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Juhani Iivari
University of Oulu, juhani.iivari@oulu.fi

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THE IS CORE - VII
TOWARDS INFORMATION SYSTEMS AS A SCIENCE OF META-ARTIFACTS

Juhani Iivari
Department of Information Processing Science
University of Oulu
juhani.iivari@oulu.fi

ABSTRACT

The paper argues that we should emphasize more the nature of Information Systems as an applied, engineering-like discipline that develops various "meta-artifacts" to support the development of IS artifacts. Building such meta-artifacts is a complementary approach to the "theory-with-practical-implications" type of research. The primacy assigned to theory and research method has effectively excluded constructive research of building meta-artifacts from the major IS journals. The paper also claims that information systems as a category of IT artifacts, and especially the focus on IS development, can help to distinguish the IS discipline from its sister and reference disciplines.

Keywords: Information system, IS discipline, design science, artifact, constructive research, sister discipline, reference discipline

I. INTRODUCTION

Benbasat and Zmud [2003] express significant concern about the identity and core of the IS discipline, arguing that

> *"topical diversity [in IS] can, and has, become problematic in the absence of a set of core properties, or central character, that connotes, in a distinctive manner, the essence of the IS discipline" (p. 185).*

They suggest that the IT artifact and related immediate nomological net should form the core of the discipline. They also discuss errors of exclusion, i.e. failures to address the core properties, and errors of inclusion, i.e. inclusion of concepts/phenomena falling outside this core set.

Weber [2003], in his editor's comment, expresses some doubts about "an inductive approach [that of Benbasat and Zmud [2003]] to identifying the core of our discipline" (p. v), and suggests that "the key to identifying a core [of IS] is finding phenomena where existing theories are non-existent or deficient" (p. vi), stating that

"I believe the core, if one exists, will not lie in theories that account for information technology-related phenomena. Rather, it will lie in theories that account for information systems-related phenomena" (p. vi).

More specifically, he expresses his belief that

"we will establish a theory of the core information systems discipline (...) if we can articulate powerful, general theories to account for the characteristics of representations that enable 'faithful' tracking of other systems" (p. viii).

This idea is naturally consistent with the Bunge-Wand-Weber ontology expressed by the same author in numerous articles.

Alter [2003] criticizes Benbasat and Zmud [2003] on several grounds. He claims on the one hand that the concept of IT artifact is too broad, aiming

"to encompass almost anything IT touches or affects directly" (p.496),

and on the other hand that it is too narrow, so that

"*hardware and software such as Excel, PDAs, SAP, Pentium chips, encryption algorithms, and Windows XP are not full fledged IT artifacts" (p. 498).*

He also contends that

"Benbasat and Zmud's criteria for including research in the IS discipline would exclude or marginalize a large percentage of the research actually done by members of the IS community" (p.504).

As an alternative to the IT artifact-centred definition of the core of the IS discipline, he proposes that this discipline could be conceptualized in terms of work systems. By a work system he refers to

"a system in which human participants and/or machines perform work using information, technology (including IT), and other resources to produce products and/or services for internal or external customers" (p. 498),

claiming that

"Almost every important work system in current organizations relies on IT in order to operate and therefore can be called an IT-reliant work system" (p.499).

It is easy to agree with Benbasat and Zmud [2003] that the core and identity of the IS discipline is a significant question. I also agree with them that the concept of IT artifact is central when outlining the core of the IS discipline. However, I suggest that it is essential to consider which IT artifacts belong to the core of the IS discipline, when IT artifacts are interpreted broadly to cover hardware, software systems, and IT applications. In this context I am ready to agree with Weber [2003] that information systems rather than IT artifacts in general should form the core of the IS discipline.

Differing from Benbasat and Zmud [2003] and Weber [2003], I would question, however, whether one should attempt to define the identity of the IS discipline in terms of a distinctive core theory. Instead, I would suggest that its identity should be based on its distinctive mission as an applied science, to support IS experts in practice. I contend that the core of the discipline for IS practitioners is to develop and maintain information systems or to manage their development and maintenance [Iivari et al., 2003]. To this end, the IS discipline should produce knowledge to support IS development, including various "meta-artifacts" intended to support the development of IS artifacts. IS development requires good understanding of IS use and impact, but the study of IS use and impact is not a part of the distinctive mission of the IS discipline. The following sections attempt to clarify these positions.

