Towards a distinctive body of knowledge for Information Systems experts: coding ISD process knowledge in two IS journals

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Abstract. This paper introduces the idea of coding a practically relevant body of knowledge (BoK) in Information Systems (IS) that could have major benefits for the field. In its main part, the paper focuses on the question if and how an underlying body of action-oriented knowledge for IS experts could be distilled from the IS research literature. For this purpose the paper identifies five knowledge areas as the most important parts for an IS expert’s BoK. Two of these are claimed as distinct areas of competence for IS experts: IS application knowledge and IS development (ISD) process knowledge. The paper focuses particularly on ISD process knowledge because it allows the organizing of practically relevant IS knowledge in an action-oriented way. The paper presents some evidence for the claim that a considerable body of practically relevant IS process knowledge might, indeed, exist, but also notes that it is highly dispersed in the IS literature. It then argues that the IS research community should take stock of this knowledge and organize it in an action-oriented way. Based on results from prior work it proposes a four-level hierarchical coding scheme for this purpose. In order to test the idea of coding action-oriented knowledge for IS experts, the paper reports the results of a coded literature analysis of ISD research articles published from 1996 to 2000 in two leading IS journals – Information Systems Journal and MIS Quarterly. The results suggest that ISD approaches form a useful framework for organizing practically relevant IS knowledge.

Keywords: information system, expert, competence, professionalization

1. INTRODUCTION

It is common for applied disciplines, especially established ones, to possess a body of knowledge (BoK). Applied disciplines such as Medicine, Law, Engineering, and Accounting have
established such a BoK, which codifies the accumulated knowledge of the discipline. Recently, the Software Engineering (SE) community proposed a guide for a SE BoK (SWEBOK, 2000). But what about the field of Information Systems (IS)? Because it is widely accepted that IS is an applied discipline (Keen, 1987; Benbasat & Zmud, 1999; Markus, 1999), should the field not have its own BoK? There has been – at least to us – surprisingly little discussion about the nature and feasibility of a practically relevant BoK. In this paper, we propose that the concept of a documented BoK supported by IS research is worth investigating in its own right for at least three important reasons.

First, from a theoretical perspective, it could revitalize the past discussion on the lack of a cumulative tradition in IS. Like other academic disciplines, IS has been driven by the dynamics of its own internal academic traditions. In the 40-year, or so, history of the field, significant growth can be observed. For example, with regard to research, a pluralism of fundamental philosophical perspectives has emerged (i.e. multiple paradigms), which is accompanied by an ever-growing sophistication of research methods. The subject matter of IS research has similarly become rich and diverse. Yet this diversity has led some to question whether IS research has any real accumulative tradition (Keen, 1980; Wand & Weber, 1990; Benbasat & Zmud, 1999). Given that pluralism has become the governing principle for most of our newly founded research institutions, the idea of cumulatively building on each other’s results must not be simply abandoned, but recast in the context of different paradigmatic streams of research, which can contribute to both the theory and practice of IS. Surely if we are all interested in contributing to practice, we as a research community have a clear need for cross-paradigmatic interaction, regardless of our philosophical biases. The Banville & Landry (1989) proposition that the community structure of IS research resembles most closely that of a ‘fragmented adhocracy’ points to both the urgency and difficulties of maintaining a productive debate across the many research subcommunities that have evolved in our field over the years. The shared development of a practically relevant BoK could address one major crisis symptom in the field, that is, the fragmentation of IS research (Hirschheim & Klein, 2003) through more boundary-spanning debates across the fragmented adhocracy. Such debates would stimulate the evolution of terminology for coding the practically relevant BoK. The emerging coding system would tie the concepts and principles of the relevant BoK to an ongoing practice, in which we are all interested regardless of our preferred academic vocabularies. It should be noted that such a coding system, when properly conceived, would promote mutual understanding and coherence of the field while avoiding dogmatic unification. Such unification is undesirable because it entails the removal of one of the pillars of the field – pluralism (Hirschheim & Klein, 2003).

Benbasat & Zmud (1999) note the lack of a cumulative tradition as one key problem for the field, identifying three reasons for it. First, a multiplicity of theoretical frames exists for most phenomena studied in IS. Second, IS researchers/scholars have been reluctant to build on each other’s work. This is partly an outcome of the lack of a shared language. Third, because of the proliferation of IS journals, it is becoming harder and harder to locate and access the work of others. This paper attempts to promote the cumulative tradition in IS by suggesting a shared language (a coding scheme) for one particular area of IS experts’ BoK, viz. ISD process knowledge. The coding scheme makes it possible to organize findings from different sources. At the same time, it respects the multiplicity of theoretical frames (ISD approaches) that can be applied.
Second, a documented BoK is a necessary condition for IS to achieve a recognized status as an applied discipline, and eventually, a profession. Various definitions of professions all emphasize the existence of a recognized, science-based BoK, the mastering of which requires the combination of academic training with experiential, supervised learning (articling, medical internship, etc.). As noted above, the SE community worked on SE BoK (SWEBOK, 2000) as a part of its effort to establish SE as a profession with associated education, accreditation, certification and licensing practices. It is beyond the scope of this paper to attempt to evaluate the details of the SWEBOK proposal. Even though McConnell & Tripp (1999) report that some states in the USA, and parts of Canada, have started the licensing of professional software engineers, it is an open question whether the professionalization project will succeed. However, the specification of the BoK need not be associated so closely with professionalization and its related politics.

Third, the documentation of a practically relevant BoK would be a very valuable resource for teaching regardless of whether one wishes to advocate institutionalized professionalization in the future or not. It would not only help to improve the processes by which practitioners build and use IS, but also improve the quality of IS experts and their clients through better, professionally guided education and training. The BoK would help to guide the academic community regarding what it should teach and to whom. It could also help textbook writers do a better job of summarizing IS research in a more meaningful fashion.

In order to promote the idea of a BoK, this paper has three principal purposes. The first is to establish a working concept for what we mean by a BoK. The second is to develop a preliminary way of testing whether IS research in principle has produced an action-oriented BoK that could inform practice if it was made more accessible. By action-oriented knowledge, we mean knowledge about alternative action options (e.g. knowledge of alternative ways of developing IS) and knowledge explicitly linked to the action options for supporting effective action. The third is to clarify whether such a BoK exists, or could exist, that is in any way distinct to IS. What we mean here is that the results of IS research do not just duplicate findings in some of its sister disciplines such as SE. This will require us to carefully compare whether IS research has produced a BoK that is different from the SE BoK (cf. SWEBOK, 2000). Because of the complexity of these questions, we cannot hope to define all aspects of a BoK in this single paper. We expect that the full meaning of the concept of a BoK can only be established through widespread debate that has, at best, only recently started.

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2 Macdonald (1995, p. 1) defines professions as: ‘occupations based on advanced, or complex, or esoteric, or arcane knowledge’. Zwerman (1999, p. 66) identifies the ‘exclusive command of systematic esoteric BoK, as the single most important defining characteristic of professionals’ and Abbott (1988) notes that ‘Despite their substantive differences . . . all agreed that a profession was an occupational group with some special skill. Usually this was an abstract skill, one that required extensive training. It was not applied in a purely routine fashion, but required revised application case by case’ (p. 7).

3 Note, however, that ACM has taken a decision to oppose the licensing of software engineers considering it as premature (Bagert & Mead, 2001), even in the context of safety-critical systems (Knight & Leveson, 2002). We believe that this opposition is more against the professionalization effort than the concept and content of SWEBOK itself.

