Chapter II
A Methodology for Situated Analysis and Design

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ABSTRACT

This chapter presents a new high level methodology for the analysis and design of information systems specifically to support routine action at the operational level of organizations. The authors argue that traditional methods fail to adequately address the unique requirements of support for routine operational action. The main innovation of the methodology is the use of an action-centred approach derived from recent work on the nature of purposeful human action, and as such, emphasises both the information requirements for action and the dependence of action upon appropriately structured environments. A brief case study illustrates how using the methodology can sensitize the analyst to opportunities to increase human efficiency and effectiveness through lighter weight information systems.

INTRODUCTION

Situated analysis and design focuses on providing information in support of routine action at the operational level in organizations. It is the outcome of applying the situational theory of action to the analysis and design of information systems (Johnston, Waller, & Milton, 2005; Milton, Johnston, Lederman, & Waller, 2005; Waller, Johnston, & Milton, 2006). A high level methodology for situated analysis and design was developed in a 3 year funded research project employing iterative theory development and testing by means of two system development case studies (Johnston et al., 2005; Waller et al., 2006) and one comparative experiment (Waller, Johnston, & Milton, 2008).

The methodology was designed specifically to address the problem of high failure rates and poor user acceptance of traditionally designed information systems at the operational level. We have argued in a previous publication that the heart of this problem lies in the implicit theory of action which informs information systems design. The traditional information systems analysis and design approach, manifested in methodologies such as SSADM (British Standards Institution, 1994), is informed by a deliberative theory of goal-directed action. The deliberative theory posits that an actor creates a mental model of the state of the world and that action invariably results from reasoning about this mental model. The traditional information system then supplies information about the state of the world to inform the actor's mental model (Johnston & Milton, 2002).

In other disciplines, there has been a move towards a situational theory of action, the idea that actors respond directly to structures in the environment in order to act appropriately. For example, work undertaken in artificial intelligence (Agre, 1997), situated cognition (Clancey, 1997; Lave & Wenger, 1991), animal behavior (Hendriks-Jansen, 1996), ecological psychology (Gibson, 1979; Heft, 2001), and situated action (Suchman, 1987) is based on this alternative theory of action.

The situated approach to systems design supplies the actor with information about action that enables routine action rather than deliberative action. Rather than attempting to represent the real world, the situated system informs actors when to do something and what to do without there being need for recourse to a representation of the state of the world; the information is located 'in' the world and can be observed directly. The purpose of this chapter is to provide a brief overview of the principles, concepts, and methods of situated information systems analysis and design. The approach is illustrated with a brief description of one of the system development cases conducted during its development.

BACKGROUND

Traditionally designed information systems are computerised models of the work system (Weber, 1997). While they provide support for managerial work such as decision making, accounting, planning, and standards production, they often do not effectively support routine operational activity, particularly in time-constrained routine environments. Estimates of failure rates are as high as 50% (Fortune and Peters, 2005). Analyses of why IS projects fail tend to focus on technical factors, such as the performance of the system, and organisational factors, such as the quality of project management, communication, management support, and user acceptance (Bostrom & Heinen, 1977; Ciborra & Schneider, 1992; Cannon, 1994; Gowan & Mathieu, 1996; Checkland & Holwell, 1998; Glass, 1998). In previous work (Johnston and Milton, 2002; Johnston et al., 2005), we have suggested a more fundamental reason for the failure of IS systems, specifically those designed to support real-time operations of the organisation. We have suggested that the problem lies with a misconceptualization of how the IS can best support these operations.

Whereas traditional systems analysis and design approaches aim to design a computerised model of the organization's work systems and processes, the situated systems methodology aims to identify ways that the environment of action can be restructured to enable new operational routines and to identify minimal informational cues that will enable actors to fluidly execute these new routines. With this aim in mind, the methodology proposes a radically different approach to analysing existing operational action systems, negotiating change, and designing new action systems that can be effectively routinized.