II. ARTIFACTS, IT ARTIFACTS AND INFORMATION SYSTEMS

Simon [1969/1996] makes a distinction between artificial, or man-made things and natural things. He associates artifacts with design, in that they are designed (synthesized) by human beings, even though not necessarily with full forethought. Since theories can also be considered "artifacts" in a sense, I exclude them from the extension of the concept of artifact by presuming that artifacts do not have any truth value as theories do[1], but are more or less useful as means of achieving certain ends.

Alter [2003] makes a distinction between "planned change" and "unplanned adaptation and change" (pp. 519-520). To me this distinction is significant in the case of artifacts, since the word "artifact" is so closely associated with design [Simon, 1969/1996] and therefore with a planned change. In fact, I feel that the dichotomy between designed artifacts and natural objects is too simple. Many "artifacts" are only partly the work of a designer. They may exhibit emergent features as an outcome of numerous local actions (e.g. use, interpretation, negotiation and redesign), but these emergent features cannot be anticipated by reference to any *a priori* design. The WWW is an excellent example of this kind of system. At a more theoretical level, the literature on the social construction of technology [Bijker et al., 1989; Bijker and Law, 1992; Orlikowski and Gash, 1994] discussed this emergent aspect of many artifacts. On the other hand, many "natural" objects in our environment are partly man-made, because of factors such as cultivation, breeding, genetic engineering, and education. Thus most things are partly man-made and partly emergent (e.g. organizations, society, culture, natural languages).[2]

It is currently quite popular in the IS literature to talk about IT artifacts rather than about information systems. Dahlbom [1996] suggested the name "Informatics" instead of "Information Systems", interpreting "information systems" as covering only a certain era of computer use (or type of application).[3] He argues that our focus should be on Information Technology (IT) rather than information systems, because the latter do not easily cover, e.g., personal computing, communication, electronic publishing, air traffic control, intelligent houses. More specifically, he claims that we should conceive our discipline in terms of "using information technology" instead of "developing information systems" (p. 34). As pointed out in the Introduction, I see development as primary if we emphasize IS as an applied discipline. The work of most practitioners, including our students, in practice, is not only to study the use of information technology, but to develop new IT artifacts (see Section V). We as researchers and our practitioners attempt to understand the use

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[1] Even though Sutton and Staw (1995) point out that there is more consensus about what theory is <u>not</u> than about what theory is, I dare to characterize my interpretation of theory as a systematic explanation of some phenomena that allows existing empirical findings about the phenomena to be explained and/or hypotheses to be generated which can at least in principle be subjected to empirical testing. By a truth value I mean that theories more or less approximate to the truth (Niiniluoto, 2002).

[2] Unfortunately, I am not able to find a better term than "artifact". "Technology", when interpreted as "a design for instrumental action that reduces the uncertainty in the cause-effect relationship involved in achieving a desired outcome "(Rogers, 1995, p. 12) might be an alternative term, but it may have too technical a connotation.

[3] The name Informatics is widely adopted in Scandinavian universities instead of Information Systems.

of IT artifacts in order to be able to develop “better” ones. In fact, the difference in emphasis between the view of Dahlbom [1996] and my own is not so great, as he also points out that we are interested in “the use of technology because we are interested in changing that use” mainly by designing/developing the technology concerned (p. 42).

I agree with Dahlbom [1996] that to focus our discipline on information systems only may be too restrictive, even though his interpretation of the concept of information system is very narrow. On the other hand, one can claim that inclusion of the use of all IT artifacts makes “Informatics” very broad. IT artifacts obviously include also more conventional artifacts such as computers and other hardware, software such as operating systems, and programming languages. Does their use also lie in the province of “Informatics”, or in that of Computer Science and Software Engineering? What about “embedded computer systems”, which may be totally invisible to human beings, such as computers controlling the fuel injection in a car?

In my vocabulary, information systems form a subcategory of IT artifacts. I interpret an information system as a system whose purpose “is to supply its groups of users (...) with information about a set of topics to support their activities.” [Gustafsson et al., 1982]. The definition implies that an information system is specific to the organizational (or inter-organizational) context in which it is implemented. In terms of Walls et al. [1992], March and Smith [1995] and Lee [1999], an information system is an instantiation of more general information technology. As a consequence, no prefabricated commercial software product is an information system as such. An information system cannot be bought, only software and hardware (and possibly data) to be used in its implementation can be bought.

