ANALYZING INFORMATION SYSTEMS DEVELOPMENT: A COMPARISON AND ANALYSIS OF EIGHT IS DEVELOPMENT APPROACHES

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Abstract — This paper analyses two fundamental assumptions associated with the analysis and design of information systems: (1) the assumed organizational role of information systems, and (2) the view of information requirements. In the case of the first assumption, it distinguishes three alternatives: a technical view, a sociotechnical view, and a social view. In the case of the second assumption, again three alternatives are explored: an objective view, a subjective view, and an intersubjective view. The paper points out the importance of these assumptions from the viewpoint of IS development through the analysis of eight IS development approaches: Information Modelling, Decision Support Systems, the Socio-Technical Approach, the Infological Approach, the Interactionist approach, the Speech Act-based approach, Soft Systems Methodology and the Scandinavian Trade Unionist approach. The first four are established traditions and the last four, newer and more emerging as IS development approaches. The analysis shows that the first two established traditions have a technical-mechanistic view of the organizational role of information systems, the view of the socio-technical tradition being sociotechnical and the infological approach reflecting all three views. Most of the emerging approaches emphasize the social nature of information systems. In the case of information requirements, the differences between the established and emerging approaches are not as striking. While the objective and subjective views dominate the established traditions, only the Speech Act-based approach and Soft Systems Methodology among the emerging approaches seem to emphasize the intersubjective nature of information requirements. Copyright © 1996 Elsevier Science Ltd

Key words: Information Systems, Systems Development, Systems Design, Systems Development Approaches, Systems Development Methodologies, Information Requirements, Requirements Analysis

1. INTRODUCTION

Behind the approaches that are used to develop information systems (IS), lie a number of implicit and explicit assumptions and views. Although the alternative assumptions and views guide the IS developer in the choice of various analysis, design, and implementation options and hence have important consequences for the development of successful systems, only rarely do they appear to be critically reflected upon or challenged [11, 45]. The need to examine the underlying assumptions of IS development (ISD) has begun to be recognized in the academic literature. Hirschheim and Klein [62], for example, note the important role that assumptions play in developing information systems. The purpose of this paper is to contribute to the debate on the underlying assumptions associated with ISD by looking at two

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1 Recommended by Peri Loucopoulos
2 ISD refers to the analysis, design, technical implementation (construction), organizational implementation (institutionalization) and subsequent evolution (enhancement, maintenance) ([32], p. 611) of information systems.
sets of assumptions: one dealing with the perceived organizational role of IS; the other, fundamental beliefs about what constitutes or determines information requirements. These two sets of assumptions are explored within the context of eight ISD approaches. The choice of these approaches as well as the assumptions are described in some detail later in the paper. We start by offering our definition of IS which then guides our choice of assumptions to be explored.

An information system is interpreted here as a computer-supported system which provides a set of people (users) with information on specified topics of interest in a certain organizational context (cf. [59]). According to this interpretation, one can distinguish three major aspects in the modelling of information systems: organizational context and users (host organization), topics of interest to the users (Universe of Discourse), and computers (technology). In accordance with this view, the paper is based on a distinction between three major levels of modelling or abstraction in IS development: the organizational level, the language level, and the technical level [70, 95]. Lyytinen [95], claims that these levels or “contexts” are exhaustive, and argues their hierarchical order as follows: “Technology, or in general, the physical world, is the basis for the language context, because language is always represented in some material carrier. On the other hand language is necessary for any organized social action that comes into focus in the organization context” (p. 11).

The significance of the technical level is axiomatic since information systems are defined as computer-based. The language level emphasizes that an information system defines a formalized language to be used to communicate about some Universe of Discourse (UoD). The related problems of information requirements analysis (e.g. [126] and conceptual schema design [3] have been the subjects of active research since the early 1970's. The recent growth in Business Process Reengineering or Redesign [60] has increased the interest in the organizational level in ISD. BPR implies that information systems are highly organization sensitive and that IS development and organizational development are likely to be very interwoven. Despite the general agreement about the three levels, there is considerable variety in the way an information system is conceived at these levels. An information system at the language level may be viewed: (1) as a system that objectively describes the state of some part of reality - the Universe of Discourse (UoD); (2) it may be seen as a system to satisfy user’s information requirements that may be very specific to each user, his or her cognitive style and other personality traits (e.g. [78]); or (3) it may been viewed as a formalization of language shared by the users (e.g. [54]). These three views are respectively characterized as ‘objective’, ‘subjective’ and ‘intersubjective’ in the following.

An information system at the organizational level may be considered a technical artifact or tool (e.g. [39]) just as a hammer, for example, which is socially (organizationally) produced and used, but which does not embody any deeper social (organizational) meaning. Such a view we term “technical”. Alternatively, an information system may be considered an artifact which entails inherent social and organizational aspects (e.g. [108, 130]). This we characterize as a “social view”. An intermediate position between these two extremes, termed the “socio-technical view”, emphasizes that an information system comprises both a technical subsystem and a social subsystem that should be designed jointly [16].

The two sets of views are examined in more detail in sections 2 and 3. Section 2 distinguishes three alternative views of the organizational role of an information system: a technical view, a sociotechnical view, and a social view. Similarly, section 3 distinguishes three views of information requirements: an objective view, a subjective view, and an intersubjective view. The ‘organizational role’ views discussed in section 2 are related to the organizational level, while the ‘information requirements’ views articulated in section 3 relate to the language level.

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1 The distinction between the subjective and intersubjective views has some similarity with the 'personal view' and 'common view' of the agreement dimension in the requirements engineering (RE) framework of Pohl [113] which we will return to later in the paper.

2 The relevance of the organizational level is the most distinctive aspect of IS development approaches when compared with the software engineering (SE) tradition reviewed by Pohl [113]. Even though there is a long history of the analysis of organizational views or perspectives from the viewpoint of IS development (e.g. [84]), there is dearth of comparative research into the organizational role of information systems in ISD approaches.
The paper applies the two sets of views to the analysis and comparison of eight ISD approaches. An "ISD approach" in this paper is interpreted as a class of specific ISD methodologies or methods which share a number of common features. This distinction will be elaborated in section 4.1. Four of these approaches are established traditions of ISD - Information Modelling (IM), Decision Support Systems (DSS), the Sociotechnical Design Approach (STD), and the Scandinavian Infological Approach - and four are more emerging - the Interactionist approach, the Speech Act (SA)-based approach, Soft Systems Methodology (SSM), and the Scandinavian Trade Unionist approach. The research approach used in the selection and analysis of these approaches is explained in section 4. The results of the analysis and comparison of the approaches are described in section 5, while the paper as a whole, is summarized in section 6.

In addition to the analysis of the eight ISD approaches, showing their similarities and differences, the paper argues the need for attention to the practical implications of the alternative views. The alternative views, we suggest, guide the IS developer in the choice of concrete analysis, design, and implementation options. The analysis also shows the considerable plurality of assumptions adopted collectively by the eight approaches.

2. THE ORGANIZATIONAL ROLE OF AN INFORMATION SYSTEM

The organizational role of an information system is concerned with the relationship and function of an IS within its organizational context. In the case of the organizational role of an information system, we distinguish three views - technical, sociotechnical and social - on a continuum describing the relationship between the information system and its host organization [73]. A technical view regards an information system predominantly as a technical artifact, and assumes that its connections with its organizational environment can be reduced to well-defined inputs and outputs and ergonomic interface questions. The social view considers an information system primarily as an organizational and social system; an information system is seen as an integral, constitutive part of organizational communication, control, coordination, cooperation and work arrangements and not only as a separate support system for these organizational activities. In the more theoretical terms of structuration theory [50], an information system as a social system can be characterized as an embodiment of interpretive schemas, facilities of coordination and organizational/social norms [108, 128]. The sociotechnical view is based on the assumption of interdependent subsystems, the technical subsystem and the social subsystem which are designed jointly (e.g. [61, 128]). It therefore is interpreted to form an intermediate value on the continuum technical vs. social.

