DESIGN SCIENCE IN ACTION: DEVELOPING A FRAMEWORK FOR INTRODUCING IT SYSTEMS INTO OPERATIONAL PRACTICE

Completed Research Paper

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Abstract

The paper presents an example of using design science research for solving a problem arising from local practice. The problem concerns adoption of new technology. The paper aims to integrate existing approaches and theories of technology acceptance and change management in a framework useful for practical purposes. It is based on the idea that the successful introduction of an IT system requires a number of conditions to be satisfied as well as means for bringing about the satisfaction of these conditions. The level of satisfaction of the conditions can be measured by a set of parameters, such as the level of strategic, tactical and operational understanding of the system by the users. Means include various types of actions, tools and strategies. The introduction process is steered via periodically measuring the parameters, and applying means that help to change the level of satisfaction of the conditions.

Keywords: Design science, technology acceptance, change management, business process

Introduction

Introduction of IT systems in operational practice is a research area that has received much attention in the past decade, see for example, (Sharma and Yetton 2003; Beaudry and Pinsonneault 2005; Andersson et al. 2005; Jasperson et al. 2005; Markus 2004; Vissher et al. 2003). The level of difficulty in achieving success when introducing a new system depends, to a large extent, on the scope and purpose of the system. Systems that are limited to automating a specific and already existing function in the organization are easier to put into operation than systems that are introduced to support new ways of working and communicating. Examples of the latter are Customer Relationship Management Systems, Enterprise Resource Planning Systems, Supply-Chain Management System, and Business Process Support Systems.

The focus of this paper is on the introduction of IT systems that aim at changing the work and communication practices of an organization. Introductions of these systems are complicated as they generally require changes in business processes, and, thereby, also changes in the organizational structure. Another complicating factor is that many users of such systems often get no or only small short-term benefits from the system, which makes them less motivated to use the system (Sharma and Yetton 2003). Thus, it is common that ongoing system introduction processes do not result in expected system use. In order to address this problem, it should be possible to assess an on-going introduction process in order to discover why it has not worked as expected and what could be done to "get it back on track".

The goal of this paper is to suggest a practically useful framework that can help in assessing the state of an already started introduction process and help to drive it to its successful end. The framework will enable organizations to understand how an introduction process proceeds and to identify effective means to improve it. The framework is called A³ – Assess-Adjust-Apply – as it is aimed at supporting an iterative method of steering the introduction process. Each of the iterations includes assessing the current state, adjusting the plan based on the result of the assessment, and applying this adjusted plan to the situation at hand. Thus, the framework offers actionable instruments that organizations can use to improve the practice of systems introductions.

The A³ framework has been built based on results from two fields of research and practice: change management and technology acceptance. Change management studies methods, models and frameworks for implementing organizational changes in a controlled and efficient manner. Technology acceptance investigates how users come to accept and use a technology, in particular in the field of Information Systems. Most work within change management has a design science focus, i.e. artifacts, such as methods, models and frameworks are designed and developed for solving practical problems. The area of technology acceptance, on the other hand, has a more behavioral science character, as it attempts to identify factors that determine how and when users accept a new technology.

The research presented in this paper follows the design science principles, and thus it substantially differs from most of the research devoted to technology acceptance. The differences concern the following aspects:

- Our research was initiated by a problem discovered in a local practice, not taken from the literature.
- Our research was conducted as a problem solving project in which the authors actively participated, not as a case study of the work done by somebody else
- The goal of the project was not to find new factors that influence technology acceptance, but to integrate already existing knowledge into a framework (i.e. an artifact in design science terms) that can be useful for solving practical problems.

The paper has the following structure. First, we present our view on design science, followed by an overview of related work. Then we introduce the problem that the paper addresses. As the next step, we review the foundational knowledge for building the A³ framework. After that, we present the main elements of the A³ framework. A demonstration of the use of the framework is presented and discussed. The last two sections contain reflections on design science based on our experiences, concluding remarks and plans for the future. The appendix contains examples of questions used for surveys and interviews.

Method – Design Science

The development of the A³ framework was carried out according to the design science paradigm. In this section, we introduce and present our view on design science.

Generating and Testing Hypothesis for Adoption

Design science research (Hevner et al. 2004; Peffers et al. 2007; Baskerville 2009) is related to finding new solutions for problems known or unknown (Anderson et al. 2011). To count as a design science solution, it should be of a generic nature, i.e. applicable not only to one unique situation, but to a class of similar situations, cf. Principle 1 of (Sein et al. 2011). There is a substantial difference between design science methodologies on the one hand and wide spread qualitative and quantitative methods (Neuman 2006) on the other. The latter are aimed at investigating real life situations as is, or as they were at some point in the past, in order to find commonalities between them that can give rise to a theory explaining the current or past state of affairs. Focusing on the present and past also allows employing statistical methods as there is a possibility to gather information on many similar real life situations, ensuring that the size of a sample is sufficiently large for relying on statistical methods.

Focusing on the present and past in such a dynamic area as IS has a major drawback. It means that research follows the industry/practice and explains its successes and failures rather than showing new ways to proceed, as argued in (Österle et al. 2010). Design science research with its focus on generic problem solving tries to overcome this drawback. This kind of research can be considered as an activity aimed at generating and testing hypotheses[1] for future adoption by practice (Bider et al. 2012). Therefore, implementation and verification of a generic solution (Bider et al. 2012) or artifact (Peffers et al. 2007) in at least one situation, is a critical part of design science, usually referred to as demonstration or proof of concept (Peffers et al. 2007). This stage shows whether a hypothesis is a candidate for adoption or needs to be discarded or improved.

Design science research, on its own, cannot provide sufficient evidence in favor of a hypothesis. It can only demonstrate that it could work on one or several specific situations. A definite proof comes only when and if the industry/practice adopts the solution, which generates sufficiently many examples of its usage in real life, so that standard qualitative and quantitative methods can be employed to prove or disprove the hypothesis generated by design science. Therefore, design science research cannot be placed in the same category as empirical research, but should be regarded as complimentary. In short, we agree with Hevner et al. (2004) that design science represents a distinct research paradigm – generating hypotheses on how the future could look like and making initial filtering of them in order to remove hypotheses not worth of pursuing. By widening the employment of design science research, the IS discipline can acquire a leading position in the field of practice.