Analysing the above definition, one can identify three levels of abstraction in an information system [Iivari and Koskela, 1987; Iivari, 1990], which closely correspond to three contexts identified by Lyytinen [1987]:

• organizational level (organizational context):[4]	Users and their activities
• conceptual/infological level (language context):	Information about a set of topics
• datalogical /technical level (technology context):	Technology

Alter [2003] proposes that work systems, and especially IT-reliant work systems, should be taken as ”units of analysis“ in our field instead of IT artifacts.[5] I agree with him that we often attempt when developing information systems to enhance work systems. Work systems represent users and their activities at the organizational level in the above framework, but to define the core and identity of our discipline in terms of IT-reliant work systems would be an attempt by IS experts to monopolize the development of work systems. I see the enhancement of work systems more as an interdisciplinary effort, in which experts from different fields are required (expertise in organizations, expertise in the application domain, and expertise in IT). IS experts represent only IT-related expertise in this enhancement effort.

Weber [2003] proposes that information systems rather than IT artifacts should form the core of the IS discipline, and more specifically he proposes the idea of information systems as representations that enable ‘faithful‘ tracking of other systems. An information system as a state tracking system refers to the conceptual/infological level above, where the information system is assumed to include faithful information about the state of things (topics) in another system. One

[4] It is not necessary to confine organizations here to “formal organizations” such as companies, for organizations may include various inter-organizational arrangements and informal organizations such as families, for example.

[5] Alter uses the term work system in a variety of contexts. I have in mind here specifically work systems supported by IT.

should note, however, that I do not confine information systems to ”after-the-fact“ tracking systems, but also allow them to include information about the future (e.g. forecasting).

Agreeing with Weber [2003], I am ready to suggest that information systems should form the core of the IS discipline rather than IT artifacts. In fact, I interpret the somewhat convoluted definitions of IT artifacts in Orlikowski and Iacono [2001][6] and Benbasat and Zmud [2003][7] as attempts to limit the focus to IT artifacts that are close to information systems. I have a number of reasons for this suggestion. First, this is consistent with the name of our discipline. Second, as pointed above, the concept of information systems allows us to incorporate the ideas of Alter [2003] and Weber [2003] and more or less those of Orlikowski and Iacono [2001] and Benbasat and Zmud [2003] as well. Third, the concept of information system as defined above implies that information is a significant part of the system. Thus this fundamental concept [Alter, 2003] is not just an empty word in the name of a discipline as it often is in the case of IT.[8] Finally, I agree with Alter [2003] that even though the core of the discipline may be defined narrowly, the borders may be broad.

III. SISTER VS. REFERENCE DISCIPLINES OF INFORMATION SYSTEMS

Many information systems are used in formal organizations and therefore organization/business studies and related behavioural fields form significant reference disciplines for IS. On the other hand, there is a concern that Information Systems borrowed too much theory from related reference disciplines to achieve legitimacy [Walls et al., 1992; Benbasat and Weber, 1996; Benbasat and Zmud, 2003; Weber 2003]. This reliance on reference disciplines is partly based on the fact that many IS departments are institutionally parts of business schools. From the Finnish perspective, however, the relationship between Information Systems and other disciplines connected with computing such as Computer Science and Software Engineering is much more tricky, because Computer Science, Software Engineering and Information Systems may belong institutionally to the same department.[9]

The report of The Joint Task Force on Computing Curricula [2001] distinguishes four disciplines of computing: Computer Science, Software Engineering, Information Systems and Computer Engineering. All these disciplines share a common *raison d’etre*, *viz*. IT artifacts. Reference disciplines such as economics, organization theory, psychology, sociology, linguistics, and philosophy, even though more or less interested in computer-related phenomena do not have the same *raison d’etre*. To me, Computer Science, Software Engineering and Information Systems as disciplines concerned with computing overlap to a considerable degree. They are all interested in basic technologies such as hardware, telecommunications, software, databases and user interfaces, even though they view them from different perspectives. The focus of Computer Science pretty much lies in these basic technologies, while in the case of applications, Software Engineering is most distinctively interested in software for embedded systems, whereas the

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[6] ”The application of IT to enable or support some task(s) embedded within a structure(s) that itself is embedded within a context(s).” (p. 186).

[7] “Bundles of material and cultural properties packaged in some socially recognizable form such as hard-ware and/ or software.”