The key innovation of the new methodology is its use of an action-centred approach to information systems analysis and design. On the analysis side, this means resolving existing routinized action systems into a hierarchy of dependent actions and goals on the one hand, and on the other hand, identifying the environmental structures (physical, temporal, and organizational) upon which these actions depend. On the design side, an action-centred approach means simultaneously reconfiguring action environments for effective situated action and providing adequate information cues to actors about the action dependencies of redesigned action sequences.

Through focusing on routinizing action, situated analysis and design can improve the effectiveness and efficiency of action. In particular, systems developed using situated analysis and design should improve human efficiency in time-constrained environments. They do this by reducing the effort expended in searching for required information about the conditions of action and deliberating on possible courses of action. They can also be lightweight and more reliable than conventional systems. Because implementation issues are explicitly addressed in the design phase of the situated analysis and design methodology, these systems are more likely to be embraced by users. The methodology is directed to identifying the minimal information requirement that will allow reliable routine performance of work processes. As such, it does not commit to the form of information delivery; this could take various digital or non-digital forms.

Information systems analysis, design, and development methodologies are generally collections of procedures, techniques, tools, and documentation aids (Avison & Fitzgerald, 2003). The situated analysis and design methodology is an action-centered approach to conceptualizing information support for routine work. While outlining procedures and techniques, it does not prescribe the use of particular tools for representation or documentation aids (although the tools used need to have particular representational capabilities).

SITUATED ANALYSIS AND DESIGN

Situated analysis and design makes use of the following three properties of actions: (1) that actions are always situated in the environment, (2) that actions are multi-scale in nature, and (3) that actions are dependent on the execution of other actions for instantiation as part of the action system. The concepts needed to make use of these properties make up the conceptual toolkit of situated analysis and design.

Conceptual Toolkit of Situated Analysis and Design

Every action is conducted by an actor in time and space, making use of resources. The *action context* is the actor, location, time, and resources associated with an action. In other words, the action context is the particular dimensions of the environment in which a particular action occurs. The set of all the actions available to an actor (in a particular location, at a particular time, and with particular resources) is conceptualised as the *action possibility space.*

Structures are patterns in the environment which constrain or enable action. Physical structures include the way work spaces are organised and the arrangement of things. Organizational structures include roles and norms. Temporal structures include blocks of time reserved for particular types of action and times at which particular actions are to occur.

Actions are multi-scale in nature. This means that both actions and the action context can be specified at different levels of detail or grain-size. Another way of saying this is that an action can be expanded into a set of lower level actions that occur in valid particularisations of the context of the higher action. For example, the action of selling a house can be expanded into the actions of the vendor putting some possessions into storage, a real estate agent showing a house to prospective buyers, the auctioneer taking bids, and the vendor signing the contract.

The actions associated with attaining a goal can be arranged into an action abstraction hierarchy (Johansson, 1989). For any particular action, asking *why* that action is conducted moves one up the action abstraction hierarchy, emphasising the goal aspects of the action (for example, the possessions are put into storage in order to sell the home). Asking *how* that action is conducted moves one down the action abstraction hierarchy to more specific levels. The lower one goes down the action hierarchy, the more detail is specified about the action context (that is, details of actor, location, time and resources). In other words, the action becomes more situated in a specific practice. By the same process, the implementation details of the higher-level action become specified more precisely as a set of more detailed actions.

In any system of actions designed to achieve a particular purpose, there are actions which are dependent on the execution of other actions for instantiation in this action system. The term *action dependency* describes this type of relation between two actions.