Movement between Two Worlds

Design science, as a way of generating and testing hypotheses for generic solutions, requires researchers to act in two different worlds: (a) the real world of specific situations, problems and solutions in local practices, and (b) the abstract world of generic situations, problems and solutions (Bider et al. 2012).

Design science does not impose any particular order of movement in the two worlds. A researcher can start with a specific problem in a specific situation, find a solution for it (situation to-be that solved the problem), and then generalize all three parts of his/her test case: situation, problem, and solution. Classification of the ways of working in this manner is presented in (Anderson et al. 2011). The researcher can also start from the other end – with finding a generic solution for a known generic problem and then try to find and implement a test case for its demonstration. A kind of "shuttling" between the two spaces is suggested in (Sein et al. 2011) in the Formalization of Learning stage of Action Design Research (ADR),

[1] In this paper we use the term hypothesis in its general meaning "a supposition or proposed explanation made on the basis of limited evidence as a starting point for further investigation" (Oxford dictionaries: http://oxforddictionaries.com). Our usage of this term bares no connotation to how it is used in positivists' research methods.

which aims at transforming situated learning results into classes of field problems and generically applicable solutions.

In the research reported in this paper, a mixed strategy has been applied. First a specific problem has been identified in practice. Then the situation and the problem were generalized. In the next step, a generic solution was developed, and then applied to the original situation/problem.

Related Research

The introduction of IT systems is an emerging and active research area. An important reason for this is the number of system introduction failures, i.e. rejected or under-used IT systems. Another reason is that the IT introduction process is of vast interest among researchers and practitioners from many disciplines, e.g. organizational theory, human computer interaction, computer and systems science, sociology and cognitive science.

Most of the existing literature on system introduction is focused on factors that determine the success of a change process and on actions to be taken in order for it to succeed. However, knowledge on success factors and change actions is not sufficient for managing a system introduction process. There is also a need to understand when and how to adjust an introduction process in order to fulfill its goals. Thus, the process has to be continuously monitored and assessed in order to discover when and why it has not worked as expected and to determine what could be done to "get it back on track".

The need for monitoring and assessment has been acknowledged in some methods for system introductions. For example, Callen et al. (2008) proposed a model CIM (Contextual Implementation Model) for assisting clinical information system implementations, which identifies three levels of contextual differences: organizational, departmental and individual. Callen et al. (2007) state that "It will be important for implementation staff to gauge what the differences in each of the three contextual categories are and how these differences would impact on the use of the clinical information system. This assessment should occur pre-implementation, during implementation and postimplementation." However, the authors do not detail how this assessment is to be carried out, neither what actions to take when problems are identified. Another work that acknowledges the importance of continuous assessment is the process oriented approach to ERP implementation proposed by Aladwani (2001). The approach consists of three phases: knowledge formulation, strategy implementation, and status evaluation. The status evaluation phase provides feedback to the management about the implementation process so that appropriate actions can be taken. However, Aladwani (2001) provides very limited details on how the status evaluation is to be executed. While there are approaches that recognize the need for continuous assessment and adjustment of introduction processes, none of them, to the best of our knowledge, offers any detailed methodological support for these tasks. Thus, a main contribution of our work is to fill this gap by proposing a practically useful framework that can help in assessing the state of an already started introduction process and help to drive it to the successful end.

Primarily, the A3 framework is related to two research areas: Change management and Technology acceptance, which are described below.

Change Management

Research about the relationships between change management and IT introduction processes constitutes a basis for the A3 framework. Results from this research area are mainly reflected in the A3 framework by the proposed means that management can use in order to adjust an introduction process.

Research on change management in connection to IT has discovered and continues to discover factors that are important for successful IT-systems introductions. For example, many researchers point to the importance of *top management support* for successfully introducing an information system, see, for example, (Sabherwal et al. 2006), (Kwon and Zmud 1987), (Sharma and Yetton 2003), (Markus 2004), (Sumner 1999). Other important factors are *project definition* and *project planning* (Kwon and Zmud 1987); *skilled and balanced project organization* (Holland et al. 1999), (Sumner 1999); *communicating project objectives and project plan* (Sumner 1999), (Holland et al. 1999); *establishing a long term vision* (Ross 1999); *communicate project progress to the rest of the organization* (Holland et al. 1999), *introduce technical support, help desks and online user assistance* (Sabherwal et al. 2006), *carry out*

user training (Sharma and Yetton 2003); and *introduce reward systems* (Markus 2004), (Sharma and Yetton, 2003); as well as the *need of a champion that has the power to act as an advocate for the information system* (Markus 2004)

An eight-step process for managing organizational change is described in Kotter (1996). The steps include establishing a sense of urgency and generating short-term wins. These steps have all been included as an instrument in the A3 framework, and are therefore described in detail in Section "Knowledge Base Used for Developing the Generic Solution". Kotter (1996) does not specifically discuss information systems introductions, but as we are interested in information systems that support new ways of working and communicating, Kotter's eight steps are relevant for our purposes.

Sharma and Yetton (2003) have presented a number of actions to ensure a successful introduction of IT systems that support interrelated tasks between users. Also these actions have been included in the A3 framework, and are described in detail in Section "Knowledge Base Used for Developing the Generic Solution"

Technology Acceptance Issues

User acceptance of new IT systems is difficult to predict and is therefore an important research area. This research area has also influenced the A3 framework, mainly the choice of instruments for assessing the status of an introduction process.

Most technology acceptance theories assume that external variables (such as characteristics of the organization, the technology, and the tasks to perform, individual and user differences) determine individual reactions (such as attitude, perceived usefulness, perceived ease of use). These reactions in turn determine the intention to use IT, which finally determine the actual use of an IT system.