[8] Space does not allow me to discuss here the concept of information and its relationship with knowledge. Note, however, that the often adopted view of data as pure raw inputs (facts) and information as processed, cooked output is totally untenable.

[9] In Finnish we use one word “Tietojenkäsittelytiede” (Information Processing Science) in academic department names irrespective of whether the department is oriented towards Computer Science, Software Engineering, or Information Systems. If the department wishes to emphasize that it covers a number of disciplines of computing, it may use a plural form “Tietojenkäsittelytieteet” (Information Processing Sciences).

interest of Information Systems lies in information systems.[10] According to its name, Software Engineering, mainly focuses on the development of software artifacts, whereas Information Systems is focused on IS development. Software Engineering is also interested in management of the software process, as exemplified by software process improvement initiatives (e.g. CMM), while Information Systems traditionally paid considerable attention to the management of IS departments and functions.

It is clear that the border between Information Systems and Software Engineering in particular is like a line drawn on water, as exemplified by the distinctions information systems vs. software artifacts, IS development vs. software engineering, management of IS functions/department vs. management of software processes/organizations. Often the same piece of research could be published equally well in Software Engineering journals or Information Systems journals. Even so, I would suggest that the concept of information system provides a research object that most clearly distinguishes Information Systems as a discipline from Software Engineering.

IV. INFORMATION SYSTEMS AS AN ENGINEERING-LIKE DISCIPLINE

Benbasat and Zmud [2003] attempt to define the identity and core of the IS discipline with regard to organization/business studies, assuming that Information Systems is a discipline within organization/business studies. Again, this view is primarily based on the institutional arrangement that means that many IS departments are parts of business schools. This institutionalized relationship led to the adoption of the epistemology of organization studies [Orlikowski and Barley, 2001], and to ignorance of the nature of the IS discipline as a science of the artificial [Simon, 1969/1996], a discipline that builds artifacts.

Orlikowski and Barley [2001] discuss the relationship between Information Technology (IT) and Organizational Studies (OS) more explicitly, suggesting that "IT and OS are best understood as overlapping rather than disjoint fields" (p. 146). They also discuss the differences between the two, proposing that

> *"The epistemology of OS research more closely resembles that of traditional science: to develop and test parsimonious explanations for broad classes of phenomena" (p. 147),*

whereas

> *"A considerable portion of IT centers on the design, deployment and use of artifacts that represent tangible solutions to real-world problems. As such, IT has a great deal in common with engineering, architecture and other fields of design" (p. 146).*

They describe the relationship between the two as follows (p. 147):

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[10] Note, however, that the distinction between information systems and embedded software is becoming more fuzzy, because the latter comprises more and more features which resemble ISs. Consider, for example, a computer system embedded into a mobile telephone. As its functionality expands, the embedded software not only implements some of the necessary functions of the telephone, in contrast to hardware implementation, but also provides a number of auxiliary services for users of the mobile phone. The usefulness of these auxiliary services can be assessed only against users' needs and activities. Actually one could talk about "embedded information systems" in this case.

> "*Their differences are complementary, as can be easily seen in the relationship between the physical sciences and engineering*".

Orlikowski and Barley do not talk about Information Systems in their paper, but I deduce that they must have primarily information systems in mind when they speak about IT.[11]

As IT becomes more pervasive in our society, one can expect many of our reference disciplines to include more and more IT-related phenomena in their studies. This has a long tradition in organization theory, especially in contingency research, where organizational technology was often operationalized in terms of automation: However, one can anticipate that the interest of these reference disciplines will lie more in the deployment and use of IT rather than in the development of IT artifacts, i.e. they will lack the design science perspective on IT.

Computer Science and Software Engineering come from strong traditions of engineering-like research. It seems that North American IS research, at least in as far as it is published in major journals such as MISQ and ISR, tended to underestimate engineering-like work, favouring more theory-oriented research. Engineering-like research into information systems is much stronger in Europe, however. For example, a relatively highly ranked journal "Information Systems" (ranked by the ISI Journal Citation report) publishes a lot of research of that type, and the annual Conferences on Advanced Information Systems Engineering (CAiSE) is oriented similarly. Research into Computer Supported Cooperative Work (CSCW) is an interesting combination of engineering-type research and idiographic research such as ethnography, as exemplified by the annual CSCW and ECSCW conferences and the special journal "Computer Supported Cooperative Work". Engineering-like research as a research method is most explicitly recognized in articles discussing IT research as a design science [March and Smith, 1995] and systems development as a method of building such artifacts [Nunamaker et al., 1990; Burstein and Gregor, 1999].

