptualisations suggest that more knowledge about uncertainty as a complex phenomenon is needed. In the next section, a framework for exploring uncertainty through a focus on its causes, consequences and their complex interplay is outlined.

7 THEORETICAL FRAMEWORK

The theoretical foundation of the research presented in this paper is a social action theory perspective. The underlying assumptions are that to understand uncertainty in ISD organisations and projects the topic has to be explored from a number of angles and that conversations as a concept helps to highlight what organisations in general and ISD projects in particular are all about. The theoretical framework presented in table 1 summarises the discussion of the concept, causes, and consequences of uncertainty.

Object of study	**Definition**: Uncertainty is defined as 'the individual's and/or group of individuals' perceived level of *not knowing* the appropriate course of action and/or its outcome at a given point in time'.
Structuralist	**Focus:** Situational causes of uncertainty. **Assumption**: Uncertainty increases when IS developers are temporarily unable to make sense of the situation. **Key question**: Which situational characteristics and events make IS developers feel that the level of uncertainty is *too high / appropriate*? **Key concepts**: Context, IS, Users, Developers, Complexity, Information scarcity, Unexpected events, Structural mechanisms.
Individualist	**Focus:** Individual action. **Assumption**: Too much uncertainty is counterproductive, while some uncertainty is essential for the emergence of novelty and change. **Key question**: How does the individual IS developer act when the level of

	uncertainty is *too high / appropriate*? **Key concepts**: N*egative action*: reduction in job performance, reduction in cognitive capacity, reality distortion / *positive action*: concentration, conversations, sense making, intention formulation.
Interactive Process	**Focus**: Situational causes and social action over time. **Assumption**: Too much uncertainty is counterproductive, while some uncertainty is essential for the emergence of novelty and change. **Key question**: How does and how is the perceived level of uncertainty influenced by the interplay between situational causes and the actions of the involved IS developers when the level of uncertainty is *too high / appropriate*? **Key concepts**: N*egative action*: groupthink, competitive rivalry, basic assumption behaviour / *positive action*: critical inquiry and evaluation of alternatives, co-operation and conversation, work activity behaviour.

Table 2: Theoretical Framework

The literature shows that when the perceived level of uncertainty is (too) high IS developers might, individually and jointly, become unable to concentrate in general and therefore to take in all the available and relevant information and engage in effective, reflective, and participative sense- and decision-making conversations. This suggests that more information may not necessarily lead to more and better use of information due to reduction in concentration and conversational capabilities and that the behaviour of IS developers in uncertain situations is important to take into account. However, uncertainty is currently an under-researched phenomenon and there is only limited knowledge about what leads IS developers to feel uncertain and at what level as well as how they behave in the face of uncertainty. There is therefore a need for research that addresses uncertainty as a complex phenomenon, e.g. by exploring the relationship between situational causes, the perceived level of uncertainty, and individual and social behaviour at different stages of the development process. To this end, the presented theoretical framework can be used as a point for departure for:

- Literature-based theory development, e.g. a literature study of the situational causes, behavioural consequences, and their relationship over time that can be derived from the existing *empirical* research about ISD in practice. Such a study will supplement and advance the conceptual findings and theoretical framework that was the topic of this paper.
- Empirically grounded theory development, e.g. data collection, analysis, presentation, and comparison of qualitative and longitudinal case studies of uncertainty and its' causes, consequences, and countermeasures as they emerge in practice and over time.
- Theory test, e.g. a quantitative questionnaire survey that tests assumptions and the relevance and levels of as well as relationships between key concepts.

A literature based, empirically grounded, and well tested theoretical framework that provides a nuanced, behavioural perspective on uncertainty may help IS developers and managers take individual action and establish organisational structures to promote the positive and prevent the negative effects of uncertainty. The theoretical framework for example already now indicates that IS developers and managers could benefit from taking actions: 1) as individuals to minimize their own inclinations to disregard relevant information by asking themselves questions such as "am I able to concentrate?", "am I taking time to look at alternatives?", "am I having trouble hearing other people's concerns?" and 2) to institute structural mechanisms, such as procedures and practices that can help reduce the tendencies and effects of groupthink, competitive rivalry, and basic assumption behaviour.

8   CONCLUSION

In this paper, the concept of uncertainty refers to a state of being that affects behaviour positively or negatively depending on the perceived level of uncertainty. It is assumed that uncertainty arises and increases when IS developers are temporarily unable to make sense of the situation because of situational characteristics, complexity, information scarcity, and unexpected events. It is concluded

that some uncertainty is inevitable and a necessary source of creative energy, but also that in high uncertainty situations IS developers might individually and jointly become unable to concentrate on all the available and relevant information and to engage in effective, reflective, and participative sense- and decision-making conversations. The research is summarised in a theoretical framework that can serve as a starting point for further theory development about the causes, consequences, and appropriate countermeasures at different levels of uncertainty and at different points in time via literature as well as qualitative and quantitative empirical studies here of. Moreover, the framework is a first step towards a nuanced, behavioural perspective on uncertainty that, in time and given more research, may help IS developers and managers take individual action and establish organisational structures to promote the positive and prevent the negative effects of uncertainty.

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