2.1 Theoretical Underpinnings of the Three Views

Figure 1.a analyzes the three views with regard to ontology, i.e. assumptions concerning social/organizational reality, on two continua: realism vs. nominalism [21], and voluntarism vs. determinism in organizational and IS development (cf. human nature in [21]). The realist view implies that reality is predictable and at least in principle manipulable, prescribable and designable, whereas a nominalist view sees the social/organizational phenomena largely as emergent and cannot be directly designed (cf. [127] for the distinction between prescribed and emergent organizations). In the case of voluntarism and determinism of organizational and IS development, the latter emphasizes the importance of social inertia.
which may be related to both the prescribed and emergent aspects of organizations. The voluntarist view, on the other hand, does not recognize or emphasize this kind of inertia. The diagonal, intersecting the first and third quadrants of the figure, forms a continuum 'design optimism vs. design pessimism' as a synthesis of the two dimensions. Design optimism assumes that only existing resource constraints limit the development and acquisition of desired information systems, and that the systems can be implemented without difficulty, if the quality of the system is good enough and people behave 'rationally' (cf. below). Design pessimism, in contrast, assumes no such ease. People are assumed not to behave rationally and the social nature of ISD makes any design exercise "wicked".

In this basic framework we interpret the technical view to have a clear design optimist position, characterized with a strong realistic ontology and a strong voluntarist view of ISD. The sociotechnical view is more moderate, but nevertheless is characterized by design optimism. The social view is the most complicated, since it intersects all the four quadrants of Figure 1.a. It especially emphasizes, however, the emergent aspects of organizational phenomena and social inertia, when compared to the preceding two alternative views. The emergent aspects appear as a result of social interaction.

![Figure 1a](image1a.png)

**Fig. 1:** Theoretical Underpinnings of the Three Views of the Organizational Role of an Information System

The extreme positions in the above interpretation are consistent with Kling and Scacchi's [84], distinction between the discrete-entity model and the web model and with Iacono and Kling's [67] distinction between the tool view and the institutional view; the former on the dimension 'realism vs. nominalism' and the latter on the dimension 'voluntarism vs. determinism' in organizational and IS development. Kling and Scacchi introduce four organizational perspectives: formal-rational, structural, political, and interactionist, in their characterization of the discrete entity and web models (pp. 23-24). The formal-rational perspective is most characteristic of the discrete-entity model and the interactionist perspective to the web model [84]. This is consistent with Figure 1.a where the discrete-entity model is associated with the technical view and the web model with the social view.

In the dichotomy of tool view vs. institutional view, Iacono and Kling [67] emphasize that tools are assumed to be easy to change and replace and the personal freedom of their use, and in the case of the institutional view, the social inertia and history dependence of the systems. This is also consistent with our

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1 The structural and political perspectives can be applied in framing both the discrete-entity and web models, even though the application differs in these two cases. It is not possible to analyze the correspondence of these intermediate perspectives with our framework in this paper.
interpretation of the technical and social views on the dimension 'voluntarism vs. determinism' in organizational and IS development.

We distinguish the sociotechnical view as an intermediate position between the technical and social views, differing in this respect from the dichotomies of the discrete-entity model vs. web model and tool view vs. institutional view. Iacono and Kling [67] seem to associate the sociotechnical approach more with the institutional than the tool view (p. 102). We interpret in Figure 1.a, however, that it is closer to the technical view in its design optimism.

Finally, Figure 1.b simply adds the dimension ‘collective orientation’ vs. ‘individual orientation’ (cf. [95]) to the above analysis. The technical view typically has an individual orientation whereas the social view, a collective orientation. The sociotechnical view, as an intermediate position, has elements of both the collective and individual orientation.

2.2 Practical Implications of the Three Views

We believe that the three views of the organizational role of an information system have important repercussions on the ISD process, especially on IS implementation. Table 1 identifies a set of issues related to ISD, with respect of which the three perspectives differ to a considerable degree.

<table>
<thead>
<tr>
<th></th>
<th>Technical</th>
<th>Sociotechnical</th>
<th>Social</th>
</tr>
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<tbody>
<tr>
<td>Priority of design</td>
<td>Technical system</td>
<td>Technical and organizational/</td>
<td>Organizational/social system</td>
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<tr>
<td></td>
<td></td>
<td>social systems equal partners</td>
<td></td>
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<tr>
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<td>Poor technical</td>
<td>Misfit between the technical</td>
<td>Social inertia</td>
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<tr>
<td>problems</td>
<td>quality</td>
<td>and organizational/social</td>
<td></td>
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<td></td>
<td>Human resistance</td>
<td>subsystems</td>
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<td>Critical conditions for</td>
<td>Technical quality</td>
<td>Additionally, fit between</td>
<td>Additionally, social</td>
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<tr>
<td>implementation success</td>
<td></td>
<td>the technical and organizational/</td>
<td>desirability and feasibility</td>
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<td></td>
<td></td>
<td>social subsystems</td>
<td>of changes</td>
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<td>Analysis and design</td>
<td>Sociotechnical design of social</td>
<td>Evolutionary development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and technical options</td>
<td></td>
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<tr>
<td>Implementation strategy</td>
<td>Empirical-rational</td>
<td>Additionally, normative-educational</td>
<td>Additionally, power-coercive</td>
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<td></td>
<td></td>
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<tr>
<td>Role of the change agent</td>
<td>Engineer</td>
<td>Facilitator</td>
<td>Arbitrator</td>
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Table 1: Practical Implications of the Three Views.

First, the primary focus of the technical view lies in seeing an information system as a technical artifact, leading to the primacy of the technical design of an IS and to the omission of any conscious design at the organizational level. It may be recognized that the artifact to be developed may have

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1 One should note, however, that Iacono and Kling's discussion has influenced our analysis of the three views (technical, sociotechnical, and social), and consequently is not independent.
different organizational/social implications. These issues are addressed, however, as afterthoughts. The social view, in contrast, emphasizes that ISD is first of all concerned with the development of an organizational system (its communication, control, coordination, cooperation, and work structures and arrangements). ISD is primarily seen as organizational design and development, with technical design concerning only the technical implementation of organizational changes. Our interpretation of the sociotechnical school as an intermediate value on the continuum between the technical and social views may become more understandable when it is viewed from the perspective of priority of IS design. The sociotechnical approach suggests that an information system consists of mutually interdependent organizational/social and technical subsystems, which should be treated as “equal partners” in IS design without any priority of action [102].

Second, in the case of organizational implementation problems, the views lead to different emphases. The technical view sees implementation problems as primarily attributed to poor technical quality of the system or to human resistance (cf. system-oriented and people-oriented theories of resistance in [97]). The resistance may be considered ‘irrational’ behavior, or in a moderate form, understandable, rational behavior from the user's own subjective viewpoint. The sociotechnical view emphasizes the misfit between the technical and social/organizational subsystems as the primary reason for implementation problems (cf. interaction theories of resistance in [97]), while the social view adds social (institutional) inertia to the list of implementation problems. As a consequence, the technical view emphasizes the technical quality of the system; the sociotechnical, the fit between the two subsystems; and the social view, the desirability and feasibility of changes (cf. [29]) as critical prerequisite criteria for implementation.

In the case of systems development strategies, the technical view relies on traditional analysis and design approaches or prototyping, whereas the sociotechnical view has its own design approach, including the design and merging of social and technical options [102]. The social view sees that ISD is constrained by historical commitments [67], and consequently emphasizes the evolutionary nature of ISD\(^1\). In the case of organizational implementation strategies, the technical view primarily adheres to empirical-rational strategies [28], whereas the sociotechnical view sees an additional need for normative-educative ones, while the social view adds the requirement of power-coercive strategies if social inertia is to be overcome. As a consequence of the above, the role of a developer as change agent can be characterized in terms of an engineer (scientist), facilitator (teacher) and arbitrator (cf. [122]).