4 The idea of an action-oriented BoK is discussed in Section 2.
For example, according to the IS 2002 Model Curriculum (Gorgone et al., 2002), IS as an academic discipline encompasses two broad areas: (1) acquisition, deployment, and management of IT resources and services (the IS function) and (2) development, operation, and evolution of infrastructure and systems for use in organizational processes (system development, system operation, and system maintenance). Applying this distinction we shall limit ourselves to a BoK for the latter, that is, systems development (but including operation and maintenance) for four reasons. First, we feel that the focus on IS development (ISD) is a good choice to test whether the development of an action-oriented BoK is feasible, because it has the longest history in IS. Since its emergence in the 60s (e.g. Langefors, 1966; Rosove, 1967; Blumenthal, 1969), the IS community has developed a considerable body of research literature related to information systems. Second, we contend that ISD forms a common theme across different types of systems and related IS specializations. Third, we claim that the core of the work of IS experts as practitioners is to develop and maintain information systems or to manage their development and maintenance. Fourth, we suggest that ISD process knowledge allows one to organize the practically relevant IS knowledge in an action-oriented way as will be demonstrated in Section 3.

In order to indicate the broad focus of research on ISD, we shall use ‘IS expert’ or ‘IS specialist’ as general terms to refer to people with a deep understanding of information systems and their development. By ‘IS developer’, we refer to the occupation of people developing information systems. The work of ‘IS experts’ is not necessarily confined to ISD as they may also serve as managers, administrators, consultants, educators, and researchers. IS experts may also work in the development of other computer artifacts such as embedded computer systems, which traditionally have not been viewed as information systems. Conversely, people who are not experts in information systems may also develop information systems, which is typically the case with end-user systems development. Hence what we are concerned with in this paper is a BoK that is, at least in some aspects, research-based and which could improve the qualifications of IS experts to take effective action. In our case we are concerned with actions that IS experts should take when striving to build high quality systems. In short, we refer to this kind of knowledge as an action-oriented BoK that could inform practice if it was made more accessible.

In order to address the issues raised above, the paper proceeds by answering the following six related research questions.

What are the knowledge areas making up the body of knowledge for IS experts?

As alluded to above, there has been something of a parallel development in SE. The ACM and IEEE Computer Society have proposed a joint project to define SE as a profession and produced a guide for a SE BoK (SWEBOK, 2000). The SWEBOK proposal notes 10 knowledge areas: software configuration management, software construction, software design, software engineering infrastructure, software engineering management, software engineering process, software evaluation and maintenance, software quality analysis, software requirements analysis and software testing. We believe these knowledge areas are insufficient for IS experts. Reflecting the broader focus of IS, this paper proposes five knowledge areas that make up the
BoK for IS experts: technical knowledge, application domain knowledge, organizational knowledge, IS application knowledge, and ISD process knowledge. These will be explained in more detail in Section 2.

What are the distinctive knowledge areas of IS experts?

When contrasted with related disciplines such as Computer Science, SE, and Organizational Science, we suggest that two distinctive knowledge areas exist: IS application knowledge and ISD process knowledge, which will be elaborated in Section 2. An analysis of the 10 knowledge areas listed in SWEBOK (2000) shows that they include little, if any, knowledge about applications.

The paper will select ISD process knowledge for a more detailed examination. The choice reflects our desire to focus on the action-oriented knowledge implied by ISD process knowledge. This focus leads to the additional question:

What are the distinctive ISD process competencies of IS experts?

In Section 2.2 we contend that the distinctive competence of IS experts lies in their: (1) expertise of aligning IT artifacts with the organizational and social context in which the artifact is to be used; (2) identifying and specifying the needs of people who are supposed to use the system (user requirements construction); (3) organizational implementation; and (4) evaluation/assessment of these artifacts and related changes. SWEBOK – by large – ignores these competences or treats them one-sidedly.

In the case ISD process knowledge, our interest also lies in how to structure such knowledge. This leads us to our next research question:

How can ISD process knowledge be organized?

Section 3 proposes a coding scheme that is based on a comprehensive list of performance and management processes in ISD (Andersen et al., 1990). ISD approaches (Iivari et al., 1998; 2000–2001) are seen to provide alternative and complementary knowledge of how to conduct those processes. The approaches provide multiple perspectives to ISD as called for by Benbasat & Zmud (1999), allowing the organizing of ISD process knowledge in a coherent manner without forcing unnecessary ‘unification’ (Hirschheim & Klein, 2003).

We pilot test the coding scheme in Section 4 by applying it to the analysis of 118 research articles selected from two leading IS journals – Information Systems Journal (ISJ) and MIS Quarterly (MISQ). This pilot study allows us to give tentative answers to the following additional question.

How are the distinctive ISD competencies of IS experts addressed in the IS research literature?

Benbasat & Zmud (1999) point out that it is not enough that a research article addresses a relevant topic; its implications should also be implementable. They further suggest the need for synthesizing the existing BoK and stimulating critical thinking. Based on these we also attempt to evaluate:
How implementable, systematic and insightful is the ISD process knowledge emanating from the IS research literature?
We will discuss these two latter questions in Section 4.

2. INFORMATION SYSTEMS BODY OF KNOWLEDGE

2.1 Knowledge areas in information systems development

Articulating what could be the knowledge areas for IS experts is undoubtedly a controversial proposition. It has been explored, either implicitly or explicitly, in numerous IS publications. Perhaps the most visible attempts at articulating the knowledge areas for IS are the IS curriculum reports, papers, and books that have appeared over the past 30 years (cf. ACM, 1968; 1979; Nunamaker et al., 1982; Buckingham et al., 1987; Couger, 1973; Gorgone et al., 1994; Couger et al., 1997; Gorgone et al., 2002). The most recent ones (Couger et al., 1997; Gorgone et al., 2002) suggest an IS BoK consisting of three major subject areas: Information Technology, Organizational and Management Concepts, and Theory and Development of Systems. These are further divided into 29 sub-areas and into more than 400 knowledge elements (Davis et al., 1997).

Even though detailed, these proposals for undergraduate level IS programs naturally focus on basic subject areas that an IS student should know and basic skills that he or she should master. We see that an IS BoK is broader and deeper than the ones articulated in those curriculum proposals. They also fail to identify and focus on distinctive knowledge areas of IS experts. For example, about half of the detailed knowledge elements in the IS‘97 BoK concern Information Technology. Another weakness is that the curriculum proposals consider the knowledge areas without a clear conceptualization of the ontological domains to which they refer.

In the following we propose five knowledge areas in the IS BoK, founding them on five ontological domains depicted in Figure 1. The ontological domains are reified social constructions that exist independently of any individual perceptions of them. They represent the underlying social constructions embodying ISD and concomitantly, the intersubjective knowledge about them. The first three knowledge areas are adapted from Freeman (1987), who distinguishes technology knowledge, application domain knowledge, and systems development process knowledge. Technology knowledge refers to knowledge associated with understanding the types of hardware and software available and how and where they might be applied. Application domain knowledge refers to knowledge about the application domain for which an information system is built. For example, in the case accounting information systems, the application domain knowledge relates to accounting concepts and principles. Systems development pro-

5The term ‘knowledge element’ is misleading in the sense that ‘knowledge elements’ in IS‘97 are detailed subject areas for pigeonholing detailed knowledge rather than knowledge elements of the IS BoK themselves. This does not preclude one from considering the classification of hierarchy of the three subject areas, 29 sub-areas and more than 400 sub-sub-areas to be part and parcel of the IS BoK.

6We refrain here from grounding these distinctions in the philosophical literature on alternative ontologies in the social sciences, but are most influenced by Habermas’s (1984) three world ontologies.
cess knowledge refers to the tools, techniques, methods, approaches and principles used in systems development.

To these three, Jones & Walsham (1992) would add a fourth: organizational knowledge, which they see as distinct from application domain knowledge. Organizational knowledge is knowledge ‘about the social and economic processes in the organizational contexts in which the IS is to be developed and used’. An important part of organizational knowledge is the work processes in the organizational context to be supported by the IS (cf. Kuutti, 1991; Alter, 2001). These four types of knowledge appear to miss the knowledge of IS application systems. Therefore, we add a fifth category, IS application knowledge. This is the knowledge about typical IT applications, their structure, functionality, behavior and use, in a given application domain. It includes the knowledge of possibilities to support activities in the intra- and interorganizational context by IS applications in a specific application domain. To sum up, we posit five knowledge areas, which correspond to five socially constructed ontological domains: technical knowledge, application domain knowledge, organizational knowledge, IS application knowledge, and ISD process knowledge.