The most influential theory in the area of Technology acceptance is the Technology Acceptance Model (TAM) presented by (Davis et al. 1989). TAM introduces two important types of individual reactions, *perceived usefulness*, and *perceived ease-of-use*. Later, TAM was extended to TAM2 by Venkatesh and Davis (2000) by adding an additional type of individual reaction, *social influence*, adapted from (Fishbein and Ajzen 1975). Other theories in the field include Model of PC Utilization (Thomson et al. 1991), Innovation Diffusion Theory (Moore and Benbasat 1991), and Social Cognitive Theory (SCT) (Compeau and Higgins 1995). Venkatesh et al. (2003) has integrated different theories and developed a unified theory called the Unified Theory of Acceptance and Use of Technology (UTAUT), which contains a set of individual reactions (i.e. performance expectancy, effort expectancy, social influence, and facilitating conditions). The individual reactions have been included in the A3 framework and are described in detail in Section "Knowledge Base Used for Developing the Generic Solution". UTAUT has been tested in a longitudinal study and found to be able to account for 70 per cent of the variance in usage intention (Venkatesh et al. 2003).

Identifying and Generalizing a Problem

The research reported in this paper originated from practical problems that were encountered in the research project INKA (Andersson et al. 2004) aimed at investigating effects from the introduction of an integrated business process support and knowledge management system into operational practice of a non-profit interest organization. As settings of the INKA project substantially influenced the research reported in this paper, below we will briefly overview the relevant details of these settings.

The project had three partners:

- HGF - a regional office of an interest organization called "Association of Tenants"
- IbisSoft - a small Swedish consulting business where the first author was working at the time
- DSV - the department of Computer and Systems Sciences at Stockholm University/Royal Institute of Technology where the rest of the authors were working at the time

HGF unites more than 60,000 tenants and its primary goal is to protect the interests of its members by giving them legal and practical advice and conducting rent negotiations with property owners on their

behalf. The regional office had about 50 employees whose tasks were to provide services to the members and to the field-level organizations.

HGF and IbisSoft had business relationships prior to the INKA project. IbisSoft had conducted several business process analysis projects at HGF, as well as developed and introduced in organizational practice a system that supported recruiting of new members. The system, called ProBis, is a Business Process Support System. ProBis had been developed prior to the INKA project start by IbisSoft on commission from HGF. The system would support several of the interdepartmental business processes, like managing projects, lobbying, processing feedback from the members, etc. Though IbisSoft had experience of developing systems for HGF, ProBis was the first system that was aimed at supporting interdepartmental processes. It was around ProBis that the INKA research project was envisioned.

When planning the research project INKA, no serious problems in introduction of ProBis into organizational practice were anticipated. Previous experience of IbisSoft indicated that though introduction of a system may take some time, it eventually will be used in practice. However, soon after the first version of the system had been developed and put into operation, we discovered that very few used it. This made it impossible to fulfill the goal of the INKA project, which was to measure effects of system introduction. An investigation was conducted on the causes of the failure, which resulted in a critique of the usability of the system, i.e. the system design was not perceived as sufficiently intuitive and user-friendly. After this discovery, the user interface of the system was completely redesigned (Andersson et al. 2005), and the users were once more invited to use the system. The result was negative this time as well, i.e. very few used the system. However, nobody was criticizing the system design any longer. The situation was plainly explained by a statement from one of the supposed users: “I am sure that the system is very good, but I do not know what I should use it for”. As nobody was “blaming” the system, the reasons for failure were to be found elsewhere.

The situation became critical. Not only the research project INKA was at risk to be canceled, but the whole investment of developing ProBis was at risk to be lost if no ways were found to make HGF use the system. A solution needed to be found in as short time as possible, and our research group was forced to switch its attention from the planned research to finding a way out of the crisis.

Scanning the literature, we discovered that the difficulties encountered were not unique but inherent in the introduction of any software system that implies an organizational change. As the research focus in the INKA project was not on the introduction process itself, we tried to first find a solution in the literature. However, our search for an existing solution gave no result. Solutions for supporting organizational change were focused on planning in the right way from the very beginning of the change process. This was not an option in our project. We were in the middle of a not so successful system introduction that could not be "rewound". The only way to proceed for us was to design a solution ourselves. In order to find such a solution, we generalized the problem as well as the intended solution, similarly to the stage Problem Formulation in ADR (Sein et al. 2011), which is governed by a principle to identify generic problems and solutions inspired by specific problems in local practices.

Summarizing the above, the generic situation as-is that we were interested in was "System introduction that implies an organizational change". The generic problem that we discovered could be defined as "An ongoing system introduction process does not lead to expected usage of the system". The generic solution we were looking for was "A method that can be employed in an ongoing introduction process with the purpose of improving systems use”. In other words, we were looking for a method of conducting introduction process (i.e. an artifact in the design science terminology) that

- helps to assess the current situation
- helps to identify ways to go forward
- is convincing and understandable for the management and other employees involved in the introduction process

The list above constitutes what is called the requirements or objectives in design science (Peffers et al. 2008).

Knowledge Base Used for Developing the Generic Solution

The core of the A³ framework is the state-oriented view on business processes (Khomyakov and Bider 2000). According to this view, a business process instance (case) is a point moving through a multi-dimensional state space towards a goal that is expressed as reaching a given surface in this space. The movement is based on dynamic planning of actions that will lead from the current point in the state space to the next one that is closer to the goal. To apply this view to the system introduction process, we needed to design a state space for this process, methods of determining the current position in it, and ways of movement in this space. The state-oriented view on business processes has been used by the IbisSoft team for the systems development purposes, and was interpreted by the INKA research team as a promising foundation for fulfilling the requirements presented in the previous section.

The dimensions of the state space should represent relevant properties of the individual participants of the introduction process as well as the organization in which the system is introduced. In order to identify these properties, we turned to the literature on change management and technology acceptance. A mature framework in technology acceptance is the Unified Theory of Acceptance and Use of Technology (UTAT) by Venkatesh et al. (2003) that highlights the conditions facilitating or hindering the technology acceptance by end-users. As UTAUT subsumes most other frameworks in the area of technology acceptance, we decided to use it as a basis for identifying properties of individual participants. For identifying organizational properties, we made use of the work by Sharma and Yetton (2003), who emphasize the importance of changing the institutional context when introducing a system characterized by a high level of task interdependence.