3. THE VIEWS OF INFORMATION REQUIREMENTS

The view of information requirements is concerned with the basic notion of what constitutes or determines an information requirement [66]. We distinguish three views: the objective, subjective and intersubjective views of users' information requirements. The objective view emphasizes the importance of impersonal features such as the organizational position and task of the user as a determinant of his/her information requirements or the objective existence of the slice of reality to be modelled by the system, while the subjective view stresses that the information requirements are first and foremost determined by the personal characteristics of the user (his frame of reference, cognitive styles, etc.). The view of information requirements as the need to attain intersubjectivity among the IS users is a more recent idea in the IS community [15, 53, 54]. This view differs from the preceding two in several respects as will become clear in the following analysis of the theoretical underpinnings and practical implications of the three views.

The three views of information requirements have some similarity with the agreement dimension in the three-dimensional framework for Requirements Engineering (RE) proposed by Pohl [113]. The first dimension, “specification”, describes the degree of understanding of requirements ranging from opaque to complete, the second dimension, “representation”, deals with the different representation forms ranging from informal to formal, and the third dimension, “agreement”, describes the degree of agreement reached on the specification, ranging from a personal view to a common view. He seems to interpret the dimension more as agreement between different stakeholders (systems analysts, manager, user, etc.) while

\(^1\) We make a clear distinction between prototyping and evolutionary approaches. The former is based on an experimental use of the prototype, whereas the latter is based on the use of the operational information system in real circumstances (cf. [68]).
we view intersubjectivity solely within the IS user community. Pohl sees the RE process as a trace in the 3-dimensional space towards more complete specification and increasing agreement using more formal representation forms. He sees the personal views of requirements as an initial state, the goal of the RE process being to increase common system specification. Even though we largely agree with this, we do not wish to exclude subjective (personal) views and differences in the desired output of the RE process.

Pohl [113], assesses that there is not much earlier research done on the agreement dimension in the RE area. In this sense the present paper complements Pohl’s analysis, focusing on ISD approaches instead of software engineering (SE) methods. The analysis also indicates interesting variations in the RE process when compared with Pohl’s view. The analysis of alternative ISD approaches shows that the view of RE as a trace towards common agreement may not generally be valid or may be misleading, because there are some ISD approaches that have emphasized personality differences as essential determinants of information requirements.

3.1 Theoretical Underpinnings of the Three Views

The following analysis is based on a very similar framework as the one used in the analysis of the three views of the organizational role of an information system. Figure 2.a depicts the three views of information requirements with regard to ontology, realism vs. nominalism, and voluntarism vs. determinism of organizational behaviour and in particular IS use. Similar to Figure 1a, realism is associated with permanent structures and nominalism with emergent processes1. The diagonal intersecting the second and fourth quadrants forms a dimension ‘functionalism vs. interpretivism’ [21]. Functionalism assumes that organizational behaviour and IS use are determined by organizational structure, which is associated with a realist ontology. Interpretivism, on the other hand, sees that organizational ‘reality’ is created by organizational (inter)action. The objective view of information requirements has a clear functionalist position; it assumes that the organizational structure (the position and tasks of a user) defines his or her information requirements, including his or her conception of the Universe of Discourse. The intersubjective view on the other hand has a nominalist ontology and emphasizes voluntarism in organizational behaviour and information requirements. Information systems are seen as integral parts of organizational sense making [15], and ISD as the development of organizational communication and the formalization of the professional language of the user community [54]. Information requirements are largely a matter of social agreement. We suggest that intersubjectivity leads to seeing information requirements primarily as emergent*. The subjective view lies between the two extremes, functionalism and interpretivism. The former in the context of the subjective view corresponds to the conception of information requirements in terms of different, ‘measurable’ personal characteristics of users (e.g. cognitive styles), whereas the interpretivist side emphasizes the uniqueness and freedom related to each user’s requirement: his/her requirements are largely his/her personal choice and interpretation, depending on how he/she prefers to view his/her organizational role, tasks, the universe of discourse, and so on.

Figure 2.b adds the dimension of collective-orientation vs. individual-orientation to the above analysis. It points out that the objective and intersubjective views have a clear collective orientation, whereas the subjective view is individually oriented.

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1 The distinction between permanent structures and emergent processes is inspired by Truex and Klein’s [129] distinction between a priori structures and emergent processes. They interpret a priori structures as objectified, relatively stable structures, whereas emergent processes may be seen at most temporal agreements in the continuous process of negotiation and renegotiation.

* Goguen [51, 52], also emphasizes the emergent nature of requirements but sees them to emerge from the interactions between the requirements engineers and the client organization rather than from the continued social interaction of the users in the client organization.
3.2 Practical Implications of the Three Views

The three views have important practical implications from the viewpoint of IS design. In the case of the objective interpretation, information requirements analysis can, at least in principle, be conducted as an impersonal activity or reality analysis; the subjective view presupposes focusing on each user's personal characteristics and requirements, whereas the intersubjective view considers requirements determination as a social rule analysis and reconstruction [54]. They also differ with regard to the question of user participation. Putting aside the ethical, motivational, and committal arguments for user participation, the objective view presupposes user participation at most in the role of an application domain expert: the user may be required to explain the intricacies of the tasks supported by the system. User participation is beneficial as far as the representatives know the intricacies of work to be supported by the information system. In the case of the subjective view, the user may be an object of different personality tests, the results of which are believed to help him/her and the analysts to understand his/her requirements, or he/she may be an individual decision maker, whose cognitive models and preferences define his/her information requirements as were outlined above. Finally, the intersubjective view sees users as integral actors in organizational communication whose participation is by definition a necessity in order to achieve intersubjectivity ([54] p. 26).

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<tr>
<th></th>
<th>Objective</th>
<th>Subjective</th>
<th>Intersubjective</th>
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<tr>
<td>Asking</td>
<td>(x)</td>
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<td>Normative analysis</td>
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<td>Strategy set transform</td>
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<td>Critical factors analysis</td>
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<td>Process analysis</td>
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<td>Decision analysis</td>
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<tr>
<td>Input-process-output analysis</td>
<td>x</td>
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Table 2: Underlying Assumptions of Strategies of Information Requirements Determination
Clearly different strategies of information requirements determination differ in their assumptions concerning the views of information requirements, or that they, in practice, are not neutral with regard to the different views. Table 2 analyzes some of the well-known strategies proposed by Davis [31] from this perspective. Davis' first strategy "asking" is, of course, a very general approach, which may be used to elucidate all types of requirements. It is clear, however, that it tends to emphasize either the subjective views of the analyst in the case of closed questions, or of the user in the case of open questions. Davis [31] also includes group-oriented methods (brainstorming, guided brainstorming and group consensus) within the category of asking ([31] p. 13). It is still an open question to what extent these group methods are able support the elucidation of intersubjective aspects of requirements. In the case of the remaining strategies our conclusion is that they primarily reflect either the objective view or the subjective view. The interesting aspect of Table 2 is the finding that except asking, none of the strategies directly reflects or supports an intersubjective view.

More recently, ethnography and ethnomethodology inspired methods of requirements analysis (e.g. [13, 14, 19, 93, 115, 124]) partially address the problem of intersubjectivity. They see the users' work as socially organized and look closely at how the users actually organize their work, and the categories and methods they use to render their actions intelligible to one another [51, 52]. Despite this orientation, they do not see increased intersubjectivity among the users as the goal of requirements analysis. Apparently, they see shared understanding among users as unproblematic and focus more on the mutual learning between the designer and customer rather than on increasing intersubjectivity among users. Their focus also lies more in the detailed understanding of users' work than users' information requirements and shared understanding of the Universe of Discourse. These methods are, however, in their infancy as methods of requirements analysis (see [115] for a discussion of their difficulties, and [2] for possible misconceptions).