We do not assume that the five knowledge areas are completely independent, but rather that each area logically, practically and historically can draw on more than one domain to create new meanings. For example, one cannot meaningfully talk about the ISD process without some knowledge of IS applications, nor about an IS application without some knowledge of an application domain. From a practical viewpoint, no IS application (e.g. a computer-based accounting control system) could be developed without drawing on the inner four ontological domains (ISD process, IS applications, technology and applications domains). However, systems development experts could differ dramatically in the degree to which they are able bring to bear knowledge about the organizational ontological domain with likely consequences for systems success (Vitalari, 1985; Mathiassen & Purao, 2002). During their historical evolution, the five knowledge areas all have influenced each other. For example, the intra- and interorganizational

![Diagram of the five ontological domains](image-url)
context (e.g. globalization) and the application domain knowledge (e.g. business domains vs. scientific-computing domains) all have influenced ‘technology’ in Figure 1 (e.g. globalization on data communication networks; application domains on programming languages such as COBOL and FORTRAN). Similarly, technology has influenced the intra- and interorganizational context knowledge (e.g. globalization and virtual and network organizations). Despite these interdependencies, the ontological foundation of the five knowledge areas is, relatively speaking, the most stable conceptual foundation of the proposed knowledge categorization.

To illustrate the knowledge areas and their differences Table 1 takes a specialized application area – oil exploration. IS application knowledge embodies knowledge of typical IS applications. One application type of oil exploration is an information system that comprises geoscientific data about the oil fields to be explored. In this case the application domain knowledge includes the geology, geophysics and geochemistry of the oil fields. This knowledge of the field is quite different from the intraorganizational knowledge procedures of oil exploration, even though the raw data is produced by the oil exploration procedures (drilling, chemical analyses, etc.). Technology knowledge refers to the technology that can be used to implement the IS application – computer hardware, operating systems and other systems software, data base packages and other middleware, etc.

IS development process knowledge covers knowledge of alternative ways of developing the IS application. This can take place in-house; this can be outsourced; or this can be done using application packages (such as ROCKWARE™; http://www.rockware.com).

Organizational knowledge refers to the business and work processes supported (‘automated’ or ‘informed’) by the application (by the oil field’s information system) as well as other organizational processes such as organizational politics associated with the IS application and its development. The organizational domain also covers human beings as actors (the users, developers, managers) involved in ISD and use. Depending on the application domain, some of the human beings may also belong as objects to the application domain (as in the case of the payroll system). Note that the organizational knowledge is not confined to the intraorganizational sphere, but also covers interorganizational issues, recognizing for example that some IS developers and users may reside outside the confines of the formal organization (e.g. government agencies who monitor oil exploration activity).

For some types of applications the differences between the five knowledge areas are quite analytical and not always so clear. For example in managerial accounting, it may be difficult to

| Table 1. An example of the knowledge types for oil exploration in an oil company |
|---------------------------------|-------------------------------------------------------------------------------------------------------------|
| Technology knowledge           | Computers, operating systems, peripherals, telecommunication and security systems to be used in the implementation of all application software for analysing data from oil exploration activities |
| IS application knowledge       | Possible functionalities of application software used to record and model oil field data                     |
| Application domain knowledge   | The geology, geophysics and geochemistry of potential oil fields                                            |
| Organizational knowledge       | Oil exploration procedures; the general organizational policies governing the oil exploration; performance monitoring rules; organizational reporting structures; organizational politics. |
| ISD process knowledge          | In-house or outsourced, application-package-based development (e.g. ROCKWARE™)                             |

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separate the application domain knowledge of accounting concepts and principles from the intraorganizational context knowledge of accounting work practices. Nevertheless, the distinction does have practical relevance, as can be seen through reusable domain models (Prieto-Diaz & Arango, 1991; Krueger, 1992) and application packages (Sawyer, 2000). Typically, the application domain knowledge is not very organization-specific (cf. organizational knowledge), because the same central concepts and principles of the application domain (e.g. geoscientific concepts in the case of oil fields) can be identified in many organizations, for example, all companies engaging in oil exploration. This ‘generality’ of application domain knowledge naturally explains the success of generic application packages (such as ROCKWARE™). The integrated Enterprise Resource Planning application packages also remind us that an IS application may cover a number of application domains such as accounting, production, control, HR, customer relationship management, etc.

When compared with the three knowledge areas in IC’97 (Couger et al., 1997) it is clear that application domain knowledge is missing in the IC’97 list. In view of the variety of the application domains of IS, this is understandable because it is impossible to teach the concepts of all application domains. On the other hand, it is significant to keep in mind that application domain knowledge has been found to be critical in software development (Curtis et al., 1988).

Bacon & Fitzgerald (2001) propose an alternative framework for the field of IS, comprising five interrelated areas: Information and Communication Technology; People and Organization; IS Development Acquisition and Support; Operations and Network Management; and Information for Knowledge Work, Customer Satisfaction and Business Performance. The first two correspond closely to the technical knowledge and organizational knowledge of our framework. Our ISD process knowledge largely covers the next two areas. Our IS application knowledge in the sense of application types is included in the IS Development Acquisition and Support area, and e-commerce in the Information and Communication Technology area. Application knowledge can be interpreted to be included in People and Organization area (especially types of usage or industry). The area of ‘Information for Knowledge Work, Customer Satisfaction and Business Performance’ in Bacon & Fitzgerald (2001) is an amalgam of several aspects. These aspects are the nature of data, information and knowledge (generic knowledge about IS applications), use in organizations (organizational knowledge), human–computer interface (IS application knowledge), information relevance, value and cost (ISD process knowledge: IS evaluation), data quality (ISD process knowledge: IS evaluation), knowledge management and organizational learning (organizational knowledge).

2.2 Distinctive knowledge of IS experts

About half of the detailed knowledge elements in the IS’97 BoK concern Information Technology. This leads to the question of whether an IS BoK specification should reflect more those

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7 Some application knowledge is included in one of the 12 sub-areas of Theory and Development of Systems (sub-area: Systems Development for Specific Types of Information Systems).

8 Other frameworks suggesting knowledge areas for the field can be found in Barki et al.’s (1988) keyword classification; Swanson & Ramiller’s (1993) study of what IS researchers write about; and Culnan’s (1986; 1987) co-citation analyses.
competence areas that are distinct for IS. If so, this leads to the additional question: ‘What is the distinctive knowledge of IS experts?’ It cannot be in the technical knowledge where experts in Computer Science and SE are likely stronger. Neither can it be in the application domain knowledge where people working in the application domain are likely more knowledgeable. It is the same situation with organizational knowledge. The only remaining candidates are IS application knowledge and ISD process knowledge. Even though we suggest these two as distinctive knowledge areas for IS experts, we do not deny the significance of the remaining three in ISD. On the contrary, there can be no doubt about the importance of technical knowledge, and there is also ample evidence about the significance of application domain knowledge (Curtis et al., 1988) and organizational knowledge (Vitalari, 1985; Mathiassen & Purao, 2002). However, the latter two are not distinctive for IS experts.