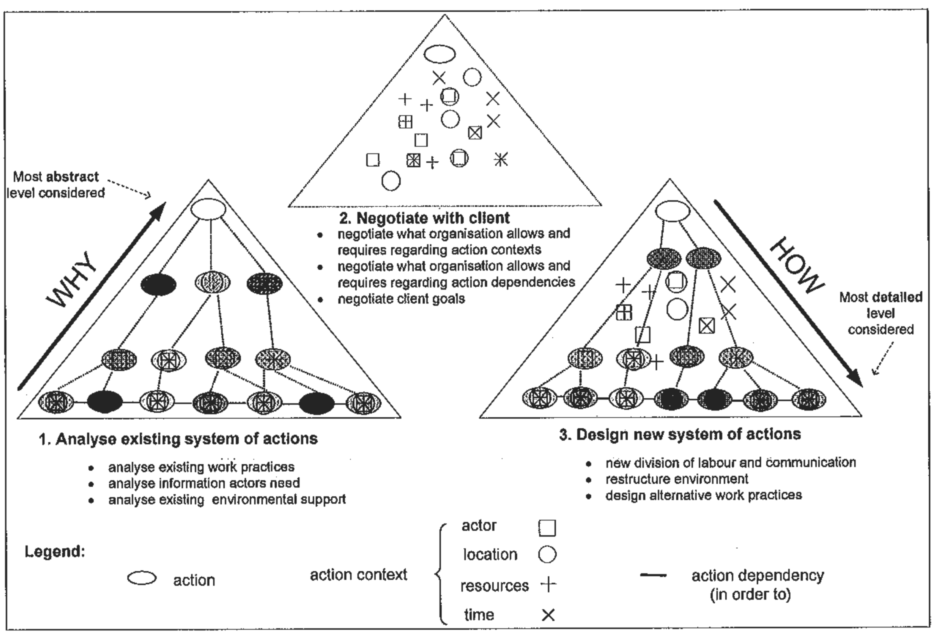
APPLYING THE METHODOLOGY

Figure 1 is a schematic depiction of the three main steps involved in applying the situated analysis and design methodology. Conceptually, each triangle in Figure 1 represents a system of actions designed to achieve the goal(s) near the apex. The steps involved in applying the methodology are elaborated in the following sections.

ANALYSING THE EXISTING SYSTEM OF ACTIONS

The first triangle in Figure 1 depicts this stage of analysing the existing system of actions. Analysis involves both description and evaluation. The existing system of actions is described in order to identify what is currently being achieved; at the same time, the efficiency and effectiveness of the existing system of actions is evaluated against their purpose. There are three conceptually distinct aspects to the

Figure 1. Applying the situated analysis and design methodology



analysis of the existing system of actions: analysis of existing work practices, analysis of information actors need, and analysis of existing environmental support for action. In practice, these analyses may occur concurrently.

Analysing Existing Work Practices

In analysing existing work practices, one needs only to go down to that level of detail which makes sense to actors in describing what they do. The situated information system is only concerned with providing information about non-discretionary action. Those actions which are not to be routinized, (because, for example, they depend on an individual's judgement) are treated as a black box in the analysis.

A variety of modeling tools to describe action systems already exist, and the choice of tool for analysis is not important to the methodology. What is important is that the modeling tools and documentation aids used are able to represent the action context and action dependencies. The basic principle is that existing work practices need to be analysed in terms of actions and their context, that is, when and where and who does what with what. These actions also need to be described in terms of their action dependencies and the purpose of each action needs to be established.

Describing the action system in this way makes it possible to identify whether the sequence of actions (what), and division of labour, use of resources, timing, and location (how) is efficient in terms of human effort and time. This analysis assists in identifying whether any actions are redundant and whether there is a need for better coordination as well as making explicit exactly where any delays are occurring.

Analysing Actors' Information Needs

In a system of actions, in order to act at the right time, actors need to know that the actions on which their action is dependent have been successfully completed. Analysis of the action dependencies reveals what information actors need in order to act. The rule of thumb is to provide actors with the information that they need in the time and place in which they need it.

Analysing Existing Environmental Support

In analysing the action context, it becomes evident as to what extent existing environmental structures (physical, organizational, and temporal) support action. By paying attention to how the existing environmental structures enable or constrain action, the analyst can see what sort of environmental redesign will improve efficiency and effectiveness. Efficiency has three aspects: temporal efficiency, or the minimisation of the expenditure of time, human efficiency, or the minimisation of mental or physical effort, and economic efficiency, or the minimisation of financial cost (Bevan, 1995). Effectiveness means that the intended goals are achieved, completely and accurately (Agerfalk & Eriksson, 2006).