Even more formally oriented methods of requirements analysis do not explicitly recognize intersubjectivity among users as the goal of the analysis, although they indirectly provide instrumental support for this view. "View integration" in the conceptual IM tradition (e.g. [12]) includes some notions of intersubjectivity, but it is usually not associated with the nominalist (constructivist) ontology underling the intersubjective view (see also [86]). Recent viewpoint-oriented requirements engineering methods (e.g. [85, 92, 103, 105]) interpret "viewpoints" more generally as perspectives of the artifact to be developed, adopted by different agents (participants or actors) without restricting "viewpoints" to "user views". They do not specifically recognize intersubjectivity defined over the user population of the system as the goal of requirements engineering but rather only sufficient consistency [47]. The work on integration of viewpoints [46, 96] and conflict resolution [38] may, nevertheless, be useful when promoting the intersubjectivity of information requirements. Recent work on design rationales, when applied to information requirements (cf. [114]), may also be instrumental in advancing it.

4 THE RESEARCH APPROACH

The purpose of this section is to introduce the ISD approaches selected for review, and the method used in the analysis.

4.1 The Approaches Selected for the Review

The field of ISD has grown dramatically over the past three decades. In addition to the expansion in the number and complexity of systems developed, the number of ISD methodologies has been growing leading to an increasingly dense "methodology jungle" [8]. To our knowledge there has been little systematic analysis of the major approaches of ISD (but see [64]) and still less any generally accepted classification for them, even though the topic has been discussed in a number of articles [62, 71, 72, 104, 134]. Banville and Landy [10], for example, characterize MIS (or IS research) as a fragmented adhocracy, in which research is rather personal and weakly coordinated in the field as a whole.

1 They may, of course, support intersubjectivity indirectly by increasing consensus on organizational goals, processes, critical factors, etc.
Part of the confusion stems from the notion of 'methodology' and 'approach'. In this paper, we explore these notions concluding that there may be value in moving beyond ISD methodologies to focus on more general ISD approaches. We define ISD approach as a class of specific ISD methodologies which share a set of common features. An ISD methodology or method refers to a codified set of goal-oriented "procedures" which are intended to guide the work and cooperation of the various parties (stakeholders) involved in the development of an IS application. Typically, these procedures are supported by a set of preferred techniques and tools, and guiding principles. An ISD approach may include zero, one, or more concrete methodologies as its instances. As an example of the first case (i.e. zero methodology instances), consider the Interactionist approach (see below) which to our knowledge has not been developed into any specific methodology, whereas the IM approach (see below) has numerous methodology instances.

Our claim is that the concept of an approach makes it meaningful to compare various ISD approaches which may be in quite different stages of their development in terms of the number of their methodology instances. The concept 'approach' also leads us to focus on more general principles underlying specific methodologies manifesting them as similarities and differences. It is possible to analogize our categorization of approach and methodology to Brooks' famous distinction between essences and accidents of software products. An ISD approach focuses on the essences of its methodology instances while concrete methodologies necessarily include also accidental features (e.g. related documentation notations), which while important in practice, do not define its essence.

We selected four traditional ISD approaches - Information Modelling (IM), Decision Support Systems (DSS), the Socio-Technical Design approach (STD) and the Scandinavian Infological approach - and four more recent ISD approaches - the Interactionist approach, the SA-based approach, Soft Systems Methodology and the Scandinavian Trade Unionist approach.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Journals/conferences</th>
<th>Textbooks</th>
<th>Founders</th>
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<tbody>
<tr>
<td>Information Modelling</td>
<td>x</td>
<td>x</td>
<td></td>
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<tr>
<td>Decision Support Systems</td>
<td>x</td>
<td>x</td>
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<td>Infological approach</td>
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<tr>
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<td>Kling</td>
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<td>Speech Act based approach</td>
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<td>Soft Systems Methodology</td>
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<td>Checkland</td>
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<td>Trade unionist approach</td>
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<td>Nygaard, Sandberg, Ehn, Kyng</td>
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Table 3: The IS Development Approaches Selected for the Analysis

In addition to the distinction between the established and emerging approaches, the eight approaches are selected to represent the variety of positions taken with regard to the assumptions. The selection of the traditions is primarily guided by their institutionalization in the scientific community and secondarily on the existence of identifiable founders and followers. Referring to Kuhn's discussion about scientific

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1 We use the terms "methodology" and "method" interchangeably; however we note that the latter term is becoming increasingly preferred, especially in Europe.
Anayisin Information Systems Development

Communities in his postscript to the second edition of his book ([87] pp. 176-178), the assessment of institutionalization is based on three subcriteria: the existence of scientific journals, scientific conferences, and textbooks. The approaches are listed in Table 3.

The IM approach has its roots in the data modeling tradition of the database field. The term 'Information Modelling' is preferred here to point its application to ISD. It has been very influential both in Europe and North America. In Europe, it has especially dominated research within IFIP (International Federation for Information Processing) TC8 (Information Systems) Working Group 8.1 (e.g. [109-111]). It has also heavily influenced specific methods such as Information Engineering [98-100]. The DSS approach has been visible for quite some time and started to emerge in the context of several experimental projects in the early 1970's [78]. The STD approach and the infological approach are more European traditions. The former has its roots in the Tavistock Institute in the late 1940's. Its application to ISD was pioneered by Enid Mumford [101], in the U.K. starting from the late 1960's. Subsequently, it stimulated interest in North America as well [16, 112]. The Infological approach initiated by Langefors [90] in the mid 1960's has been influential especially in Scandinavia.

The four more recent approaches - the Interactionist approach, the Speech Act (SA)-based approach, Soft Systems Methodology (SSM), and the Scandinavian Trade Unionist approach - are called emerging, since they do not have an institutional status comparable to the four traditions introduced above and their relevance to ISD may not be fully recognized. The Interactionist approach refers to the body of research conducted at the University of California, Irvine, by professor Rob Kling as his colleagues. The SA-based approach to ISD borrows its basic concepts from the linguistic philosophy of Searle [119-121]. It was pioneered by Fernando Flores and Terry Winograd (e.g. [49, 132]) in North America and Goldkuhl and Lyytinen [54, 55] in Europe. SSM is a general systems approach developed by professor Peter Checkland and his colleagues at the University of Lancaster [29, 30, 131]. Although SSM was originally a general systems approach, without any specific orientation towards information systems, its developers are increasingly perceiving it to be well suited to ISD. Within the IS community SSM has been incorporated as an integral part in such approaches as MULTIVIEW [9] and FAOR [118]. The Trade Unionist approach is a tradition that has evolved mainly in Scandinavia as a trade union response to the challenge of Scandinavian co-determination arrangements and laws enacted in the mid-1970's that ensured the employees and unions the right to participate in the design of and decision-making concerning computer systems [40]. This approach was initially based on a strong 'class politics' perspective to organizations [84]. This Marxist ideology has, however, been weakening recently and the approach is in a transition towards "cooperative design" [57]; it has raised considerable interest lately [88].

The eight approaches are by no means assumed to be exhaustive and/or mutually exclusive. Nor is that our goal. Exhaustiveness is not considered any absolute goal since it is a moving target. Rather a careful and convincing analysis of the selected approaches is our preference, and in order to keep this paper within reasonable limits, the analysis is confined to these eight approaches. Moreover, the approaches are not necessarily mutually exclusive because they have influenced each other to some greater or lesser extent during their evolution.

4.2 The Method of Literature Analysis

Given that the primary purpose of this paper is to analyze two assumptions underlying the concept 'information system' in the eight approaches introduced above, we must acknowledge that this kind of analysis faces many difficulties. First, as we noted above the approaches are not necessarily clearly distinct and they have continued to evolve over time. One way to deal with this is to try to evaluate these approaches as intellectual traditions in their original forms. We prefer, however, to view them in their contemporary form to make the analysis more pertinent to current research. Second, we must take into account that there may be considerable variation within each approach. One solution to this, applied by [104], is to treat them as "ideal types" in the Weberian sense. Ideal types have the benefit that they make it

Kuhn also mentions professional societies, informal and formal communication networks and citations as means of identifying community structures. Analysis of the latter two is beyond the scope of this paper. Professional societies can be expected to coincide largely with scientific journals and conferences.
possible to find clearer differences between the approaches, but they are normally purely theoretical con-
structions that do not exist in reality. Therefore, the analysis could remain at a rather general and abstract
level without any clear addressable target.