In the following we will focus only on ISD process knowledge for two reasons. First, we believe that the core of the work of IS experts as practitioners is to develop and maintain information systems or to manage their development and maintenance. Second, we suggest that ISD process knowledge allows the organizing of practically relevant IS knowledge in an action-oriented way, as will be demonstrated in Section 3. Therefore much of the application knowledge could and should be linked with the ISD process in order to make it action-oriented. This is why this paper takes the viewpoint that ISD process knowledge is central.5

Referring to ISD process knowledge, we have previously (Iivari et al., 2001) claimed that the distinctive competence of IS experts lies in their: (1) expertise of aligning IT artifacts with the organizational and social context in which the artifact is to be used; (2) identifying and specifying the needs of people who are supposed to use the system (user requirements construction); (3) the organizational implementation; and (4) evaluation/assessment of these artifacts and related changes.10 We use the notion IT artifacts instead of traditional IS because many software artifacts, which are not considered traditional IS, comprise more and more features that resemble IS. Consider, for example, an embedded computer system in a mobile telephone. As the functionality of these systems expands, the embedded software not only implements some of the necessary functions of the telephone in contrast to hardware implementation, but the software provides a number of auxiliary services to users of the mobile phone. The usefulness of these auxiliary services can be assessed only against users’ needs.

1 The alignment of IS plans with organizational objectives – or more recently, the converse – has consistently been reported among the key concerns of IS managers and business executives (e.g. Brancheau et al., 1996). This is despite the concerns of Reich & Benbasat (2000)

9To take an analogy with the medical profession, we see the development and maintenance as the core of the work of IS experts as the diagnosis and treatment of patients is the core of physicians. To continue the analogy, a physician may have knowledge of a human being (and its organs) as biological, physiological, chemical, psychological phenomena (application knowledge). If he is not (effectively) able to link these knowledge constituents to the diagnosis and treatment of patients (process knowledge), he is not able to apply the former knowledge in his work. Hence action-oriented process knowledge is critical.

10We make a distinction between the first two because organizational alignment and user requirements construction may be quite distinct activities, for example in an ISD project involving business process redesign or re-engineering.
who suggest that there is no comprehensive model for this ‘alignment’ construct. It is beyond the scope of this paper to discuss the concept in detail. Our only point is that we interpret alignment differently. To us, it reflects the ‘fit’ of an IT artifact (see Iivari, 1992), an information system or a software product, with the organizational and social context of its use rather than the ‘fit’ between IS plans and organizational objectives. From our perspective, the alignment of an IT artifact and its social context is usually a continuing process rather than a one-time decision as illustrated by Majchrzak et al. (2000). Our major interest here lies in the process of aligning. There is a rich body of literature within IS that addresses the issue of making an information system ‘fit’ its organizational and social context (Iivari et al., 1998). Moreover, one can observe that the issue of IS alignment is ignored in the SE tradition.

2 Requirements construction continues to be the major bottleneck in ISD. It is, of course, one of the knowledge areas in SWEBOK (2000). It is beyond the scope of this paper to explore how requirements construction is understood in various communities. We only wish to emphasize the richness of approaches to requirements construction identifiable in the IS and SE communities (Jayaratna, 1994; Jirotka & Goguen, 1994; Iivari & Hirschheim, 1996; Kotonya & Sommerville, 1998).

3 Organizational implementation refers to the implementation research tradition in IS. The problem of organizational implementation is totally neglected in SWEBOK despite the fact that organizational implementation is often problematic (Alter & Ginzberg, 1978; Keen, 1981; Swanson, 1988).

4 Evaluation/assessment of IT artifacts refers to the formal and informal evaluation of information technology artifacts and/or IS projects. This too is largely ignored in SWEBOK even though it is an area richly explored by the IS field (Bjørn-Andersen & Davis, 1988; Delone & McLean, 1992; Farbey et al., 1993; Smithson & Hirschheim, 1998).

The above working definitions support our contention that the distinctive feature of ISD methods and approaches, when compared with SE methods, is that they handle or at least recognize the organizational alignment process. We identified a number of ISD approaches and traditions with their numerous method instances that explicitly or implicitly address the organizational alignment of IS (Iivari et al., 1998). We therefore conclude that ISD approaches and methods provide an action-oriented framework for condensing and packaging the IS community’s collective understanding of organizational alignment (as defined above) and requirements construction.

3. A CODING SCHEME FOR ISD PROCESS KNOWLEDGE

3.1 A framework for ISD process knowledge

The extensive IS literature suggests that the IS community, during its 40 years, or so, of history has developed a considerable BoK concerning the process of ISD. Much of this knowledge concerns ISD methods, techniques, tools and approaches. On the other hand, one would expect that IS research has also distilled more substantive recommendations concerning the
These findings typically concern specific aspects that should be taken into consideration when building an IS. The following are three simple examples: (a) ‘When marketing IT and when considering its effects, managers should consider the gender of their users, no less than their ethnicity’ (Gefen & Straub, 1997); (b) ‘Trainers . . . may wish to emphasize usefulness issues for men, while offering women a more balanced analysis that includes productivity aspects, process issues, and testimonials from peers and superiors’ (Venkatesh & Morris, 2000); (c) ‘CTs should be designed to allow changes in any initial coordination protocols as the team’s relationships and understandings evolve’ (Majchrzak et al., 2000).

One obvious problem of taking stock of the existing ISD process knowledge is a proper knowledge representation scheme. The simple textual representation of the BoK as in SWE-BOK (2000) may not be the best way of illustrating the complexity of the BoK. The representation problem is more acute in IS because of the very large number of ISD methods. Even though the variety of ISD methods may be condensed into a more reasonable number of ISD approaches, it is clear that one cannot expect one canonical ISD approach in IS. One reason is the variety of information systems to be developed. On the other hand, it is also clear that different ISD approaches also share many features. Therefore, in the following two subsections we will outline a two dimensional framework for ISD process knowledge representation. One dimension consists of a list of ISD performance and management processes (Andersen et al., 1990). The other dimension consists of the hierarchy of ISD techniques, methods, approaches, and paradigms taken from livari et al. (2000–2001) and briefly summarized in subsection 3.3.

Our rationale is based on the idea that ISD techniques, methods and approaches provide more or less comprehensive support for the process of ISD.\(^{1}\)

The purpose of this section is to sketch some basic ideas suggesting how an inventory of ISD process knowledge could be extracted from the IS literature and documented in a concise and precise format. The framework will be pilot tested in Section 4.

### 3.2 ISD processes

Andersen et al. (1990) proposes a method-independent view of the ISD process that distinguishes product-oriented and process-oriented views of systems development. They call the product-oriented view ‘systems development performance’ and the process-oriented view ‘systems development management’. Based on this distinction, Table 2 lists a number of ISD performance processes and ISD management processes. The initial list of ISD performance and management processes derived from the extant literature was modified based on the results of our analysis, which is described in Section 4. Admittedly, the list is incomplete.

As most of the processes in Table 2 are sufficiently self-explanatory, we will only discuss those that may require some explanation. Supplier management refers to the selection, contracting, cooperation and other relationships with possible vendors of required hardware and/or software, possible subcontractors responsible of the outsourced development of some parts

\(^{1}\)Of course, this is only a working assumption acceptable for a pilot study to demonstrate the concept of a codable BoK. For a truly practically relevant BoK only those ISD techniques, methods, approaches, and paradigms should be included for which there is some corroborating evidence that they are indeed judged useful by knowledgeable practitioners.
of the system, and possible consultants providing knowledge and expertise required in the ISD process. Methodology management refers to the selection, tailoring, use and evaluation of appropriate tools, techniques, methods, approaches and paradigms in the ISD process. Performance management includes scheduling and budgeting ISD performance and ISD management processes, controlling that they are performed according to schedules and budgets, and in the case of deviations, taking corrective actions.

### 3.3 ISD approaches

Elsewhere (Iivari et al., 2000–2001), we introduced a four-tiered framework for ISD process knowledge. It distinguishes ISD techniques, methods, approaches, and paradigms. Paradigms relate to the basic philosophical assumptions that guide our interpretation of reality. Approaches embody a set of related features that drive interpretations and actions in ISD. They are interpreted as a class of specific ISD methods that share a number of common features. Methods within an approach share similar goals, guiding principles, fundamental concepts, and principles of the ISD process (Iivari et al., 1998). The fundamental concepts of an approach may emphasize processes (such as Structured Analysis and Design), data (Information Modeling), objects (Object-Oriented), and others alike. Principles of the ISD process cover alternative process models such as the linear waterfall, prototyping, evolutionary development, spiral models, etc.