As UTAUT by itself is not well suited for practical managerial intervention, we also needed a practical framework for taking action in a change management context. Such actions can be viewed as influencing movements in the state space. One of the most well established and broadly used methods in the area of change management is the approach proposed by Kotter (1996). The actions of this approach were included in the A³ framework. While most of the actions of Kotter (1996) focus on communication, planning and creating awareness, there is also a need in system introduction processes to establish more permanent structures for supporting use and maintenance of the system. In order to fill this gap, we made use of the actions proposed by Sharma and Yetton (2003), which were included in the A³ framework.

Below, we give a short overview of the sources used as a base for A³:

Kotter's eight stages for implementing a major organizational change (Kotter 1996) are as follows:

1. Establishing a sense of urgency
2. Creating the guiding coalition
3. Developing a vision and strategy
4. Communicating the change vision
5. Empowering broad-based action
6. Generating short-term wins
7. Consolidating gains and producing more change
8. Anchoring new approaches in the culture

Sharma and Yetton (2003) emphasize a set of actions for changing the institutional context to ensure a successful introduction of IT systems:

1. Instituting new structures. This means introducing structures in the organization that support the use of the systems, e.g. create a training group, or introduce a help-desk.
2. Instituting new performance control systems, more exactly, the ones that favor system usage, e.g. introduce a system that rewards the most active users. This helps to increase the motivation of users in situations where they do not perceive the benefits of using the system for themselves (e.g. when they do not perceive any improvement in their own performance).
3. Instituting new coordination mechanisms. New IT systems often require changes in existing work processes, which have to be redesigned in order to ensure benefits from the system. These changes may also involve changes in the existing power structures. Sharma and Yetton (2003) have observed

that a successful system introduction requires a process of mutual adaptation of organization and system.

4. Instituting changes to performance goals. An introduction process is often characterized by a period of decline in performance. The pressure of reaching high performance goals may induce the users to reject the system or settle on a minimal level of its adoption. To prevent such behavior, it is helpful to lower the performance goals during the introduction process.

UTAUT (Venkatesh et al. 2003) identifies the following four constructs/individual reactions that determine the intention to use the system and, thereby, actual use of the system:

1. Performance expectancy, which is defined as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance".
2. Effort expectancy, which is defined as "the degree of ease associated with the use of the system".
3. Social influence, which is defined as "the degree to which an individual perceives that important others believe he or she should use the new system".
4. Facilitated conditions, which is defined as "the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system".

The knowledge in the three works above is structured in three different ways. Kotter (1996) structures the knowledge around a plan of actions that needs to be in place from the beginning of the introduction project. Sharma and Yetton (2003) structure the knowledge around institutional changes that should be made in the organization itself to ensure the success of the introduction project. Venkatesh et al. (2003) structure the knowledge around the conditions that hinder or facilitate the motivation of the users to accept the system. None of these ways of structuring suited the situation at hands – being in the middle of an unsuccessful introduction and desiring to find a way out of it. The knowledge from the three sources needed to be restructured in order to be incorporated in A³ framework, which was done having the state-oriented view on business processes in mind.

Developing a Generic Solution - A³ Framework

In this section the A³ framework is presented. The framework is based on the following assumptions:

- There is a set of conditions to be satisfied in order to ensure the success of the introduction, for example, users being motivated to use the system, and system and organization being aligned
- The degree/level of satisfaction of these conditions can be measured
- There exist means to be employed to increase the level of satisfaction of any particular condition

In addition, we assume that the system to be introduced is “good enough for the purpose”, i.e. it is functional and in principle able to provide adequate services for the organization. The framework concerns only the introduction process as such. Discussions of the needs to adjust or improve the system are considered to be outside the scope of this framework. In practice, however, a business situation can represent a mixture of the introduction process and the system development and tuning process, especially when agile development principles are employed.

Based on the assumptions above, we have built a framework according to the following plan:

1. Identify measurable parameters (indicators) that could be used for determining the level of satisfaction of the conditions needed for achieving success
2. Identify methods for measuring these parameters, e.g. using questionnaires or deep interviews
3. Identify means appropriate for increasing the level of satisfaction of the conditions required for success, e.g. promote the vision, train the staff, introduce a help-desk

4. Relate means to the parameters so that the right means could be selected when a certain parameter shows that the corresponding condition is not satisfied[2]

The framework is presented in Figure 1. The central part of the framework consists of the parameters used for measuring the level of satisfaction of conditions that are important for achieving success. The blocks below and above the parameters represent means for changing the values of parameters; we call them "means of control" of the introduction process. Arrows between the means blocks and parameter blocks show which means are proper to employ when trying to influence the value of a certain parameter.