NEGOTIATIONS REGARDING THE NEW SYSTEM OF ACTIONS

In traditional information systems analysis and design under the waterfall model, a requirements analysis is conducted to determine client needs. In situated analysis and design, a negotiation phase occurs based around aspects of action; broadly, what is to be done and how it is to be done. This stakeholder negotiation differs from that which occurs in traditional information systems and design.

In any organization, choosing which actions are to be routinized is a matter of negotiation between stakeholders, and is not evident *a priori*. Any increase in efficiency or effectiveness needs to be weighed against the effects on actor satisfaction. For example, actors who gain satisfaction from relying on their professional skill and judgement to carry out particular actions, may not wish to see these actions routinized.

Negotiation of the Action Context and Action Dependencies

Organizational constraints are limitations on the action context and action dependencies; specifically, what is allowed and what is required by the organization. What is allowed by the organization can be understood as the set of actors, locations, times, and resources that can be associated with action. A subset of these contains what is required by the organization. What is required by the organization may reflect the organization's preferred way of operating or may be in response to outside pressures, such as legislation. The organization may have requirements regarding the action context. For example, in a health care context, the organization may require that certain actions be conducted by a particular type of actor, (e.g., doctor), a particular actor (e.g., Doctor Jones), in a particular type of location (e.g., sterile environment), a particular location (e.g., Ward 7), using a particular type of resource (e.g., expandable patient record) or particular resource (e.g., written patient record)—or any combination of these. The time may also be constrained. For example, operations that take more than 4 hours may have to be begun in the morning.

The organization may also have some requirements regarding action dependencies, for instance, regarding the order of actions. For example, the organization may require that treatment for a private patient does not commence until the level of health insurance cover is established.

However, some of what the organization allows or requires will be negotiable, especially as some of the perceived requirements will be simply the way things have always been done. It is only in the negotiation phase that the analyst can identify which constraints are 'hard' (Johnston et al., 2005); that is, those which the organization cannot or is unwilling to see changed. These 'hard' constraints are those constraints that necessarily govern aspects of any redesigned system; that is, they are not negotiable with the client. Thus, the 'hard' constraints contained in the second triangle in Figure 1 are also present in the third triangle depicting the new system of actions.

Negotiation of Client Goals

The client's goals for the system can be viewed as another type of 'hard' organizational constraint. Describing the existing system of actions includes establishing the purpose of existing work practices. In terms of Figure 1, it involves moving up the action abstraction hierarchy. The analyst makes a pragmatic decision to move up the action abstraction hierarchy until reaching those actions which the client considers are the goals. As well as describing the purpose of what is done, these higher-level actions become constraints on what is done.

As Figure 1 indicates, in the design phase, all organizational constraints that have been identified through negotiations as 'hard' are taken as given aspects of the new system of actions.

DESIGNING A NEW SYSTEM OF ACTIONS

Designing a new system of actions involves taking account of hard constraints identified in the previous stage and making use of the action possibilities of the mix of possible actors, locations, resources, and temporal ordering. This means moving down from the agreed goals, through the 'hard' context and dependency constraints and designing a new set of actions, dependencies, and contexts which satisfy the agreed goals. The action possibility space is also deliberately manipulated to constrain and enable particular actions. The purpose is to increase efficiency and effectiveness through routinization of action. Working within the 'hard' constraints, use may be made of the way that existing environmental structures enable or constrain action or the existing environmental structure may be changed in order to routinize the action.

Providing information to support routine action is also of key importance. Information is conveyed through representation of the possibility for action. This information assists actors not only to know *what* to do next but also gives them the required information that allows them to *do* the next thing. In designing a new system, the action system need only be specified with enough precision that actors know what they have to do.

The system redesign choices are directed to improving operational efficiency and effectiveness. Because the methodology is intended to support routine action, improvement in system efficiency and effectiveness will mainly be achieved by minimising human effort and time, and improving reliability. Particular emphasis is placed on eliminating unnecessary actions in search of information and improving action reliability by careful design of environmental structure.