In this paper we have selected a different approach. The idea is based on Kuhn [87]. He emphasizes
throughout his book the importance of textbooks as manifestations of existing paradigms and in the
dissemination of paradigms to the next generation. “They are the bases for a new tradition of normal
science” (p. 144) and “expound the body of accepted theory” (p. 10). Applying his suggestion, we have
chosen one or two books, preferably textbooks, to represent each established approach. The selection of
books is based on two main criteria. Firstly, a book should be a good representative of the tradition from
the viewpoint of ISD. Secondly, the goal has been to select books by leading authors who have effectively
influenced the development of the tradition they represent. The books representing IM [98-100, 109]
represent European and North American views. The book of Keen and Scott Morton [78], is a classic in
the DSS field, and the textbook of [123] one of the best-known on the topic, with particular emphasis on
how to develop a DSS. The two books on the sociotechnical approach [102, 112] represent European and
American views. Mumford’s [102], book summarizes the ETHICS methodology, and the book of Pava
[121], represents an important extension of the sociotechnical approach to nonroutine office work.
Finally, the two books [94, 125] on the sociotechnical approach [102, 112] represent European and
American views. Mumford’s book summarizes the ETHICS methodology, and the book of Pava
[121], represents an important extension of the sociotechnical approach to nonroutine office work.

To counter any potential criticism that may be attracted to the use of textbooks, we wish to direct
attention to the following four points. First, the selected books are highly research-oriented in the sense
that they include numerous summarizing references to existing research or are heavily based on the
authors’ earlier research. Taking into account that they are written by leading researchers in the field, one
can expect that the results of our analysis reflect the mainstream research in each tradition. Second, the
use of books should be assessed taking into account the alternative of using original research contributions
representing each tradition. In view of the breadth of some traditions, it is clear that the review of original
research contributions could not be exhaustive. When one furthermore recognizes the problems of
drawing strict borderlines for the traditions and internal variation within them, it becomes obvious that in
choosing an “appropriate” selection of the articles to be reviewed, one may reach almost any conclusion in
the case of some traditions. The important point in the use of textbooks is that the authors of the books
have made their selection of “the body of accepted theory” independently of the purposes of this paper.
Third, applying Argyris and Schon’s [4] distinction between “theory-in-use” and “espoused theory”, one
can argue that textbooks make it possible to analyze the “theories-in-use” better than by adhering to
original research papers. Fourth, the use of textbooks assures that the results are highly relevant from the
viewpoint of IS education since they are mediated to practice through the education of future IS
professionals.

In the case of the emerging approaches, where it is too early for textbooks, we had to rely on a more
comprehensive analysis of the existing literature. The analysis of the Interactionist approach is based on
the following articles: [67, 80-84]. Although the SA-based approach has aroused considerable interest in
the IS community recently (e.g. [5-7, 33-37, 48, 49, 54, 55, 74, 76, 79, 91, 132] our analysis is based
mainly on the works of Auramäki, Flores, Goldkuhl, Lehtinen, Lyytinen and Winograd [5, 48, 49, 54, 91,
95, 132]. SSM has been published in a number of books [29, 30, 131]. Within the IS community it has also
aroused considerable interest, being integral parts of such approaches as MULTIVIEW [9] and FAOR
[118]. In order to keep our discussion as close to what Checkland intended, the analysis of SSM is
primarily based on the original texts on SSM emphasizing the most recent ones. The analysis of the Trade
Unionist approach is based on the following material: [23-27, 39-44, 89, 106, 116, 117]

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1 A second risk is that the ideal types may turn out to be too extreme, which may lead to unnecessary controversy and
misunderstandings.

2 The major neglect of ISAC as a representative of the Scandinavian infological tradition concerns conceptual/infological
modelling of the Universe of Discourse (UoD). Sundgren [125], complements Lundberg et al. [94], in this respect.
5. RESULTS OF THE ANALYSIS

5.1 The views on the organizational role of an information system

The assumptions of the eight ISD approaches, concerning the organizational role of information systems, are summarized in Table 4.

Information Modelling: Martin [99], defines an information system as “a system of data and processes that can be used to record and maintain information” (p. 467). An information system consists of one or more applications. An application system refers to “the automated and related manual procedures supporting a set of business processes” (p. 448). Even though ISD in information engineering (IE) is very heavily based on the analysis of the organization to be supported, the view of the organizational role of an information system is technical. Information Strategy Planning (ISP) results in a number of business areas based on the functional and entity modelling of the organization. The applications to be developed are identified in the Business Area Analysis (BAA) based on more detailed data modelling and process modelling. Martin [99], does not describe exactly their identification, but proposes JRP (Joint Requirements Planning), JAD (Joint Application Design), and prototyping as major means of the further specification and design of individual applications [100]. The procedure for JAD, suggests that information systems are specified as input data, output data and related processing in the detailed procedure steps of the processes identified in BAA.

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*** Strong orientation  ** Some orientation  * Weak orientation

Table 4: The Views of the Organizational Role of an Information System

In terms of Kling and Scacchi [84], the view of information systems in IE seems to reflect the discrete entity perspective that was associated with the technical view. One should nevertheless note that IE strongly emphasizes the interaction between the organization and information technology. While the identification of information systems in IE is heavily based on organizational analysis and modelling, Martin [99], underlines in the context of ISP that the purpose is not only to analyze the enterprise and to identify information needs leading to the computerization of the existing procedures, but it should identify the fundamental activities and the fundamental information needs likely leading to rethinking the enterprise structure (p. 20-21). He points out that more advanced (information) technology justifies a different corporate structure. “A computerized corporation ought to have different procedures from a corporation with manual paperwork. A corporation with workstations on all knowledge workers’ desks,
connected by a corporatewide network to databases, ought to have different procedures from a corporation with batch processing” (p. 62).

The framework for information system development advanced by Olle et al. [109], resembles in many respects IE. They characterize an information system as: “a means of recording and communicating information to satisfy the requirements of all users”, engaged in a business activity “by providing the information it needs or by automating some or all of it” (p. 229). Olle et al. [109], assume information systems to be identified in the Information Systems Planning stage as change alternatives that are new ways of doing things in an information system or a business activity in order to deal with some business problems (p. 222).

Decision Support Systems: In the case of the DSS tradition, our conclusion is that it primarily reflects a technical view, but includes aspects of a social view. Keen and Scott Morton [78], interpret a DSS in rather technical terms as: “a conversational, interactive computer system with access through some form of terminal to the analytical power, models, and data base in the machine” (p. 58). They also emphasize the role of a DSS as a support tool under the control of managers (p. 2). On the other hand, they emphasize the predominance of the organizational, political, and behavioural context of DSSs (pp. 50, 71, 171-172, 189), having a relatively rich discussion on these contextual factors in their book (pp. 61-73). They also recognize the implementation problems of DSSs (pp. 71, 175-176), devoting a chapter to DSS implementation (pp. 189-211). They remark that “the failure of a system or a model is now rarely due to technical inadequacies” (p. 50), and mention “political factors that may make these technically excellent products organizationally infeasible” (p. 71). Despite these remarks, they regard a DSS as a discrete entity that may be embedded in a rich organizational environment: “the ‘system’ is not an artifact but a set of computer routines that must be meshed into the organizational, political and behavioural context” (p. 189). To summarize we interpret that the view of the organizational role of a DSS in Keen and Scott Morton [78], is primarily technical, but includes social elements. The view cannot be regarded as sociotechnical, however, since Keen and Scott Morton [78] do not see any clear need for the organizational design of DSSs. Organizational perspectives referred to above are only mentioned in the “entry” of the DSS design process (p. 174). The book of Sprague and Carlson [123], does not essentially change our conclusion. Even though they emphasize the organizational nature of DSSs more than Keen and Scott Morton [78] do (p. 26), they in fact pay less attention to the social aspects of DSSs.