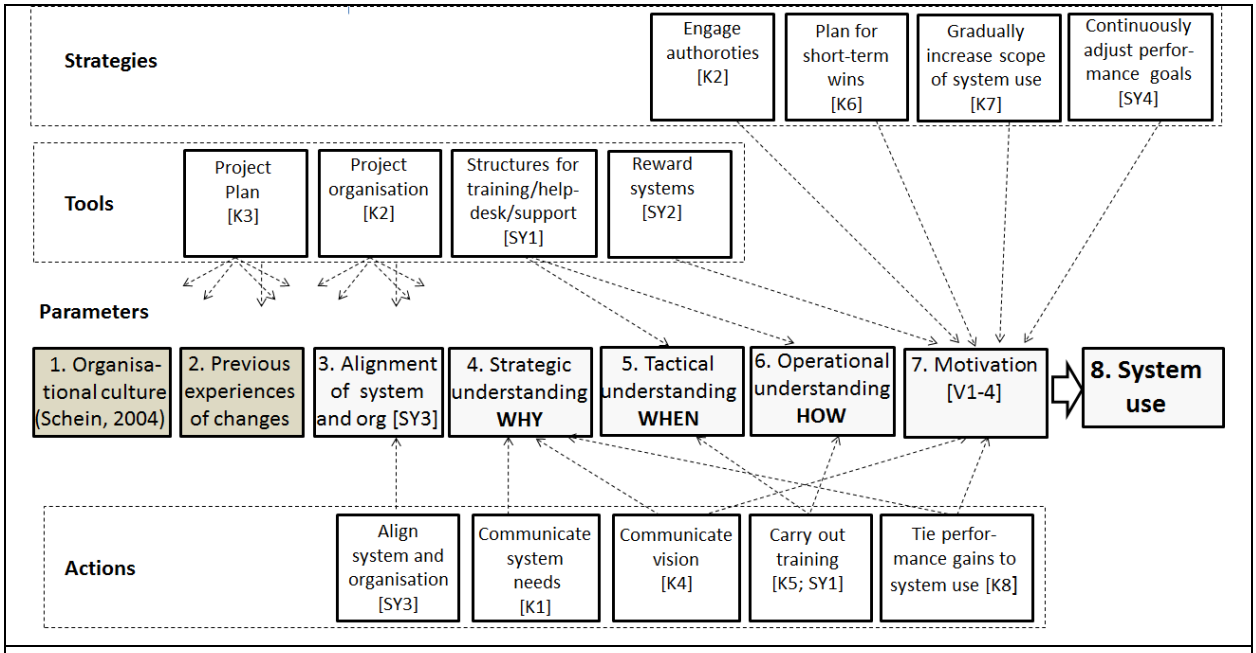

Figure 1. The A[3] Framework

Abbreviations in square brackets inside blocks refer to the sources from the previous section: Kn - refers to the n-th phase of the (Kotter 1996) plan, SYn – refers to n-th action from (Sharma and Yetton 2003), and Vn – refers to the n-th construct from (Venkatesh et al. 2003)

Parameters 3-7 are directly connected to the conditions to be satisfied for the introduction to be successful[3]. The first two parameters, with grey background, are different from the others; they are not related to the conditions to be satisfied but to contextual conditions that existed prior to the introduction, in particular concerning social and organizational aspects. These fixed parameters cannot be changed but are still important to take into consideration.

Means of control are divided into three categories: actions, tools (artifacts) and strategies. Relations between these categories, which are not represented in Figure 1, are as follows. Actions **may be included in** tools, more exactly in the *Project plan*. Tools **support** actions, e.g, *Structures for training/help desk/support* (a tool) supports *Carry out training* (action). Strategies **are implemented** in tools, e.g., project plan.

One feature of the A[3] framework is that all elements and most of their relationships can be visually represented in a relatively small diagram. The diagram makes it easier to discuss a situation at hands, e.g.

[2] This plan is built in accordance to the state-oriented principles overviewed in the previous section. Step 1 corresponds to designing a state space for the process, Step 2 –to finding methods of determining the current position in it, and Steps 3 and 4 to finding the ways of movement in this space.

[3] Condition parameters represent different aspects of the introduction process itself, that is, organizational (3), cognitive (4-6), and affective (8) aspects. The cognitive aspect, i.e. understanding of the system by its users, is represented by parameters *Why*, *When*, and *How* that highlight three different kinds of knowledge needed for successful use of the system.

what the values of parameters are, which means have already been employed, and which means to employ to improve the values of particular parameters. More details on the elements currently included in the A3 framework are given in the subsections below. First, the parameters are presented, then the means of control (i.e. actions, tools and strategies) and finally a process model of how the A3 framework is to be applied.

Parameters - Short Overview

1. *Organizational culture* comprises a complex mix of organizational attributes such as external and internal orientation, values and norms, and how these can be expressed in routines, management style and interaction patterns (Schein 2004). In our framework, *organizational culture* refers only to the management style accepted in the organization. We have identified three such styles - *command based* style, *democratic* style and *authority based* style. *Command based* style means that managers can issue orders for their subordinates to follow, and they follow them even when they do not agree or do not understand the rationale behind the orders. *Democratic* style means that managers gain approval for their decisions among colleagues by reaching consensus. *Authority based* style means that there are some important people in an organization who do not formally belong to the management, but whose opinion have considerable weight in the organizational decision-making.
2. *Previous experiences of changes* refers to how the organization and its members view the outcomes of previous organizational changes, including system introductions, in particular their successes and failures. Successful experiences make it easier to be confident about future changes, while the opposite creates expectations of new failures (Markus 2004).
3. *Alignment between system and organization* refers to how well the organization has been aligned to the system being introduced. Introduction of a new system often requires adjustment of internal working procedures, including distribution of responsibilities, to the principles designed into the system. "Holes" in the spectrum of responsibilities should be eliminated. For example, if a system should help to share information, somebody should be responsible to timely feed the system with it. If the role of information provider is not defined and assigned to particular members of staff, there is a risk that everybody will be waiting for somebody else to provide the information.
4. *Strategic understanding* means the users' knowledge on why the system has been commissioned and installed in the first place, and what problems it is meant to solve. This includes both what the organization will gain from it and how each user can personally benefit from its introduction.
5. *Tactical understanding* means the users' knowledge of when (i.e. in what situations) they should use/not use the system.
6. *Operational understanding* means user's knowledge of how to use the system. For example, in a given situation, a user knows how to reach a particular screen and perform a search by entering the correct search criteria.
7. *Motivation*. The motivation of users to use the system can be negative, neutral, or positive. In contrast to the previous parameters that primarily address cognitive and organizational aspects, this parameter reflects *individual perceptions* of the system. This is directly related to the four individual reactions from UTAT (Venkatesh et al. 2003). These reactions can be considered as sub-parameters of the *Motivation* parameter.
8. *System use* refers to the actual use of the system in relation to its intended use. This parameter is directly or indirectly dependent on the values of all other parameters. For example, it is difficult to imagine that *System use* could be high if the level of *Tactical* or *Operational understanding* is low.

The most practical way of measuring parameters is through surveys/questionnaires and interviews. Not having enough space to discuss this issue in the frame of this paper, we only give some examples of questions suitable for measuring the parameters in the Appendix.

Means of Control – Short Overview

1. An *action* is a one-time effort undertaken in order to change the value of particular parameters. A typical example of an action is *Carry out training*. Examples of other actions and their relationships

to parameters are shown in Figure 1. Typically, actions are first included in the project plan and then executed, though some actions can be performed on the fly.