An ISD method is interpreted as an organized collection of concepts, techniques, beliefs, values, and normative principles supported by material resources. A technique consists of a well-defined sequence of elementary operations that more or less guarantee the achievement of certain outcomes if executed correctly. The framework includes an inheritance structure in which each ISD approach inherits the paradigmatic assumptions of the paradigm it represents. Similarly, each ISD method inherits the features of the ISD approach (including its goals, guiding principles and beliefs, fundamental concepts, and principles of the ISD process), and the paradigmatic assumptions of the paradigm it represents indirectly through the ISD approach to
which it belongs. In sum, paradigms may be concretized into approaches and approaches into methods with constituent techniques. Techniques are the most detailed and elementary items of process knowledge. They can be incorporated into more than just one ISD method. Figure 2 illustrates the resultant structure.

Mathiassen (1981) points out that each systems development method has a more or less limited area of application. Generalizing this idea, we divide ISD approaches into application area-independent and application area-dependent. The application area-dependent approaches are confined to a special application area such as transaction processing systems, decision support systems, groupware systems, interorganizational systems, etc. The application area-independent approaches, on the other hand, are general in the sense that they are not confined to any special application category but are applicable to any application area. In our previous works (Iivari, 1991; Iivari et al., 1998) we identified 11 ISD approaches; 10 of which (i.e. Structured Analysis & Design, Information Modeling, Socio-Technical Design, Informational, Object–Oriented, Interactionist, Speech Act-based, Soft Systems Methodology, Professional Work Practice and Trade Unionist) are application area-independent ISD approaches. The Decision Support Systems approach was the only application area-dependent ISD approach identified in Iivari et al. (1998; 2000–2001). It was recognized that the list of ISD approaches identified in these papers was not exhaustive. As emphasized in Iivari et al. (2000–2001), the framework is dynamic, allowing the incorporation of new methods and approaches. For example, Figure 2 includes (for illustration purposes) two more recent ISD (or software development) approaches: open source development (Feller & Fitzgerald, 2002) and agile development (Abrahamsson et al., 2003) with associated methods such as XP (Beck, 2000) and DSDM (Stapleton, 1997) in the case of the agile approach. Based on our literature analysis in Section 4, we will also extend the framework to comprise the development of groupware systems, interorganizational information systems, knowledge management support systems and geographical information systems to name just a few.

We believe that our framework of ISD paradigms, approaches, methods and techniques is an ISD knowledge representation scheme that allows us to classify and understand the myriad ISD methods proposed in the literature. As described in Iivari et al. (2001) the framework is also dynamic, allowing easy incorporation of new methods and approaches. This is important as von Krogh & Roos (1996) propose scalability as a significant property of an effective knowledge coding structure. The resultant knowledge structure should resemble a classification tree that allows us to make finer and finer distinctions. The framework in Figure 2 allows for a gradual concretization of ISD process knowledge. Paradigms may be concretized into approaches and approaches into methods with constituent techniques. On the other hand, our framework forms only a skeleton for action-oriented ISD process knowledge. It can, however, be supplemented with a number of other components of ISD process knowledge. These may include references to facts (e.g. about the applicability of a specific technique or method to a specific problem to be associated with the respective technique or method in Figure 2); case histories (e.g.

12According to Abrahamsson et al. (2003), Rapid Application Development (RAD) can be considered an antecedent of the Agile approach, if not an agile method as such.
Figure 2. Hierarchy of ISD paradigms, approaches, methods and techniques.
successful cases of an application of specific methods and approaches to be associated with
a particular method or approach in Figure 2); theories (underlying techniques, methods,
approaches and paradigms), comparisons of ISD techniques, methods, approaches and
paradigms (to be associated with the classes of ‘ISD techniques’, ‘ISD methods’, ‘ISD
approaches’ and ‘ISD paradigms’ in Figure 2 depending on the units of comparison). As an
example, consider the case of failed ISD projects. Even though published cases of failed ISD
projects do exist, they have not been systematically catalogued to the best of our knowledge.
Their linking with the existing knowledge structure of paradigms, approaches, methods and
techniques might yield important new insights that could help us avoid repeating similar prob-
lems in the future (those who do not know the errors of the past, are condemned to repeat them,
as Satayana might say).

3.4 The coding scheme

The resultant coding scheme of ISD process knowledge forms a hierarchy of concepts as illus-
trated in Figure 3. ISD process knowledge is interpreted to concern ISD performance and man-
gement processes summarized in Table 2. ISD approaches in Figure 3, as a concept,
correspond to ISD approaches in Figure 2. The exact list of ISD approaches identified in the
analysis of articles in ISJ and MISQ are listed in Tables 3 and 4. ISD approaches (with their
associated methods and techniques) are viewed to provide knowledge (tools, techniques, rec-
ommendations, ideas, etc.) to conduct or guide those processes. The knowledge provided by
different approaches may be complementary (e.g. Structured Analysis and Design vs. Socio-
technical Design), alternative (e.g. Structured Analysis and Design vs. Object-Oriented Anal-
ysis and Design) or conflicting.

The framework focuses only on the level of ISD approaches in Figure 2. There are two rea-
sons for this. First, we believe that the concept of ‘ISD approaches’ makes it possible to con-
dense the myriad of ISD methods (over 1000 according to Jayaratna (1994) and Avison &
Fitzgerald (1995)) to a meaningful number (20–30 estimated by Iivari et al., 1998). Second, the
underlying paradigms of different ISD approaches have been analysed in a number of earlier
publications (Hirschheim & Klein, 1989; Iivari, 1991; Hirschheim et al., 1995; Iivari et al., 1998;
2000–2001). It is unnecessary to repeat these analyses in this paper.

One should note that any BoK should not be static. This is particularly true in the case of IS
where new application areas may require new ISD approaches. Therefore we do not propose
the coding scheme of Figure 3 as a fixed structure; rather it can be extended and revised when
our understanding of ISD process knowledge advances. Moreover, new ISD approaches may
be inserted in the framework and the list of ISD performance and management processes sup-
ported by ISD approaches may similarly be revised.

4. A PILOT STUDY OF CODING ISD PROCESS KNOWLEDGE

This section outlines a pilot study for a body of ISD process knowledge extraction as a pre-
liminarily ‘proof of concept’ test that our framework for ISD process knowledge is viable and
does in fact manifest itself in the IS research literature. We conducted a pilot study to take stock of ISD process knowledge in the articles published in ISJ and MISQ between 1996 and 2000. These two journals were chosen to represent the suspected differences between European and North American journals. We selected the years 1996–2000 for this pilot literature survey and analysis simply because we felt 5 years was a reasonable base to test the workability of our coding scheme and to draw some preliminary conclusions. We decided to focus on the practical implications of the articles in ISJ and MISQ from the viewpoint of ISD.

Because of our focus, we excluded articles that discuss research methods in IS, articles on the management of an IS department or function (which we interpreted to be organizational knowledge), and so on. We looked at each full article in MISQ and ISJ to determine if there was anything in the article that related to ISD process knowledge. If so, we included it in our sample to be analysed. This procedure led to a ‘sample’ of 61 articles from ISJ and 57 articles from MISQ.