V. INFORMATION SYSTEMS AS AN APPLIED SCIENCE

Both Benbasat and Zmud [2003] and Weber [2003] attempt to define the identity of the IS discipline in terms of a distinctive core theory. Instead I would suggest that its identity should be based on its distinctive mission as an applied science. As Benbasat and Zmud [2003] point out (p. 191):

> "our focus should be on how *to best design IT artifacts and IS systems* to increase their compatibility, usefulness, and ease of use or on how to best manage and support IT or IT-enabled business initiatives" [Benbasat and Zmud, 2003, p. 191-192]. [*italics* added by JI]

To this end, the IS discipline should produce knowledge to support IS development.[12] Alter [2003] is worried that the core and nomological net suggested by Benbasat and Zmud [2003] would

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[11] I consciously speak about the IS discipline as an engineering-like discipline rather than as an engineering discipline. The reason is that engineering is often closely associated with mathematics and natural sciences. Oxford English Dictionary Online (06.09.03), for example, identifies meaning of engineering in the context **engineering science** as "as a field of study, esp. that part of it which can be treated according to the laws of mathematics and the physical sciences; used esp. as the name of a department in places of higher education".

[12] I use the term development in a broader sense than design, to cover all the life-cycle activities of requirements construction, design, technical implementation, and organizational implementation of an IS

exclude a large amount of current research. If we take the above mission of the IS discipline seriously, it does not matter so much whether a piece of research includes errors of inclusion or errors of exclusion provided that it has something meaningful and useful to tell IS practitioners, i.e. that it can help them to develop “better” information systems.

But how can we provide the knowledge needed to support IS development? The North American IS research community has believed that the best way to support practice is to focus on descriptive-explanatory theories, hoping that they will lead to practical implications relevant to practitioners.[13] It seems, however, that this approach failed badly. A pilot analysis of the practical recommendations made in articles in MISQ between 1996 and 2000 showed that these were weak [Iivari et al., 2003]. One gains the impression that many authors included practical implications just as afterthoughts, conceivably finding difficulty in imagining any potential practical implications even when adopting a longer time perspective. It was really difficult to experience any sense of “ahaa” when reading most of them. As a consequence, it is no wonder that practitioners are not interested in those major IS journals [Kock et al., 2002]. The weakness of the practical implications implies that either the authors of the articles were unnecessarily modest in drawing practical implications from their work, or else their research emphasized rigour more than practical relevance. In the most serious cases this theory-guided research will have led to research topics and problems that are simply not of interest to practitioners.

Benbasat and Zmud [1999] note that “Academic work could impact practice through the development of tools, techniques, and practices”, noting that such research contributions are infrequently observed [in major journals such as MISQ and ISR] (p. 9). The development of such *”meta-artifacts”* to support the development of IS artifacts is a complementary approach to the ”theory-with-practical-implications” type of research. Following Walls et al. [1992], meta-artifacts can be divided into *meta-artifacts for the IS product* and *meta-artifacts for the ISD (information systems development) process*. The former comprise technical implementation resources such as application domain-specific software components, application frameworks, application packages, ERP systems, development environments, IS generators, or their prototypes, which can be used in the technical implementation of an IS artifact,[14] and also more abstract models and principles such as various architectural models, analysis and design patterns, and application-dependent design principles for use in the design and implementation of the IS product,[15] while the latter correspond to the ”design process” in the information system design theory of Walls et al. [1992] and comprise systems development approaches, methods, techniques and tools, for example.

These “meta-artifacts” are often relatively complex, and their development involves constructive research [Iivari, 1991] of building the artifacts [March and Smith, 1995]. It is clear that constructive research is badly neglected in IS research. Well-known classifications of IS research methods such as those of Benbasat [1985], Jenkins [1985] and Galliers and Land [1987], for example, do not recognize anything resembling the constructive research method. Nunamaker et

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artifact and its re-development (evolution). Note also that I interpret development as being capable of taking place in-house or being based on application packages.

[13] An alternative explanation is that the major objective of the IS community was to achieve legitimacy in terms of criteria applied in organization/management studies without much concern to the practical relevance.

[14] Of course, meta-artifacts for the IS product also include programming languages, DBMSs, UIMSs, etc. I assume, however, that they belong more to the province of Computer Science and Software Engineering.