2. A *tool* is a physical, organizational, or informational artifact that is used during the whole introduction process, or some part of it. Some of the tools created for the introduction process may even remain in the organization after the introduction has been completed. Examples of tools and their relations to parameters are presented in Figure 1.

   The most important tools are *Project plan* and *Project organization*, which affect all parameters except *Organizational culture* and *Previous experience*. The plan specifies which actions should be undertaken, when and by whom. The plan also implements strategies chosen for the project. *Project organization* defines participants of the introduction project, their roles and their responsibilities. An example of an important role is an early adopter who starts using the system before others (Rogers 1962). *Project organization* should be coordinated with *project plan*, and other tools.

3. A *strategy* is a general recommendation for forming the introduction process. Strategies affect the selection and design of tools, especially such tools as *Project plan*, *Organizational structure* and *Reward system*. Examples of strategies presented in Figure 1 are:

   - *Engage authorities* means finding and engaging in the introduction project employees who have strong social influence on other employees in the introduction project.
   - *Plan for short-term wins* means stepwise introduction of the system so that some results can be achieved before the system is fully introduced. Using this strategy presumes that the most attractive features of the system are introduced before others, even if they are less important in the end.
   - *Gradually increase scope of system use*. The scope can be increased in two dimensions. One dimension is the number of people that use the system, another is the amount of functionality introduced. The introduction can start with early adopters and a subset of functionality and gradually involve more people and functionality.
   - *Continuously adjust performance goals* deals with the fact that a decrease in organizational performance is to be expected during the period when the new system is introduced. The performance targets should be lowered until the users get familiar with the new system and ways of working.

Process Model

The A³ process model is presented in Figure 2. It is an iterative process that resembles other general purpose iterative cycles, like Deming's PDCA Cycle (Plan-Do-Check-Act). The main difference here is that the process can be started in the middle of an already ongoing introduction. The latter warrants starting with assessment rather than with initial planning. Below, we describe the steps in the A3 process in more details.

Select Parameters and Methods of Measurement

In this step, parameters as well as methods for measuring parameters are selected based on the situation at hand. We believe that in most cases, the parameters introduced in this paper could satisfy the needs of an average introduction process. However, a particular introduction process can use fewer parameters or introduce additional ones. Furthermore, methods for measuring parameters need to be selected. The main types of methods are interviews, questionnaires, and observations.

Assess Process State by Measuring Parameters

The aim of this step is to assess the current process state by measuring the parameters. This can be done by interviewing end-users participating in the introduction process, using the questions selected in the previous step. In the first iteration, all parameters should be measured, especially if A³ is applied in the middle of the ongoing introduction. However, even if it is used from the beginning, one can start with measuring the first two parameters *Organizational culture* and *Previous experiences of changes*.

When the process is assessed in the later iterations, some parameters can be excluded. It would be sufficient to measure only the controllable parameters that have been identified as problematic earlier in the process.

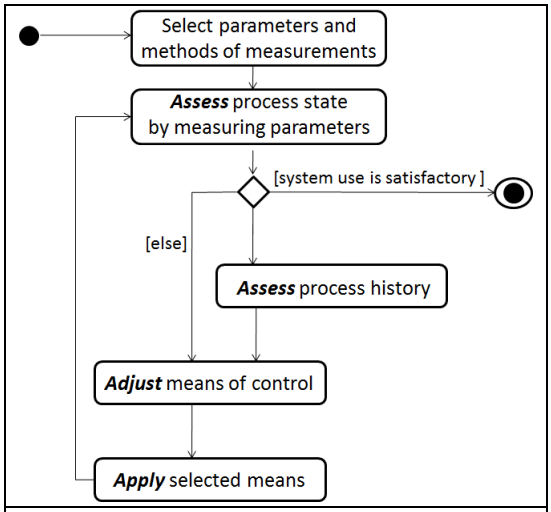

Figure 2. A^3 process model

Assess Process History

If A3 is employed in the middle of ongoing introduction, means that have already been used need to be discovered, as well as the results of their employment. This may influence which means to select and apply in the future. Assessing the process history can be done by interviewing project managers as well as co-workers that have participated in the introduction process. Managers can provide information about the means that have been applied in the process, while co-workers can report on the outcomes of applying these means. It might not be necessary to assess the entire process history; to save time, it can be sufficient to concentrate on means that influence parameters for which undesirable values have been observed.

Adjust Means of Control

The aim of this step is to adjust the means to be used in the introduction process, including selection and adaption of new means. When this step is entered for the first time, the means are selected based on the assessment of the current state and, possibly, the history. In later iterations, the needs for adjustment depend on the results of the assessment made in the previous step. If the values of parameters are not satisfactory, but have expected values, the process can continue with already selected means, thus no adjustment is made. If some parameters have lower than expected values, the selected means can be modified, or new means can be added to affect the parameters with the low values.

Apply Selected Means

At these step, selected means are applied. Selected strategies are implemented in the selected tools, like *Project Plan*, *Project organization*, etc., and selected actions are completed according to the *Project plan*.

Demonstration

Demonstration, or proof of concept (Peffers et al. 2007), is the application of a solution (or artifact in terms of (Peffers et al. 2007)) designed by researchers to a real life situation. In our case, the A3 framework was applied to the same situation as that in which the problem had been initially discovered (see Section "Identifying and Generalizing a Problem"). This section describes the application as well as its results.

Select Parameters and Methods of Measurement

To assess the current situation, we used the parameters given in Figure 1. The usage of the system ProBis was quite low at HGF, which could be easily seen in the system logs. To assess other parameters and the process history of the introduction, the INKA team carried out surveys with all employees and deep interviews with the management.

For conducting the main survey, a questionnaire with 24 questions related to the ProBis introduction was designed. It included questions related to both the current state of affairs, and the history of the ProBis introduction. The former included such questions as whether an employee knew the purpose of ProBis, or in which working situations it should be used. The questions about the history included such questions as whether an employee got training, or whether he/she knew about the structure of the introduction project and its plan. The main (ProBis) questionnaire was also adapted to the purpose of analysis of previous systems introductions and organizational changes; a separate version of the questionnaire was created for each systems introduction and organizational change we investigated. Interviews with the management were conducted after surveys in order to get a better understanding of the situation revealed by the surveys. Some details of our assessment and its results are presented in the subsequent subsections.[4]

Assess Process State by Measuring Parameters

Assessment of the *organizational culture* was conducted by carrying out interviews with management. Totally, three interviews were carried out. According to the management, the culture was of a *democratic* nature. The management preferred to convince rather than command.[5] This corresponded to our own observations during the project.