To simplify the analysis and the representation of the results, we mapped the articles into a two-dimensional table where ISD performance and management processes (see Table 2) constituted the rows, and ISD approaches (see Iivari et al., 2000–2001), the columns.13 During the

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13As a special column we included ‘General’ to refer to ISD process knowledge that is not specific to any ISD approach or type of a system to be developed. It is knowledge associated with ‘ISD approaches’ in Figure 2, assuming that it is at least potentially common to all specific ISD approaches.
analysis we inductively inserted new candidates for ISD approaches (or more likely families of ISD approaches) such as Business Process Reengineering/Redesign, Groupware Systems, End User Computing Systems, Knowledge Management Systems and Inter-Organizational Information Systems. We did this without any formal detailed analysis of the goals, guiding principles, fundamental concepts and principles of the ISD process of these candidate ISD approaches (see Iivari et al., 1998). Yet we felt comfortable that these candidate ISD approaches would fit within the four-tiered framework.

The idea behind the analysis was to focus on the practical implications of the articles from the viewpoint of ISD. However, it turned out that the articles in ISJ reported such implications rather weakly. Therefore, in the case of ISJ we decided simply to map the articles, after a ‘holistic’ reading, in the resultant framework to test its usefulness. Table 3 summarizes the results in terms of number of references addressing ISD performance and management processes from the viewpoint of the identified ISD approaches.14

Table 3 shows that ISJ is quite rich in the variety of ISD approaches discussed. In addition to the category ‘General’, we identified 14 specific ISD approaches. These are Business Process Reengineering (BPR), Structured Analysis and Design (SA/SD), Information Modeling (IM), Object-Oriented (OO), Socio-Technical Design (STD), Soft Systems Methodology (SSM), Decision Support Systems (DSS), Groupware (GW), Speech Act/Language Action-based (SA/LA), End User Computing (EUC), Knowledge Based Systems (KBS), Inter-organizational Information Systems (IOS), Critical Social Theory-based (CST), and Intranets.

Articles in MISQ, on the other hand, described their practical implications relatively well. In addition to the practical implications reported by the authors of the MISQ articles, we also made use of the executive overviews of the articles. Appendix A presents some examples of how we coded the articles.

Table 4 summarizes the results in terms of the number of references addressing ISD performance and management processes from the viewpoint of the identified ISD approaches. It shows that MISQ is more limited in the number of ISD approaches discussed (we identified only seven approaches). Much of the research published in MISQ seems to be more ‘general’ in the sense that it is not specific to any ISD development approach or type of system to be developed. On the other hand, MISQ is richer in addressing the diversity of ISD processes.

5. DISCUSSION

At the outset, this paper set six research questions.

1 What are the knowledge areas of the BoK for IS experts?
2 What are distinctive knowledge areas of IS experts?
3 What are the distinctive ISD process competencies of IS experts?

14Because same reference may be included in several cells in Table 3, the sum of numbers in Table 3 is greater than 61 (the number of ISJ articles analysed).
Table 3. The number of references in ISJ articles 1996–2000

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How can ISD process knowledge be organized?
How are the distinctive ISD competencies of IS experts addressed in the IS research literature?
How implementable, systematic and insightful is the ISD process knowledge absorbable from the IS research literature?

The paper proposes five knowledge areas: technical knowledge, application domain knowledge, organizational knowledge, IS application knowledge, and ISD process knowledge. After contrasting them with the sister and reference disciplines of IS, two of these – IS application knowledge and ISD process knowledge – were identified as distinctive. The subsequent analysis was focused on ISD process knowledge emphasizing its practical relevance as action-oriented knowledge. In the case of ISD process knowledge the paper identified four distinctive ISD competences of IS experts: expertise of organizational aligning IT artifacts, user requirements construction, organizational implementation, and evaluation/assessment of these artifacts and related changes.

The paper also proposed a coding scheme that is based on a comprehensive list of performance and management processes in ISD (Andersen et al., 1990) and ISD approaches (Iivari et al., 1998; 2000–2001). ISD processes were seen to provide alternative and complementary knowledge of how to conduct those processes. The pilot study comprising 61 articles from ISJ and 57 articles from MISQ shows that the knowledge representation framework for ISD

Table 4. The number of references in MISQ articles 1996–2000

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<td>Performance management</td>
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<td>Software configuration management</td>
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process knowledge, based on ISD performance and management processes and ISD approaches, is a rich one allowing us to map much of the practical implications of current IS research and to represent it in a compact yet understandable way. Even though not analysed in the paper, this supports our assumption that a hierarchy of techniques, methods, approaches and paradigms combined with specific ISD performance and management processes might provide a convenient knowledge representation framework for ISD process knowledge. This is true not only for ISD methodology knowledge, but also for its associated substantive knowledge.

The pilot study also provides support for our conjecture that organizational aligning IT artifacts, user requirements construction, organizational implementation, and IS evaluation/assessment form distinctive ISD competencies of IS experts. Organizational alignment was most addressed in both journals (27 hits in ISJ and 18 in MISQ). Requirements construction was the third most popular in ISJ (19 hits) but considerably less in MISQ (9 hits). IS implementation and acceptance was the second most popular in MISQ (16 hits) and fourth most popular in ISJ (11 hits). IS evaluation was the fifth most addressed topic in MISQ and shared sixth in ISJ, even though the number of hits in both journals was considerably lower than in the case of the previous three competencies (four hits in ISJ and 10 in MISQ). On the other hand, Tables 3 and 4 suggest weak attention to user interface design, architectural design, database design and software design. Of course, one could argue that there are special journals that focus on these issues and hence they should not be dealt with in ISJ or MISQ. At the same time, as far as ISJ and MISQ represent IS journals more generally, this neglect of central design issues is worrisome because it may create among practitioners an impression of low practical relevance of IS research.

The pilot study also makes it possible to identify differences in the profiles of the two journals. ISJ clearly displays a wider array of ISD approaches (14 approaches) than MISQ (7 approaches). All seven approaches in MISQ, except GIS, are covered by ISJ. It is an open research question whether this difference in the variety of ISD approaches can be attributed to differences in the European and North American IS research traditions. On the other hand, MISQ seems to cover slightly more ISD processes (ISJ has four processes with nine or more hits whereas MISQ has seven).

Our final research question was how implementable, systematic and insightful ISD process knowledge was in the two journals. Whilst it is difficult to make a generalized statement on this point, the recommendations appearing in the MISQ articles do seem to be implementable, that is, prescribed in a manner that could be put to use (Benbasat & Zmud, 1999). But the same cannot be said regarding systematicity. Coding the MISQ and ISJ articles leads to the impression that the practical implications are somewhat fragmented. It is difficult to see cumulative trends in them. Even though the fragmentation may partly be an outcome of our detailed analytical framework, it is consistent with earlier assessment of the IS discipline (Banville & Landry, 2004).

We can imagine the development of a hypertext-based repository system that allows rich linking of the knowledge components and elements. It is, however, beyond the scope of the present paper to discuss the structure of this knowledge repository in more detail.
One reason for the fragmentation may be that the existing research appears not to be driven by ‘holes’ in our understanding of the practical implications. Instead, the practical implications are typically reported mostly as afterthoughts of the research. Thus, we advocate a systematic analysis of the practical implications of all IS research. This might help to identify the ‘holes’ and direct future research to answer the practically relevant questions identified (i.e. to ‘fill the holes’). In the case of *insightfulness*, we expected to find a stronger and more systematic body of practical implications from the IS research articles, but our impression is one of disappointment. There is a distinct lack of substantive practical implications – no sensation of ‘ahaa’ when reading them. This leads us to wonder whether IS researchers have been unnecessarily modest in drawing practical implications from their work or whether their research has emphasized more rigor over relevance. Whatever the reason, we believe this to be a major problem for the field.

6. CONCLUSIONS AND FINAL COMMENTS

This paper has attempted to establish a foundation for a building a cumulative IS BoK. In line with Benbasat & Zmud (1999), we see this as essential for an applied discipline such as IS. We interpret BoK quite broadly in that it is knowledge of the relevant phenomena associated with some activity such as IS development. It comprises facts, rules, techniques, case histories (cases), stories (and narratives), theories, hypotheses, philosophies, metaphors, etc. (Iivari & Linger, 1999). By knowledge we refer to ‘a set of organized statements of facts or ideas, presenting a reasoned judgment or an experimental result, which is transmitted to others through some communication medium or in some systematic form’ (Bell, 1976, p. 175).