[15] Programming patterns, normal forms in relational databases, principles of modularization and information hiding may be more familar examples. I interpet again that they belong more to Computer Science and Software Engineering.

al. [1990] propose systems development as a specific research method to be used for constructing the meta-artifacts discussed above. If systems development methods are really to be applicable in their development, this should put an end to the regression of meta levels between artifacts. Systems development methods as meta-artifacts for the ISD process could be employed for developing other meta-artifacts, including meta-artifacts for the ISD process.

VI. THE RELATIONSHIP BETWEEN THEORY AND ARTIFACTS

It is clear that the IS discipline was essentially shaped by the publication policies of the major journals in the field. The requirements of a strong theory and rigorous empirical research methods effectively excluded meta-artifacts from these journals, largely because abstract meta-artifacts such as systems development approaches and methods are extremely difficult to validate in practice. The question is whether we can relax the most stringent validation requirements so that meta-artifact contributions could also be acceptable in major IS journals.

March and Smith [1995] discuss research as a design and natural science, suggesting four research activities: build, evaluate, theorize, and justify.[16] *Build* means the construction of an artifact for a specific task, demonstrating that such an artifact can be constructed. *Evaluation* is the process of determining whether the artifact represents any progress relative to the performance of existing artifacts. *Theorizing* explains why and how the effects occurred, i.e. why and how the artifact works, and *justification* performs an empirical and/or theoretical research to test the theories proposed. Building and evaluation represent design science activities, and theorizing and justification natural science activities.

March and Smith [1995] seem to presuppose that evaluation takes place using either formal, mathematical analysis (such as algorithm analysis), or empirically. The question, however, is whether this requirement is too strict as a publication criterion. Will it exclude or delay the publication of significant new artifacts? For example, would Dahl and Nygaard's ideas of OO programming have been published in the 1960's, or Codd's idea on relational databases in the early 1970's if this requirement was applied, especially in view of the limited capacity of computers at that time, which did not allow full demonstration of the benefits of the ideas. As a weaker option, one could conceive that "ideational" evaluation could be sufficient, i.e. evaluation that shows that the new artifact includes novel ideas which address significant "theoretical" or practical problems encountered in the existing technology. Empirical evaluation of the artifact could be postponed for further research.

To increase the direct utilization of research results in practice, Benbasat and Zmud in their previous paper [1999] recommend that we should

> *"Develop cumulative, theory-based, context-rich bodies of research to be able to make prescriptions and be proactive" (p. 14).*

Even though desirable in principle, it seems that this theory-driven research seriously failed to produce results which are of real interest in practice, as discussed in Section V.[17] March and Smith [1995] seem to apply a slightly weaker criterion when claiming that, given that the performance of an artifact has been evaluated, it is important to theorize on why and how the

[16] Natural science in March and Smith (1995) covers traditional research in the physical, biological, social, and behavioural domains (p. 253).

[17] It seems that Benbasat and Zmud's (1999) recommendation to develop theory-based, context-rich bodies of research also includes a potential internal contradiction. I will not discuss this issue in any more detail.

artifact worked or did not work in its environment. The question, however, is whether a paper that suggests a new, practically relevant artifact and demonstrates empirically that the artifact outperforms existing alternatives is acceptable to major IS journals unless the author is able to theorize over its performance.

Simon [1969/1996] assumes artifacts to be interfaces between an "inner" and an "outer" environment, both being subject to natural laws. This idea would provide a promising starting point for the idea of a theory of artifacts. Weber [1987] also remarks that

> *"it would be a strange quirk of nature if human assemblies of natural objects did not manifest order in the same way that natural assemblies of natural objects manifest order" (p. 13),*

and then proceeds to an outline of a theory of discrete artifacts. Referring to Brooks [1987], one can claim, however, that software systems contain arbitrary complexity, because they are designed at will by different people. It is only constraints on the current technology, other resources, and above of all imagination that limit software products.

Thus the big question mark for me is whether we are able to combine theories of artifacts with theories of their inner, and especially of their outer, environments. Walls et al. [1992] propose the interesting idea of an "IS design theory". This idea would be divided into two parts: the design product and the design process. They suggest that an IS design theory for an IS design product should consist of meta-requirements (the class of goals to which the theory applies), meta-design (the class of artifacts hypothesized to meet the meta-requirements)[18], kernel theories (theories from the natural and social sciences governing design), and testable design product hypotheses (used to test whether the meta-design satisfies the meta-requirements).