For assessing *Previous experiences of changes*, two recent IT systems introduction projects at HGF were studied, alongside with three organizational changes not connected to IT. Both systems introductions were of departmental nature. One system supported recruiting of new members[6]; the other was a case management system for conducting rent negotiations and solving conflicts between HGF members and property owners. Three non-IT connected organizational changes concerned: (a) downsizing the head office, which included making a considerable number of people redundant, (b) introducing a project office (c) merging two departments into one.

The goal of our investigation was for each project above to understand the level of success achieved, the time it took to complete the project, and the means that had been used during the project. The instrument used was a survey of all employees engaged in each project according to an adjusted questionnaire, and interviews of project leaders who had led the projects. Practically, all HGF employees (about 50 people) were engaged in surveys and interviews.

The result of the investigation showed that it took a long time, between three and five years, to successfully introduce a new IT system at HGF. One of the reasons for the slow introduction was the organizational culture at HGF, which required that end-users were to be convinced, not forced, to start using an IT system. Furthermore, the investigation showed that all introductions of IT systems had been successful in the end, but only after the management had introduced a project organization and a project plan. For the two IT systems introductions investigated, the project organization and plan were introduced two or more years after the project start. Another finding was that in the two IT systems introductions, *strategic understanding* among the co-workers had always been high. According to the management, the project leaders had used substantial resources to communicate system needs and vision to the end-users.

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[4] The order of presentation in this section corresponds to the order of parameters in Fig. 1 and Section "Process Model". This does not exactly reflect the order in which our investigation was conducted, as the same instrument, interview or survey, was often used to assess both parameters and the history.

[5] Based on our experience this kind of culture is often encountered in Swedish organizations in general, and in Swedish interest organizations, e.g., trade unions, in particular.

[6] This system was developed by IbisSoft – the same company that developed ProBis.

The conclusion was that the *Previous experience of systems introduction*, though positive, was not encouraging the end-users to quickly adopt a new IT system, but rather to take things slowly and wait until the management became more serious about using it.

We also discovered substantial difference between systems introductions and non-IT organizational changes. While the first ones did not have any plan and project structure in the beginning, the second type of changes was always conducted according to a plan and had a project structure. This led us to the conclusion that the management of HGF did not consider a system introduction as an organizational change.

For assessing the rest of the parameters, a survey according to the main ProBis questionnaire was carried out among the employees involved. In total 27 employees participated in the survey. The result was analysed and the key findings were as follows:

- *Strategic understanding*. The end-users' strategic understanding of the Business Process Support System (BPSS), i.e. ProBis, was high.
- *Tactical understanding*. The end-users' tactical understanding of using the BPSS was low. A majority of the end-users had problems understanding when to use the BPSS and which terms to use when recording business events in the system.
- *Alignment between system and organization.* The alignment between the system and the organization was low. The system did not use the same terms as were used in the organization. This was interpreted by the INKA team as a major reason for the low tactical understanding.

Assess Process History

In this step, the already applied means and their outcomes were to be identified. This was done by carrying out interviews with the management, and questionnaires among the end-users about the outcome of the applied means.

The main finding was that the project so far had been managed in an ad-hoc manner: "here is a system, here is what it is for, here is your training session, now, please use it". In particular, we discovered that no *Project organization* and no *Project plan* existed. This was despite the fact that the experience of the previous IT systems introductions at HGF had shown that the introduction would stall until these tools had been employed. One consequence of lacking a project plan was that the training sessions had not been followed up by users starting using the system in their own practice. Thus, users forgot how to use the system (operational understanding) by the time they were asked to do so.

Presenting the Results of Assessment to the Management

After completing our investigation, the results of the assessment above and the A3 framework itself were presented to the HGF management in two meetings. Both the assessment and the framework were well understood and received by the management. In particular, the management appreciated the importance of the causal mechanisms that we had discovered based on the analysis of the history of previous systems introductions. We had shown that, though in the end successful, these introductions took unnecessarily much time and effort. The main reason for this was that systems introductions were not conducted in the same manner as other types of organizational changes.

Adjust Means of Control

In this step, the following recommendations were communicated to the HGF management by the INKA team:

- make efforts to align system and organization in order to increase the users' tactical understanding;
- introduce a project organization and plan, as a structured introduction process seems to be a necessary condition for the users to start using an IT system at HGF;
- include in the project plan activities aimed at attaining short-term wins, gradually increasing the scope of system use, and continuously adjusting performance goals.

The management agreed on the recommendations and, in September 2006, introduced both a project organization and a project plan. One of the first steps in the plan was to improve alignment between the system and organization by agreeing on a common terminology to be used in the system and organization. These measures increased the use of the system.

Observations

In our experience of using A³, we made the following observations:

- Parameters measurement via anonymous surveys and deep interviews were met with understanding and full cooperation from both employees and management.
- The analysis revealed knowledge about the organization previously not recognized by the management and employees. Some examples of such knowledge were given above. Other examples include knowledge on the appreciation of already introduced systems by the employees. The users in general understood the value of the introduced systems for themselves and for the organization. The analysis of previous experience showed that already introduced systems had a high number of users that recognized some benefits for themselves, while only a small number considered the systems as inadequate for personal reasons.
- A main advantage of the A³ framework was the ease with which it was possible to introduce the management to the problems of introduction and engage them in finding solutions. All this was achieved without requiring them to read management literature on change management or research articles on technology acceptance (which is not easy to understand for non-academics).

We consider that the observations above are sufficient to conclude that the requirements on the solution listed at the end of the Section entitled "Identifying and Generalizing a Problem" were satisfied, at least, as far as the demonstration phase is concerned.