APPLICATION CASE STUDY

The situated analysis and design methodology described was developed in a 3 year grant funded research project (Australian Research Council Grant, DP0451524). Based on an initial theoretical proposal (Johnston & Milton, 2002), the methodology was iteratively tested and refined through application in two real-world system analysis and design cases in contrasting organizational settings (Johnston et al., 2005; Waller et al., 2006). In each case, the current instantiation of the methodology was used to analyse the redesign of a dysfunctional operational system and to propose a more effective and better routinized alternative employing light weight digital information technology. While the research arrangement in each case did not include implementation of these systems by the researchers, management acceptance of the proposed systems was high. In addition, a case-based experiment was conducted in which an experienced but traditionally trained systems analyst separately repeated the analysis and design tasks for one of the case problems in a simulated setting. Systematic differences in approach and proposed solution confirmed the potential of the new methodology to produce paradigmatically different proposals for this business problem (Waller et al., in press).

To illustrate the application of the approach and the insights it produces, we now present a brief account of the first case study conducted. Cabling Communications Pty Ltd (pseudonym), a workforce management services company, had an outsourcing contract with a larger telecommunications provider, Telco (pseudonym), and subcontracted the work it received to a team of 40 technicians working as independent contractors installing residential telecommunications equipment. Cabling managed the installation of 100-150 telecommunications products each day, and the disconnection of a roughly equivalent number. Cabling's management were interested in a redesigned system that would result in improved efficiency and effectiveness as well as cost savings to cabling, and which could be applied to any workforce management activities that cabling might undertake in the future.

A customer places an order with Telco for a telecommunications connection. Each installation requires a visit from a technician to the customer's house. Telco sends cabling details of the required work, one day in advance. The work is imported into a software package that represents each job as a dot on a map of the city and the router, a member of the centrally located cabling dispatch team uses this package to visually allocate the jobs to technicians according to their base region. Technicians receive a listing of jobs by e-mail the night before. Each installation technician routinely communicates with cabling's job dispatchers at least 10 times per day. Technicians may choose to communicate with dispatchers via SMS or phone. SMS messages arrive at a central dispatch inbox as e-mails. These messages are the data source for (partly) automated updates by the dispatchers of various central computerised systems provided by cabling for internal job status, inventory and management reporting, and by Telco for the actual network connection activation.

In keeping with the routine nature of the activity system being analysed, the researcher-analyst embedded herself in the work environment using a mixture of participatory observation techniques. The researcher first trained and worked as a dispatcher. Semi-structured interviews were also conducted with dispatchers, technicians, and warehouse staff, and their work was directly observed with the researcher asking questions about their activities as they worked. Of particular importance was the participant observation; the experience of actually working as a dispatcher enabled the researcher to obtain a deeper understanding of the system than the traditional systems analyst who relies largely on observation and questions. A version of the methodology described was used to analyse existing activity systems and identify opportunities for improvement.

The main area of dysfunction identified using the situated systems analysis approach was that daily coordination between field technicians and the central dispatchers in the course of connecting and provisioning the broadband connection were not effectively routinized. There were two problems here. Firstly, transcription of equipment ID numbers to SMS was time consuming and a source of error, a problem that suggested various technical solutions given that all equipment used was bar-coded. The second was more subtle. Dispatch responded to routine communications from technicians (phone calls and SMS) and non-routine phone calls from others in the order in which they arrived. This meant that dispatchers experienced downtime waiting for the phone to ring or an SMS to arrive, interspersed between periods of intense activity in which calls were received, notes made, and data entered manually into multiple systems without regard for priority.

Our proposal to cabling was that technicians upgrade to smartphones (converged mobile phone/PDA devices) which could transfer data via GPRS and which would be fitted with a separate barcode reader attachment (at the time, smartphones with built in barcode readers are just emerging). Rather than develop an application on the smartphone, we proposed that the smartphone browser act as a "thin client," accessing and updating secure information on the cabling Web server. This meant that the technician could access jobs from a home PC and print them out, just as under the current system. However, the technician could now execute the job activity reporting by accessing a cut-down Web page, displaying these jobs using the smartphone browser. Those transactions requiring an equipment ID number could be completed by scanning the barcode on the telecommunications equipment. Previously, the information for these transactions was manually entered into an SMS or read over the phone to a dispatcher who updated the various systems manually.