The Socio-Technical Design approach: Not surprisingly, the view of the organizational role of an information system in the case of the STD approach is sociotechnical. Both books [102, 112] include explicit design of technical and social options for an information system.

The Infological approach: The view of the organizational role of an information system in the Infological approach comprises technical, sociotechnical and social aspects. ISD in ISAC [94] is intimately related to “change analysis” which is the first phase of ISAC. Change alternatives identified and selected in Change Analysis are assumed to normally combine different development measures such as ISD, organizational development including individual development, and development of the direct business activities (p. 118-119). Change analysis clearly places priority on the organizational/social design of the system. However, Lundberg et al. [94], do not pay any particular attention to the social meanings of information systems. Even though Lundeb erg et al. [94] do not directly propose joint development of technical and social options, they emphasize that the change alternatives should be subjected to both social and economic evaluation. This implies some sociotechnical thinking. Information (sub)systems are identified as a result of detailed “activity analysis”. Activity analysis is continued until identified information processing activities can be classified as unformalizable, formalizable but unautomatable, and automatable (pp. 148-149). If we exclude unformalizable subinformation systems, we can conclude that information subsystems simply formalize and computerize the identified organizational activities. In this sense information (sub)systems are seen as separate technical artifacts.

The Interactionist approach: The view of the organizational role of an information system in the Interactionist approach is clearly social. As discussed in section 2, Kling et al. propose the web model as a

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1 Cf. the Infological approach below

1 One explanation for the exclusion of organizational design is the individual orientation of their book [77]. A second explanation might be that Keen and Scott Morton [78], see the social aspects largely as emergent and consequently not designable. It is hard to find any direct support for this second explanation from their book, but their emphasis on the evolutionary design is consistent with it.
contrast to the discrete entity model of an information system [80, 83, 84] and later the institutional view as a contrast to the tool view [67, 82]. According to Kling and Scacchi [84], “the basic unit of analysis of the discrete entity model is a computing resource” (p. 9): “A computing resource is best conceptualized as a particular piece of equipment, application, or technique which provides specifiable information processing capabilities” (p. 6). They continue that “computer-based technologies are tools, and are socially neutral” (p. 6), the use of which is isolated “from the actual work practices and organization of labor within which automated data systems are typically developed and used” (p. 3). Web models on the contrary “make explicit the salient connections between a focal technology and its social and political contexts” (p. 3). In addition to their information processing capabilities, “computer-based technologies are also social objects which may be highly charged with meaning” (p. 7-8). Kling and Iacono have proposed the distinction between the tool and institutional views in their recent papers [67, 82]. They suggest that when “analysts emphasize the information-processing capabilities of a computer-based technology, they are foregrounding its “toolness” or instrumental value for particular social units”, whereas when “analysts emphasize the social and political choices that organizational actors have made over time, they are foregrounding its institutional character” (p. 104). They contend that computer-based information systems (CBIS), developed from complex, interdependent social and technical choices are better conceptualized as institutions than as tools, because “the image of a CBIS as a tool is associated with tremendous personal freedom”, “there is an underlying assumption that computer-based technologies have no inherent politics: they are consistent with any social order” and “attention is focused on a future of technological perfection”, whereas “institutional analyses emphasize the social use of CBIS and social control over computing arrangements”, “politics play an important role” and the focus lies on “the developmental trajectories of CBIS. Institutions develop a character based on the interest they have served in the past, their organizing ideologies, and the world views which bind their participants together” (pp. 104-105). Further, the institutional view emphasizes the social ‘inertia’ related to computer-based information systems (82] p. 11).

The Speech Act-based approach: The view of the SA-based approach is clearly social. Goldkuhl and Lyytinen [54], suggest the notion of information systems as “social systems only technically implemented” ([7] p. 127). More specifically, Flores and Ludlow [49], claim that organizations are essentially institutional arrangements to create, take care of and initiate commitments and Lehtinen and Lyytinen [91], propose that an information system consists of speech acts that create, set up, control, and maintain an organization’s transacting contracts, and report on their status. Flores and Ludlow [48], also point out that “technology is not design of physical things. It is design of practices and possibilities to be realized through artifacts” (p. 153).

Soft Systems Methodology: The view of the organizational role of an information system in SSM is not very well articulated, but we conclude that it includes both technical and social aspects. Checkland and Scholes [30] conceive an information system to entail data manipulation, which machines can do, and meaning attribution which is uniquely a human act (p. 55). They furthermore suggest an approach for ISD that is essentially based on defining a human activity system to stimulate debate on the relevance of the human activity systems. Once a ‘truly relevant’ system has been agreed upon, one can proceed to the analysis of information flows. For each activity identified in the relevant human activity, one can ask what information would have to be available to enable someone to do this activity and what information would be generated by doing it (pp. 56-57). The priority of the human activity system analysis reflects a social view of an information system. The relatively mechanistic procedure of identifying required information suggests that an information system is perceived to be an isolated technical artifact.

The Trade Unionist approach: The view of the organizational role of an IS in the Trade Unionist approach has both a technical and social orientation. Earlier projects such as DEMOS, when analyzing computer use in planning and control, emphasized that “in this area the computer serves as a controlling instrument, in contrast with a device such as a lathe which could be categorized more aptly as a working machine” ([27], p. 250). The second generation of the Trade Unionist approach, ‘the collective resource approach’ [23, 39] strongly advocates a tool view as an ideal of computer artifacts, a tool being under complete control of the users. This was associated with the technical view in the second section. Although the authors do not make it clear, the emphasis on the tool view is partly explained by the specific application area of the UTOPIA project, computer use in text and image processing in the graphic industry. Even though the second generation adheres to the tool perspective, it at the same time
emphasizes that "the systems design process must be regarded as part of a larger organizational development process" ([40], p. 33). Ehn [39] also points out that "in designing artifacts we do not merely design the artifacts themselves: deliberately or not, we also design conditions for their human use" (p. 1) or "a changed or reformed practice" (p. 171). He also underlines the social nature of the artifacts in several contexts (pp. 39, 100-101, 124, 208). It is noteworthy, however, that the design in Ehn [39] is assumed to take place in terms of the computer artifacts and their use situations (cf. [57]) without providing any deliberate approach for designing the work practice per se independently of the computer artifacts. The likely reason for this paradox in the "work-oriented design" is that the essential part of work knowledge is assumed to be tacit [39, 40, 891 and therefore largely beyond the scope of research. As tacit, it is not describable, it is difficult to communicate, reflect upon and deliberately design without "design by doing" using mock-ups and prototypes, etc. It seems that the third generation, 'the cooperative design' approach [56] has not changed this tool-oriented view of computer artifacts.

5.2 Views of information requirements

Table 5 depicts the views of information requirements in the eight ISD approaches.

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*** Strong orientation  ** Some orientation  * Weak orientation

Table 5: Views of Information Requirements

Information Modelling: The view of user information requirements in the IM approach is predominantly objectivist, but includes some subjectivist and intersubjectivist features. The objectivist stance in IE [98-100] is clearly visible in the whole approach. The identification of business areas in Information Strategy Planning (ISP) is essentially based on the cross checking of business functions and entities (data subjects). Both functional modelling and entity modelling in ISP take place in a very impersonal way as a process of identifying fundamental business functions and entities. Business Area Analysis continues the entity analysis leading to a normalized (usually 3NF) data model and a more

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1 In fact, one can argue the title of Ehn's [39], thesis "Work-oriented design of computer artifacts" is a misnomer. A more appropriate title would be "Computer artifact-oriented design of work".