The results of the demonstration phase, though indirectly, also allows us to judge the practical usefulness of the three streams of work, (Kotter 1996), (Sharma and Yetton 2003), and UTAUT (Venkatesh et al. 2003), used in forming the A³ framework. The demonstration indicates that these streams provide the potential to form the basis for practically useful solutions/artifacts. One observation is that the approach suggested by Kotter (1996), which was originally intended for change management projects in general, can also be applied to IT introduction processes. Another observation is that, though UTAUT was originally aimed at determining the conditions facilitating or hindering the technology acceptance by end-users, its theoretical constructs are also fruitful for designing practical management tools. Furthermore, the demonstration indicates that the state-oriented approach to viewing business processes (Khomyakov and Bider 2000), originally designed for dealing with routine but flexible processes, can be successfully used for dealing with complex knowledge intensive processes. This view helped us to integrate the three different streams of work mentioned above into a framework where they complement each other to bring about a holistic view on the IT systems introduction process.

Reflections on Design Science

Our experiences from the INKA project have resulted in a number of reflections on practical issues of undertaking design science research in a real life situation. The most important of them are listed below:

- It is *difficult to plan design science research* in advance. Not only might a research plan need to be changed on the fly, but even the topics of the research could change. The researchers need to be prepared to switch to new issues as a consequence of practical challenges that appear during the project. In our case, we needed to switch from investigating effects of adoption to the adoption process itself.
- Design science research in a real life situation might have a tight deadline for producing a solution, which causes work conditions that imply *time pressure*. Missing a deadline might mean losing out on an opportunity to test a generic solution/artifact on a real life case, and it may take a long time before a new opportunity appears. In our case, the whole project ran a risk of being terminated.
- A real life situation with a problem that does have known solutions can still present an *opportunity* for the design science research. This happens when the known solutions are not applicable to a particular class of situations. Our research on A³ was initiated by the fact that the existing solutions to the problem

discovered were aimed at situations where the introduction process could be planned right from the very beginning. The situation we encountered was different which warranted inventing a new solution.

- The demonstration phase (proof of concept) of a design science research project requires *collaboration between researchers and practitioners*, especially the managers of the organization in which the suggested generic solution is being implemented. To engage practitioners, the solution should be presented not as an abstract artifact, but instead in connection to the situation and problem in their own organization. In our case, the breakthrough in management engagement was achieved after we made the investigation of their past experience of systems introduction and organizational change. The investigation showed both positive and negative sides of their experience. This inspired the managers to listen to ways of minimizing the negative sides.

Reflection on our experience in this and some other research projects lead us to view the design science research as movement between individual and generic situation-problem-solution spaces. This view, shortly summarized in the beginning of this paper, is presented in full in (Bider et al. 2012). As in case with A³, this view was developed based on the state-oriented perspective on business processes.

Conclusion and Plans for the Future

Research in the fields of change management and technology acceptance has created and continue to create a body of knowledge that can be effectively used in practical projects of IT-systems introduction. However, this knowledge is not always suitably structured for practical tasks. One of these tasks is to deal with an introduction process that gets stuck in the middle. Our goal with the A³ framework was to restructure this knowledge to make it easier to apply in practice. More exactly, the framework facilitates conducting the introduction process in an iterative manner: *Access-Adjust-Apply*, were *Assess* stays for assessing the current situation, *Adjust* stays for adjusting the current set of means, and *Apply* stays for applying this means to move the process forward.

Based on our experience of applying the framework in practice, A³ satisfies the objectives set prior to its creation. More exactly:

- It gathers the main components of the introduction process, i.e. conditions to investigate and satisfy and means available for achieving this end, in one relatively small diagram that is easy to overview. It makes A³ a suitable "language" for discussing the problems and solutions in the frame of a real project. Our practical experience with A³ in this respect is quite encouraging.
- It suggests the way for assessing the situation at hands via parameter measuring, and thus the framework can be applied not only from the beginning, but also in the middle of the introduction process. Note that our focus on assessing the situation does not mean that A³ cannot be applied from the beginning of the introduction process. Even in the beginning, it is worth to assess the situation by measuring, at least, the first two parameters: *Organization culture*, and *Previous experience*.
- It connects means with particular conditions (values of parameters), which sets the focus of planning on means that are suitable for the current situation, not to the introduction in general.

In addition, the framework can facilitate new research by setting a focus on finding better methods for measuring parameters, and discovering new and better actions, tools, and strategies. Note that we do not claim that the parameters, actions, tools and strategies presented in Figure 1 are the only, or the best ones. New research and practice may require changes in all *layers* of A³.

As for plans for future, we believe that the following directions are worth exploring:

- Finding new situations where A³ can be applied to subject our generic solution to additional tests.
- Converting the framework into a solid practical methodology that includes examples of questionnaires and interviews to measure parameters, as well as guidelines on how to choose means dependent on the values of the parameters, and how to implement particular strategies.
- Finding industrial partners who would like to adopt the framework.

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Appendix: Examples of Questions

In this appendix we present examples of questions that can be (have been) used for measuring various parameters via questionnaires or interviews.

Examples of questions for measuring *Strategic understanding* are:

- *What is, in your opinion, the purpose of the system*? (This question can have a fixed set of alternative answers listing possible purposes, or request an answer in natural language. If alternative answers are to be provided, they need to be tailored to the specific organization and system.)
- *What do you gain from using the system when doing your tasks*? (Requires an answer in natural language.)
- *What does the organization gain from the usage of the system*? (Requires an answer in natural language.)

Examples of questions for measuring *Tactical understanding* are:

- *In which of the following situations should you use the system*? (Question with a fixed set of alternative answers, where the alternatives consist of relevant as well as irrelevant situations. These alternatives need to be tailored to the specific organization and system.)
- *Do you know what information you should enter into the system in the following work situation* (Question with a fixed set of answers. To be tailored to each particular work situation.)

  [ ] Yes [ ] Not always [ ] No
- An example of questions for measuring *Attitude and motivation*
- Would you use the system if nobody in the management demands that you use it? (Question with a fixed set of alternative answers.

[ ] Yes [ ] Yes if others use it [ ] No

If the answer is yes there is no need to investigate the parameter further. Otherwise, measurement of individual reactions can be of help.