However, an important part of this solution was that it proposed that the SMS messages received by dispatch be routed into several queues based on transaction priority. This meant that dispatchers could now effectively balance their activity of updating the diverse central systems over peaks and trough of input activity. We conceived this part of the solution as a restructuring of the temporal organization of the dispatchers' work environment.

In a sense, using advanced mobile devices to take information systems to a mobile work force is an obvious move and a current trend in out-of-office technology. However, our action-oriented analysis approach allowed as to pinpoint the problem as involving *both* the need for very minimal, highly specific information transfer *and* the simultaneous restructuring of the dispatchers' action environment to allow the coordinated activity to be effectively routinized. It is just this ability of our analysis and design approach to sensitize the analyst to the opportunities to improve the effectiveness of routine aspects of work using light-weight information solutions and properly restructured work environments which we claim as its main benefit.

A conventionally oriented analyst could have been tempted to see the main problem as a lack of technical integration between the cabling systems, the Telco systems, and the technicians' mobile devices. This would be consistent with the traditional view that the job of information systems is to provide an integrated abstract model of the physical work system. However, given that cabling was not in a commercial position to affect the Telco system, we chose to interpret this as a solution constraint. Similarly, a technocentric analyst might be tempted to see job-scheduling as the change opportunity since resource allocation is a well trodden theory area, and novel GPS-based bidding systems exist to facilitate new approaches. It was because our approach allowed us to see that the current arrangement was largely optimal in terms of socio-cultural constraints and goals (incentives to technicians) that we were deflected from these technology-push approaches.

WHAT IS DIFFERENT ABOUT SITUATED ANALYSIS AND DESIGN?

Situated analysis and design has some points of similarity with other related methodologies, in particular, soft systems methodology (SSM), multiview, ETHICS, cognitive work analysis, and business process reengineering.

Checkland and Holwell (1998) have described SSM as "a set of principles of method rather than a precise method." Situated analysis and design also fits this description. Situated analysis and design shares with SSM a broad concern with providing information in support of action. However, whereas situated analysis and design is concerned with routine action, SSM is concerned with ill-defined problem situations. Although the terms appear similar, the 'activity systems' of SSM are quite different from the 'action systems' of situated analysis and design. The activity systems of SSM are conceptual and may bear little relation to actions in the real world (Checkland & Holwell, 1998). In contrast, the action systems of situated analysis and design are descriptive of the actions actually undertaken in the organization.

ETHICS (Mumford, 1983) entails a participatory design approach to systems analysis and design, with particular attention to job satisfaction. Situated analysis and design shares with ETHICS an appreciation of the importance of implementation issues and the view that technology must be appropriate to the organization. The two approaches are not incompatible and it is conceivable that situated analysis and design could be conducted within an ETHICS framework. While ETHICS focuses on the organizational processes involved in systems analysis and design, situated analysis and design focuses on the analytic processes. In order to conduct situated analysis and design using an ETHICS framework, the situated analysis and design would be conducted using the organizational process of participatory design. Job satisfaction would be negotiated as a 'hard' constraint'.

Like situated analysis and design, multiview (Avison & Fitzgerald, 2003) also explicitly includes attention to implementation issues and the relationship between the social and the technical. However, it presupposes a computerised solution. Moreover, the analysis techniques used in multiview (both Multiview 1 and Multiview 2) are quite different from the situated analysis and design focus on situated action. Multiview 1 analyses information needs using conventional data flow and entity models while Multiview 2 uses object-oriented analysis.

Business process reengineering (Hammer, 1990) pays attention to performance measures other than direct cost saving. The situated analysis and design approach subsumes the approaches of business process reengineering in providing a more general conceptual framework to identify opportunities to improve the efficiency and effectiveness of action. However, business processes are not the same as actions. Business processes are commonly understood as a fixed sequence of well-defined activities that converts inputs to outputs (Melao & Pidd, 2000). According to this view, the world can be perceived as a succession of changing states; this is quite different from the situated analysis and design view of fluid actions occurring in the environment.