2 Button and Harper [22], contend that if the design of computer artifacts is to be based on understanding of the actual lived-work of those who must use the computer system, this has to be grounded in analytical explications of work that reveal the practices through which the users orderly handle the contingencies of their work situations.
detailed process model. The most articulated procedure for specifying individual application systems, JAD, suggests that specification is very heavily based on further analysis of the processes at the level of procedures [100]. The subjective view in IE is most clearly visible in the use of Critical Success Factors in the identification of information requirements especially for executive information systems [100]. The intersubjective view is visible only weakly. One can nevertheless identify some flavor of intersubjectivity in the process of integration of different user views ([99], pp. 253-254).

Olle, et al. [109], are not very explicit in the case of information requirements, but its view is mainly objectivist. Information requirements are implicitly based on impersonal business activity and entity modelling. The authors also briefly introduce critical success factors which again display objectivists leanings.

**Decision Support Systems**: The view of information requirements in the DSS tradition is predominantly subjectivist. Keen and Scott Morton [78] emphasize in several contexts that a DSS must be tailored to match the decision maker (pp. 6, 11, 50, 58). They also introduce individual differences as an important model of decision-making (pp. 73-77), remarking that the: “implications of individual differences for DSS are obvious. The system should mesh with the cognitive structure of its users” (p. 73). They also utilize the perspective effectively in the DSS design process, in particular in the comparison of the descriptive and normative models in the predesign phase of DSS development (pp. 174-176). The descriptive and normative models lead us to question to what extent the definition of information requirements in Keen and Scott Morton [78], reflects the objective view. Unfortunately, the authors are not very explicit in defining these concepts. Our interpretation is, however, that the descriptive models usually reflect the subjective view (cf. [78] p. 175), whereas the normative models may be based on a more objective analysis of the decision-making activity. Keen and Scott Morton [78], emphasize, however, that the normative models may be infeasible, and advocate matching the initial DSS to decision makers' current processes and later evolution of the system toward the normative model by facilitating learning and willingness of decision-makers to explore alternative models (pp. 174-176). Earlier in their book, Keen and Scott Morton [78], introduce a framework for information systems based on Anthony's hierarchy of planning and control activities and Simon's distinction between programmed (structured) and nonprogrammed (unstructured) decisions (pp. 79-98). Even though they discuss the differences in information requirements at different levels of decision-making (pp. 82-85), it seems to us that the framework is primarily presented to locate and distinguish DSS as a category of information systems, rather than as an effective method to be used in information requirements analysis.

Sprague and Carlson [123], also recognize subjective factors as part of information requirements, but their conclusions concerning how to meet these requirements seem to differ from those of Keen and Scott Morton [78]. They emphasize that a DSS should “provide decision makers with a set of capabilities to apply in a sequence and form that fits each person's cognitive style” (p. 27), but later on conclude that “if a DSS is to support varying styles, skills, and knowledge, it should not attempt to enforce or capture a particular pattern. Rather, the DSS should help decision makers use and develop their own styles, skills and knowledge. If this requirement can be met, the cost effectiveness of DSS should improve because several decision makers could make effective use of the same DSS” (pp. 98-99). The authors do not clearly state how the requirements and capabilities of this kind of a generalized DSS are derived: Are they generalized from the subjective requirements of individual decision makers, possibly aiming at increasing the intersubjectivity of related decision makers on the requirements, or are they based on a more “objective” analysis of the decision-making activity?

It should be noted that Sprague and Carlson [123] do not suggest any specific methods for the “objective” analysis of information requirements. They introduce Anthony's classical hierarchy, Simon's

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1 Even though Martin [99] emphasizes that data modelling in BAA is a synthesis procedure (p. 247), he discusses the (user) view integration only superficially.

2 For instance, they may be based on some “theory” of the decision-making activity in question (e.g. financial portfolio theory in the case portfolio management). It is, of course, by no means necessary that these “theories” omit individual differences (e.g. in risk aversion), but they typically are impersonal.

3 In fact, Keen and Scott Morton [78] only briefly refer to the framework in their later description of the DSS design process (pp. 171-187). They suggest it as a means to identify which decisions may benefit from decision support (p. 173).
distinction between the structured and unstructured decisions, Simon's intelligence-design-choice model for a decision-making process as well as the Hackathorn's and Keen's classification of decision interdependencies into independent, sequential interdependent and pooled interdependent (pp. 26-27, 94-95). However, most of these frameworks are not effectively used in the later information requirements analysis and definition of DSS capabilities, based on their ROMC framework (pp. 99-119). In fact, only the intelligence-design-choice model is clearly referred to, but it is not clear whether the authors suggest it as a method to be used in information requirements analysis or whether it is an illustration framework for the components of the ROMC model. Taking into account the relative lack of methods for the "objective" analysis of information requirements, we conclude that the requirements and capabilities are derived as a generalization of subjective requirements of individual decision makers. This generalization is not specifically introduced in terms of intersubjectivity.

The Socio-Technical Design approach: Since Pava [112], hardly addresses the definition of information requirements, the following analysis of the STD tradition is based on ETHICS [102]. We conclude that the view is mainly objectivist, since key information needs in ETHICS are derived starting from the mission and key objectives of the part of the organization which lies within the design boundary, proceeding then to key tasks and finally to their information needs ([102] pp. 72-74). It is surprising, however, that in later design of organizational and technical options these key information needs are not taken up or at least not explicitly integrated in the design of these options (pp. 91-97). The design of organizational options refines the key tasks into various operating, problem prevention/solution, coordination, development and control activities, which are allocated to different organizational units (large work groups, their sub-groups, small teams and individuals), whereas the technical options are mainly defined in terms of technical components, the descriptions of which implicitly include some understanding of the conceptual/infological features of the system. There is no explanation for these features, but overall the process - as a seemingly impersonal activity analysis - supports an objectivist view. On the other hand, the user participation emphasized in ETHICS brings a subjective element into information requirements analysis.

The Infological approach: In the case of the Infological approach the view of the information requirements is clearly objectivist. Information requirements in ISAC are derived using activity analysis in change analysis and activity studies. After decomposing activities into more detailed ones, it is possible to identify information processing activities which are potential candidates for information subsystems (cf. [94] pp. 148-152). Further information analysis continues the refinement of each information subsystem using precedence, component and process analyses, which specify the inputs and output and the derivation rules of the subsystems more precisely (pp.198-203). These analyses take place in a very impersonal manner. But, as in the case of ETHICS, user participation indirectly supports a subjective view. The view of information requirements in [125] can be interpreted to have a clear subjectivist flavor, however. He assumes that "the ultimate purpose of a data base is to serve as a source of knowledge to more or less well-defined group of end users. The end users need information, that is knowledge, in order to solve problems or make decisions" (p. 2). Sundgren [125], interprets information as new knowledge, emphasizing that information is always somebody's information and exists only in the mind of a human being as a part of a mental frame of reference (p. 10).

The Interactionist approach: The Interactionist approach does not address information requirements to the extent to allow any conclusions to be drawn.

The Speech Act-based approach: The view of information requirements in the SA-based approach is most distinctively intersubjective, but also includes objectivist aspects. Goldkuhl and Lyytinen [54] claim that ISD means to make common the rules of language by achieving formal language intersubjectivity (p. 20). The linguistic orientation naturally emphasizes common understanding among the participants in the communication [91]. On the other hand, the concrete examples of the application of the SA-based

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1 The authors remark, however, that group and organizational support systems "need to provide personal as well as group instances of ROMCs. The former are defined by and for individuals, while the latter are standard for all individuals in the group" (p. 142). It is not clear, however, whether the consensus is concerned with the intersubjectivity of language and communication among the user community or just more generic DSS capabilities.

4 One can imagine that the consensus form of participation in Mumford [102], also supports intersubjectivity of information requirements. Mumford [102], does not yet make this explicit. Recall also that ETHICS does not specifically include mechanisms for the conceptual/infological design of information systems (cf. [95]).
approach to modelling information systems [5, 7, 55, 91], suggest that the information requirements can be derived from a rather objective analysis of agents, instrumental acts and related speech acts.