An IS design theory for the IS design process would comprise a design method (a description of the procedures for artifact construction)[19], kernel theories and testable design process hypotheses (used to verify whether the design method results in an artifact which is consistent with the meta-design). It is difficult for Walls et al. [1992] to find any examples of such IS meta-artifacts with well-defined kernel theories, however. It may also be misleading to consider "design theories" as a category of theories. A "design theory" as introduced in Walls et al. [1992] does not necessarily include any explanation of why the "meta-design" satisfies the meta-requirement and the "design method" results in an artifact that is consistent with the meta-design.[20]

Orlikowski and Iacono [2001] offer five premises for theorizing about IT artifacts. These are quite abstract and not specific to IT or information systems in any way. It remains to be seen whether their principles lead to any theorizing that is able to link IS meta-artifacts and descriptive-explanatory theories. Note, however, that they seem to exclude meta-artifacts for the ISD process from IT artifacts, as evidenced by their assessment that an article on Information Engineering [Beath and Orlikowski, 1994] does not make any reference to technology that might be developed using the method in question.

It is not necessarily only the obsession of the major IS journals with theories that excluded contributions focusing on IS meta-artifacts. Many meta-artifacts are very difficult to investigate "scientifically", since they are complex and short-lived, because of their technology dependence. At least meta-artifacts for the ISD process are discussed too much in terms of commercial labels

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[18] Meta-designs correspond to meta-artifacts for the IS product in Section V.

[19] Design methods correspond to meta-artifacts for the ISD process in Section V.

[20] Even though the idea that a design method results in the desired outcome gives the impression that this design method is a sufficient condition for the outcome (like an algorithm), the guidelines of Walls et al. (1992) for testing the design product/process hypotheses indicate that this is not the case. This testing essentially corresponds to evaluation of the design product and design process meta-artifacts.

(such as UML + RUP), which are packages of knowledge that are too complex to be evaluated as a whole. On the other hand, one can imagine a research approach in which a limited number of their essential features were evaluated empirically at a time, in the hope that these partial tests would lead to cumulative evidence on the value of the meta-artifacts in the longer run. As a prerequisite for this strategy, we should pay more attention to the morphology of the meta-artifacts. Henderson and Cooprider [1990] make a significant contribution in this respect, and recent work on meta-modelling is also relevant here [Kumar and Welke, 1992; Rossi andd Brinkkemper, 1996]. I also attempted in my own work [Iivari, 1986; Iivari et al., 1998, 2001] to create some order in the realm of ISD approaches, methods and techniques. Morphological analyses of meta-artifacts may lead us to identify their permanent features, which are not so much dependent on current technology, so that research does not degenerate into constant technology surfing in order to be current [Benbasat and Zmud, 1999].[21]

VII. CONCLUSIONS

It is argued in this paper that information systems as a category of IT artifacts, and especially the focus on IS development, can help to distinguish the IS discipline from its sister and reference disciplines. It is also claimed that we should emphasize more the nature of Information Systems as an applied, engineering-like discipline that develops various ”meta-artifacts” to support the development of IS artifacts. It is also argued that the primacy assigned to theory and method effectively excluded constructive research on the building of meta-artifacts from the major IS journals. To complement the ”theory-with-practical-implications” research strategy, we should focus more on the meta-artifacts discussed above, and to understand these, we should pay more attention to their morphology. This approach may also make it easier to subject meta-artifacts to empirical evaluation.

Editor's Note: This article is the seventh in the series titled *The IS Core***.** At the time of publication, the papers in this CAIS series included Articles 31 through 41 and the editorial in Article 42. These articles were motivated by Benbasat and Zmud [2003] in the MIS Quarterly and by Article 30 [Alter 2003] in this journal. The article was received on September 30, 2003 and was published on November 24, 2003.

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[21] The evidence suggests that abstract meta-artifacts for the ISD process such as ISD approaches, methods and techniques, are not as short-lived as more concrete software meta-artifacts for the IS product or the ISD process.

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ABOUT THE AUTHOR

Juhani Iivari is 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 in information systems. His research broadly focuses on theoretical foundations of information systems, information systems development methods and approaches, organizational analysis, implementation and acceptance of information systems, and the quality of information systems. Iivari's publications appear in such journals *as 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*, and *Omega*.

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