In some respects, the abstraction action hierarchy used in situated analysis and design is similar to that advocated in cognitive work analysis (Rasmussen & Pejtersen, 1995; Vicente, 1999). Both involve abstraction away from the details of existing work practices to goals in order to facilitate redesign. However, situated analysis and design is more explicitly centred around action and the intention of situated analysis and design is to support routine operational activity whereas cognitive, decision-making activity is typically the focus of cognitive work analysis. Cognitive work analysis involves reengineering the physical surroundings; no consideration is given to altering the organizational or temporal environment.

FUTURE TRENDS

Mobile communication technologies are particularly suitable for use in systems designed using the situated analysis and design approach. As well as enabling lightweight systems, they enable routine action by providing information to actors where and when they need it. Future increases in the technical capabilities of mobile communication technologies can be exploited in innovative practical applications of the situated analysis and design approach. Similarly, the development of ubiquitous computing (Prekop & Burnett, 2003) will enable even more innovative and lightweight situated systems.

CONCLUSION

The primary purpose of situated analysis and design is to support routine action, which is not explicitly considered in conventional IS methodologies. The situated system is designed to provide information about the action context and the action dependencies in order to enable fluid routine action without excessive dependence on deliberation. The action possibility space is manipulated to ensure that the action context is appropriate to the required action. The possibility for action is represented to inform the actor about satisfaction of the action dependencies.

Applying the situated analysis and design methodology can enable organizations to increase efficiency and effectiveness with a lightweight system that is acceptable to users. As well as increasing temporal efficiency, systems designed using situated analysis and design also aim to increase human efficiency; in particular, to reduce wasted human effort in search of information.

Situated systems can not replace traditional information systems; complete support for work systems should include both situated and traditional components. For example, interaction of actors with situated systems potentially provides a stream of high quality data for traditional systems that support managerial action. Because this data authentically captures the operational reality, it is of higher quality than that obtained through a mandated process of data entry conducted parallel to actual work. This not only increases the quality of decision making, it also reduces data collection costs and user resistance to these systems.

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KEY TERMS

Action Abstraction Hierarchy: The actions associated with attaining a goal can be arranged into an action abstraction hierarchy (Johansson, 1989). For any particular action, asking *why* that action is conducted moves one up the action abstraction hierarchy to more abstract levels. Asking *how* that action is conducted moves one down the action abstraction hierarchy to more specific levels. At the bottom of the hierarchy are actions conducted by a specified actor using specified resources, at a specified time, in a specified location.

Action Context: The action context is the actor, location, time, and resources associated with an action. In other words, the action context is the particular dimensions of the environment in which a particular action occurs.

Action Dependency: An action dependency is the relation between two actions, whereby one action is dependent on the other action for instantiation as part an action system.

Action Possibility Space: A conceptualisation of the environment as a space of all possible actions. This term can be applied at the level of a specific actor in a particular time, place, and with particular resources at hand. It can also be applied to the more general level of the possible actions available to a type of actor with time, place, and resources unspecified.

Effectiveness: Effectiveness means that the intended goals are achieved, completely and accurately (Agerfalk & Eriksson, 2006).

Efficiency: Efficiency has three aspects: temporal efficiency, or the minimisation of the expenditure of time, human efficiency, or the minimisation of mental or physical effort, and economic efficiency, or the minimisation of financial cost (Bevan, 1995).

Environmental Structure: Recognisable patterns in the environment that constrain or enable action. Physical structures include the way work spaces are organised and the arrangement of things. Organisational structures include roles and norms. Temporal structures include blocks of time reserved for particular types of action and times at which particular actions are to occur.

Goal: A goal is understood as a more abstract level of specifying an action (answering the "why" question for those actions below it in the action abstraction hierarchy).

Routine Action: Routine action is characterised by the removal of discretion in the conduct of an action in one or more of the following aspects: what action is done, when the action is done, and how the action is done. This is removal of discretion at a meaningful grain size rather than complete removal of discretion.