We do not expect that the IS BoK will ever be as systematic as in the natural sciences, medicine or engineering. Despite the limitations caused by the nature of IS as a behavioural rather than a purely technical discipline, we see the progress towards a more systematic BoK as a reasonable objective, especially if the alternative objective is to do nothing to systematize IS research findings.

The most significant contribution of this paper is a proposal for how a more systematic BoK could be built to promote the practical relevance of IS research. The paper advocates an action-oriented organization of BoK to support the development and maintenance of IS and their management. The paper proposed that the framework of ISD paradigms, ISD approaches, ISD methods and ISD techniques might provide a skeleton for organizing the findings of IS research in an action-oriented way so that the findings are linked to IS and their development, maintenance and management processes. ISD approaches were viewed as central in this coding as a means to condense ISD process knowledge in a reasonable number of approaches when compared with ISD methods. At the same time, ISD approaches allow for a diversity of ISD research.

The coding scheme was pilot tested at the level of approaches by coding 118 articles from *ISJ* and *MISQ* using a two-dimensional framework that on the one hand consisted of a set of IS performance and management processes and on the other hand ISD approaches.
test offered promising results, suggesting that the coding scheme is worthy of continued and wider experimentation. At the same time the results showed some interesting differences between two leading European and North-American journals.

The paper has a number of research implications that can be crystallized into four points:

1. **The body of knowledge of IS experts should be specified and documented.**
   
   This paper proposed five knowledge areas: technical knowledge, application domain knowledge, organizational knowledge, application knowledge, and ISD process knowledge. Although this paper has specifically focused on ISD process knowledge, claiming that ISD process knowledge provides a natural way to organize the ISD BoK in an action-oriented way, this does not mean that the other four knowledge areas are somehow less important. Indeed, the five knowledge areas taken together explains the variety of ISD approaches identified in Section 4 (another major factor is the alternative paradigmatic assumptions of different ISD approaches, cf. Hirschheim et al., 1995; Iivari et al., 1998). Some of the approaches primarily reflect the organizational domain of IS (most notably STD and BPR), some the application domain (IM most notably), some the technology domain (OO most notably) and many approaches reflect the type of application (DSS/EIS, Groupware, KMS/KBS, IOS, GIS). The multitude of ISD approaches and methods additionally complicates the formulation of an ISD process BoK.

   In order to pilot test the coding scheme and to obtain a first impression of the existing ISD process knowledge, the paper analysed the articles published in ISJ and MISQ between 1996 and 2000, focusing especially on the practical implications reported in the articles. Despite its limitations, the detailed analysis of the practical implications reported in MISQ casts doubt about the existence of a considerable body of ISD process knowledge relevant to practitioners – especially scientifically validated knowledge. This may provide an explanation for ‘The dwindling interest by industry practitioners in research published in “top-tier” IS journals’ noted by the panel on ‘IS Research Relevance Revisited: Subtle Accomplishment, Unfulfilled Promise, or Serial Hypocrisy?’ and subsequently published in CAIS (Kock et al., 2002).

2. **The distinctive competence areas of IS experts should be identified.**
   
   This paper proposed two distinctive competency areas of IS experts: IS application knowledge and ISD process knowledge. Although the paper does not discuss in any detail the area of IS application knowledge, this does not mean to imply that this area is unimportant. Indeed, IS application knowledge is critical to the success of systems development. However in this paper we focus on ISD process knowledge, which we posit contains competencies of: (1) organizational alignment of IT artifacts; (2) user requirements construction; (3) organizational implementation of IT artifacts and related organizational changes; and (4) evaluation of IT artifacts and related changes. The pilot analysis of articles in ISJ and MISQ provided some evidence about the existence of these distinctive knowledge areas. Despite the fact that these competencies should neither be seen as firm nor exhaustive, they are our attempt at starting a discussion within the IS community to identify what these distinctive competencies are. We believe that such a discussion is critical to forming a professional identity within the IS community.

3. **Future research should be directed to strengthen the applicability of the body of knowledge especially in the core competence areas of IS.**
The survey of articles published in *ISJ* and *MISQ* showed that the practical implications of IS research are modest at best. Even though the analysis showed to some extent that existing IS research reflects the proposed distinctive areas, some of them were quite weakly addressed, and there was also considerable variation between the two journals. Therefore we suggest that the practical relevance of IS research needs to be emphasized more and research on the distinctive competence areas encouraged (i.e. IS application and ISD process knowledge). This conclusion points in a similar direction to Benbasat & Zmud's (2003) call for focusing on the IT artifact and its immediate nomological net, but is less limited for two reasons. First, it avoids the positivistic model-building connotations of Benbasat & Zmud (2003). Second, it is broader as it also recognizes the importance of work procedures (cf. Alter, 2001), hence the nomological net that could be constructed around our two distinctive competence areas would be more inclusive.

The distinctive competencies of IS experts help advance the identity of IS as a discipline among its fragmented membership. Institutions like the Association for Information Systems (AIS), International Conference on Information Systems (ICIS), etc. need a shared world view that is flexible and built from the ground up. They need to draw on a community that shares meaningful visions and stands for more than a coalition of loosely aligned interest groups, yet engages in vigorous, pluralistic debates.

On the other hand, the weak attention to such central ISD issues as user interface design, architectural design, database design, and software design, even though not distinctive to IS, in the two IS journals is also worrisome from the viewpoint of the practical image of IS. Therefore, we suggest that IS journals should also garner and publish papers in these areas, hopefully papers that reflect an IS perspective to these design areas.

4 The body of knowledge should be organized in an action-oriented way, using a rich and dynamic knowledge representation framework that allows one to recognize the diversity of systems to be developed, the variety of methods and approaches of their development, and the evolution of ISD process knowledge

The paper suggested that ISD process knowledge provides a natural way to organize the IS BoK in an action-oriented way. The framework should also comprise ISD methodology knowledge (such as ISD techniques, methods and approaches) and related facts, cases, theories, comparisons and practical implications. The paper proposed that the four-tiered framework of ISD paradigms, approaches, methods and techniques might provide such a knowledge representation scheme. Our review of the IS research published in two well-recognized IS journals provides some evidence that the framework might form a rich, action-oriented representation scheme for ISD process knowledge. The framework is also dynamic (Iivari et al., 2000–2001), allowing flexible assimilation and accommodation of new knowledge as ISD process knowledge evolves.

As noted above, our analysis of the current IS literature was very limited. It obviously can be extended to cover a wider variety of the IS literature and a longer time period. One could consider other sources in addition to research articles, including textbooks, practitioner articles and books, research monographs, consulting reports, etc. This paper has consciously emphasized research-based sources of BoK for two reasons. First, when talking about BoK we wish
to emphasize the quality of the included knowledge so that one can reasonably trust that it is based on a ‘reasoned judgment or an experimental result’ (Bell, 1976). High quality scientific journals apply the most stringent quality standards in this respect. Second, the objective of the present paper was to push IS researchers to work in the direction of an increasingly systematized and cumulative BoK relevant for practitioners.

One should also note, however, that specifying and documenting the existing BoK and organizing it is formidable task. It would require a worldwide collaboration of IS researchers. AIS would be a natural group to organize such an effort. It is unrealistic to expect that it could be done in one shot, rather a more evolutionary strategy of building the IS BoK appears feasible. We hope that our coding scheme and pilot test will stimulate the IS community to work in that direction, addressing topics with the prospect of significant practical implications and organizing their findings in an action-oriented way.

REFERENCES


Towards a distinctive body of knowledge for Information Systems experts

Standing Committee, Bled, Slovenia, June 27–29, pp. 1025–1036.