Soft Systems Methodology: Information requirements in SSM has both intersubjective and objective features. As described in section 5.1, SSM assumes information requirements to be dependent on the human activity system selected. Once a 'truly relevant' human activity system has been agreed upon, one can proceed to the analysis of information flows. For each activity identified in the relevant human activity, one can ask 'what information would have to be available to enable someone to do this activity and what information would be generated by doing it' ([30] pp. 56-57). A distinguishing aspect of SSM is that it assumes several systems models, human activity systems, potentially relevant for analysis and understanding a given organization. These models are subjected to a debate and the selection of the truly relevant human activity system is assumed to be such that different stakeholder groups can find 'accommodation', i.e. that they are prepared to 'go along with'. This process of achieving 'accommodation' has aspects of intersubjectivity. Once the truly relevant human activity system has been selected, however, the detailed information requirements analysis proceeds in a fairly objectivist way.

The Trade Unionist approach: The Trade Unionist approach is not very explicit in its view of information requirements. This is partly explained by its history. Its first generation projects were more interested in the conditions of the trade union influence on the decisions concerning computer systems rather than on novel design approaches. The second generation, the "collective resource approach" is entirely based on one project, UTOPIA, in which the aim was to develop computer-based tools for text and image processing. Because of the nature of the application, the system relied on direct iconic modelling (of page make ups) rather than on symbolic models (see [1] for the distinction between the iconic and symbolic models). It seems that in this case information requirements were not the major concern, but rather the implications of the system on work. The design approach in UTOPIA was heavily based on the use of mock-ups. The third generation, "cooperative design" has extended the "design-by-doing" approach to entail prototyping [26]. Bødker and Grønbæk [26], also include an example of prototyping a more conventional, symbolic information systems, but they do not describe in detail how the initial information requirements for the prototype were derived.

Prototyping may in principle support objectivist, subjectivist and intersubjectivist views of information requirements. Nevertheless, our general impression is that the Trade Unionist approach places its major emphasis on objective, although essentially tacit, requirements of work.

6. SUMMARY AND CONCLUSIONS

6.1 Summary

This paper has analysed two sets of assumptions in eight ISD approaches: the organizational role of information system and the view of information requirements. In the former case, the paper distinguished three alternatives - technical, sociotechnical and social views of the organizational role of IS - and in the latter case again three alternatives - objective, subjective and intersubjective views. The findings of the paper indicate that IM and DSS among the established traditions have a fairly technical-mechanistic view of the organizational role of information systems, while the view of the STD approach is sociotechnical. The Infological approach seems to reflect all the three views. The four emerging approaches, the Trade Unionist approach as the only exception, emphasize the social nature of an information system, forming in this respect a striking contrast to the established approaches (cf. Table 4).

In the case of information requirements, the established traditions were dominated by the objective and/or subjective views; the intersubjective nature of information requirements was largely omitted. Among the emerging approaches, the SA-based approach and SSM to a lesser extent differed in their emphasis on intersubjectivity (cf. Table 5).

6.2 Conclusions

It could be concluded that the newer, emerging approaches arose because the established traditions failed to deliver on their stated promises (cf. [63, 64]). Indeed, the emerging approaches have adopted very different sets of assumptions in an attempt to overcome the limitations of the "orthodox" approaches.
Whilst many in the field may know of the existence of these "emerging approaches", precisely how they differ - fundamentally and conceptually - is not widely known. This then is one of the key contribution of the paper - to show how they differ.

The results of our analysis can be expected to be of interest from three angles: 1) from the viewpoint of IS research and theory, 2) from the viewpoint of IS practice, and 3) from the viewpoint of IS education. Before proceeding into them, let us summarize the significance of the paper from the latter two points. The paper pointed out that the alternative views on the two assumptional dimensions have implications that can be expected to also have practical relevance (see Tables 1 and 2). These implications are currently mediated to practice by ISD methodologies, techniques and tools reflecting the approaches. Because of the findings concerning the established traditions were primarily based on widely used textbooks, they are of importance from the viewpoint of IS education, since the underlying assumptions are transmitted to future IS professionals through education. Because of the above two-way influence on practice, we contend that the prevailing assumptions need to be critically reflected upon.

The paper makes several contributions to IS research and theory. Firstly, the interpretations of the two assumptional dimensions in Figures 1 and 2 provide bridges from the classical philosophical dimensions of nominalism vs. realism and voluntarism vs. determinism (see [21]) to more concrete IS specific concepts. Secondly, the distinctions between the two sets of views extend earlier frameworks and allow a more refined analysis and understanding of ISD approaches and methodologies. For example, many articles in the book of Jirotka and Goguen, [75], on requirements engineering apply a broad interpretation of the sociotechnical systems, covering both the sociotechnical and social views above. Even though the interpretations of the “technical” and “social” vary in the sociotechnical tradition, especially when sociotechnical ISD approaches are included [107], the sociotechnical tradition views the distinction between the two subsystems as unproblematic. Woolgar [133], however, recognizes that this may be fallacious. In the case of information requirements, we wish to note that the intersubjectivity of information requirements is not widely recognized. Intersubjectivity based on social agreement has fundamental implications in the sense that it questions the possibility of complete requirements. Thirdly, the frameworks summarized in Figures 1 and 2 direct attention to the potentially emergent nature of the social meaning of information systems and information requirements, shaped in the social interaction of users, in their work to be supported by an information system. Emergence naturally leads to the problem of IS evolution, partly as the continued social construction of the meaning of the system by users and other stakeholder groups and partly as the continued need to develop the system to better satisfy the changed requirements. Fourthly, as pointed out above, the analysis helps to understand the underlying assumptions of the eight approaches. Even though the analysis of the established traditions was mainly based on textbooks, we contend that the findings can be expected to reliably reflect the assumptions made by the mainstream research in each of those traditions. However, the results are based on a qualitative interpretation of the texts documenting the selected ISD approaches. Therefore, the results summarized in Tables 4 and 5 should be interpreted not as absolute facts but summaries which indicate the orientations of the approaches. Fifthly, we believe that the emerging approaches indicate the future trends of ISD approaches and methodologies towards a richer understanding of the social nature of information systems and a more intersubjective view of information requirements.

When claiming that ISD approaches are evolving towards a richer understanding of the social nature of information systems and a more intersubjective view of information requirements, we do not suggest that the alternative views are categorically wrong, only that they are biased. We accept that different assumptions concerning the organizational role may be justified in the case of different information systems; for instance a technical view may be totally warranted in the case of a personal information system, but the important point is that most information systems are organizational in the sense of supporting, implementing and/or constituting organizational activities. The more complex these information systems are in their relationships with the host organization, the more relevant the social view becomes. In the case of information requirements, we do not consider the three views mutually exclusive; they can be applied co-existently, different information systems emphasizing the views differently. For example, the subjective view may dominate a personal decision support system, and an objective view may be highly relevant in a case of a routine operational-level information system, supporting some well-defined organizational activity or a well-understood application area. Consider the Air Traffic Control system case discussed in [13] and [115]. It appears that the core information requirements of the Air
Traffic Control systems are objectively determined (e.g., information about airplanes, flights, etc). Their ethnographic analysis of this case indicated, however, the significance of subtle, often implicit, cooperation as central to the functioning of the system, the significance of intersubjective 'at a glance' understanding of controllers' displays as essential for the controllers' work, and the danger of personal tailorability of the system.

The evolution of ISD towards a richer understanding of the social nature of information systems and more intersubjective view of information requirements is partly explained by technological developments and the evolution of application areas to cover knowledge work (e.g., CSCW). Information systems are increasingly organizational and interorganizational communication systems. Such communication systems, by definition, necessitate an increasing attention to the intersubjectivity of communication. The established traditions largely do not provide such attention. The four newer approaches, which are stronger in addressing these issues, are however, incomplete as ISD methodologies. This poses a considerable challenge to the further development of ISD approaches and methodologies. We hope this paper paves the way for such future work.

REFERENCES