Jones, M. & Walsham, G. (1992) The limits of the knowledge-richness of the knowl-


Biographies

Juhani Iivari is a Professor in Information Systems at the University of Oulu, Finland, and the Scientific Head of the INFWEST.IT Postgraduate Education Program of five Finnish Universities in the area of information systems. He received his MSc and PhD degrees from the University of Oulu. He also served as the national coordinator of the Finnish Doctorate Programme in Information Systems 1993–94. Iivari serves in editorial boards of seven journals. His research has broadly focused on theoretical foundations of information systems, information systems development methodologies and approaches, organizational analysis, implementation and acceptance of information systems, and the quality of information systems. Iivari has published in journals such as Australian Journal of Information Systems, Behavior and Information Technology; Communications of the ACM, Data Base, European Journal of Information Systems, Information & Management, Information and Software Technology, Information Systems, Information Systems Journal, Information Systems Research, Journal of Management Information Systems, Journal of Organizational Computing and Electronic Commerce, MIS Quarterly, Omega, Scandinavian Journal of Information Systems and others.

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Heinz K. Klein earned his Dipl.Kfm. (equivalent of MBA) and PhD at the Faculty of Business Administration of the University of Munich. In 1998, he received an honorary doctorate by the University of Oulu for his academic contributions to the development IS research in Finland and in 2000 the MISQ Best Paper Award for 1999. He is currently Invited Chair at Salford University and Adjunct Professor at the School of Management of the State University of New York at Binghamton, where he previously led the IS group in. He has held a variety of research and teaching appointments at major universities in Germany, Canada, Finland, Denmark, New Zealand, and South Africa. Well known for his contributions to the philosophy of IS Research, foundations of IS theory and methodologies of information systems development, he has written articles on rationality and the emancipatory ideal in ISD, principles of interpretive

field research, critical realism and the intellectual foundations of alternative approaches to information systems development. His work has been published in the best journals of the field such as the MISQ, ISR, Information and Organization, ISJ, CACM, JMIS, Decision Sciences, and others. He also co-authored or edited several research monographs and international conference proceedings in IS and serves on the editorial boards of scholarly journals and the ‘Wiley Series in Information Systems’. His mentoring of doctoral students and junior faculty has produced several nationally and internationally renowned university faculty in IS.

APPENDIX A

To illustrate how we undertook the coding, let us discuss a few examples. Table A1 depicts the beginning of a table coding the practical implications of two ISD approaches identified in MISQ and general implications, which are not confined to any particular ISD approach. We have a similar table coding the practical implications of the remaining five ISD approaches identified in MISQ.

Jain et al. (1998) (categorized as OA-GEN and DB-GEN) discuss data management in distributed environments. In reading their paper, it is clear that their emphasis is on the organizational context, which we therefore coded as ‘Organizational alignment’. Jain et al. (1998) is confined to neither any particular type of systems (except distributed) nor any particular ISD approach. Because a database is a part and parcel of almost any information system, we classify their paper in the category ‘General’. At the same time Jain et al. (1998) also address database design (DB-GEN), without proposing any specific practical implications relevant in this context.

Lim & Benbasat (2000) compare text-based and video representations in two task contexts, analysable vs. less analysable tasks. We interpret that their paper is confined to neither any particular type of systems nor any particular ISD approach. Therefore it is classified as ‘General’. More specifically, it is coded as (OA-GEN) because it emphasizes the alignment between the task and the information system. Therefore it is coded to concern ‘Organizational alignment’. However, because the two representation forms were equivalent in terms of verbal information content, their paper can also be interpreted to address user interfaces (UI-GEN).

The article of Choudhury & Sampler (1997) (OA-DSS; RQ-DSS) is an example of an additional difficulty. The article does not explicitly specify the nature of systems it has in mind, but addresses environmental scanning in very general terms. Because of this focus, it is, however, coded to concern Decision Support Systems and Executive Information Systems. The authors’ concern is with the decision rights on activities to be supported in terms of knowledge specificity and time specificity of information. Information is high in knowledge specificity if it can be interpreted and used effectively only by individuals possessing specific knowledge, and it is high in time specificity if it loses soon its value if not used immediately after it first becomes available (Choudhury & Sampler, 1997). We interpret that especially knowledge specificity concerns the alignment of an information system (DSS/EIS) and its organizational context. Knowledge specificity implies constraints on who can be users of the knowledge-specific information. Time specificity on the other hand imposes requirements to the speed of the information system (RQ-DSS). The article also includes implications concerning database design (DB-DSS) and software design (SW-DSS).

More details of the entire coding process are available upon request from the authors.

<table>
<thead>
<tr>
<th>Process</th>
<th>General</th>
<th>BPR</th>
<th>DSS/EIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>System development performance</td>
<td>One should design a distributed database so that it is congruent with an organizational context in order to realize greater effectiveness: organizations with high inter-site data dependence, high concentration of IS decisions, high concentration of IS resources at the central site, and low autonomy related to data resource management granted to local sites realize greater degree of data resource management success.</td>
<td>OA-BPR Cooper (2000) Creativity in requirements and logical design Broadbent et al. (1999) Before embarking on any form of BPR, managers should complete a business audit of their infrastructure capabilities using a list of 23 infrastructure services.</td>
<td>OA-DSS Choudhury &amp; Sampler (1997) In general the decision rights for activities that require highly knowledge-specific information should be assigned to the individuals who possess the specific knowledge. For information that is low in knowledge specificity in use but high in time specificity, the decision rights should be located close to the point of information acquisition as possible. One option for information that is low in both time specificity and knowledge specificity is to collocate the decision rights for these activities with those complementary activities that require highly specific knowledge in order to minimize interactivity coordination costs. Pinsoneault &amp; Rivard (1998) IT and managerial work. Zigurs &amp; Buckland (1998) Task/technology fit in the GSS</td>
</tr>
<tr>
<td>Organizational alignment</td>
<td>OA-GEN Jain et al. (1998) One should design a distributed database so that it is congruent with an organizational context in order to realize greater effectiveness: organizations with high inter-site data dependence, high concentration of IS decisions, high concentration of IS resources at the central site, and low autonomy related to data resource management granted to local sites realize greater degree of data resource management success.</td>
<td>OA-BPR Cooper (2000) Creativity in requirements and logical design Broadbent et al. (1999) Before embarking on any form of BPR, managers should complete a business audit of their infrastructure capabilities using a list of 23 infrastructure services.</td>
<td>OA-DSS Choudhury &amp; Sampler (1997) In general the decision rights for activities that require highly knowledge-specific information should be assigned to the individuals who possess the specific knowledge. For information that is low in knowledge specificity in use but high in time specificity, the decision rights should be located close to the point of information acquisition as possible. One option for information that is low in both time specificity and knowledge specificity is to collocate the decision rights for these activities with those complementary activities that require highly specific knowledge in order to minimize interactivity coordination costs. Pinsoneault &amp; Rivard (1998) IT and managerial work. Zigurs &amp; Buckland (1998) Task/technology fit in the GSS</td>
</tr>
<tr>
<td>Lobby for organizational policies with a tight definition of ‘need to know’, for policies on ‘intended use’ of personal data, for policies restricting outside sharing of personal data, and for policy that limits data collection to minimal levels required for business: See CON-GEN Carlson &amp; Davis (1998) The manner of presenting the advantages of technology may need to be tailored to the hierarchical level of the trainee. When training or installing communication systems for directors and executives.</td>
<td>RQ-BPR Cooper (2000) Creativity in requirements and logical design Broadbent et al. (1999) Before embarking on any form of BPR, managers should complete a business audit of their infrastructure capabilities using a list of 23 infrastructure services.</td>
<td>RQ-DSS Choudhury &amp; Sampler (1997) The use of automated ISs for environmental scanning is probably most appropriate for information acquisition.</td>
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</table>

16If not referred to in the main text, the references used in Table A1 are not included in the bibliography. The reader is advised to consult the specific issue of MISQ for bibliographic details of these references.