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# How to Design Things with Words – a Communicative Perspective on Design Research in Information Systems

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## Abstract

Design research is establishing itself as a research approach in Information System (IS). Topics of IS design research include system development methods and conceptual modeling languages that often find their way into CASE tools. However, there is also a lot of confusion about the differences between design and design research, the idea of "design science", and the role of the IT artifact in IS. In this paper we critically examine some design science approaches, in particular the guidelines of Hevner, and propose an alternative approach in which design is viewed as communicative action and design research in IS is ultimately aimed at improving information and communication processes in organizations.

**Keywords:** Design science, Language/Action Perspective, research methodology

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# 1 Introduction

The role of design in IS research has been a subject of debate for many years. Walls et al (1992) expressed the need for Information System Design theories. A design theory does not address the design of a specific artifact, but a class of artifacts, e.g. transaction processing systems, and its core consists of a set of meta-requirements and a meta-design meeting these meta-requirements. In their seminal article, Hevner et al (2004) argue for a full recognition of "design science" in IS, while at the same time providing a set of guidelines on how to sort out the good IS design research from the bad. In their view, the goal of behavioral science research is truth, while the goal of design science is utility, so, although they are related, one cannot be reduced to the other. Design research in IS appears to gain legitimacy, although an empirical study of Backlund (2005) on the contents of ECIS proceedings shows a decline in the number of studies where artifacts are constructed or tested. Hevner et al (2004) are a bit ambiguous when it comes to the role of theory in Design Science (Venable, 2006): on the one hand, the goal of design is said to be utility, not theory, but on the other hand they also talk about kernel theories applied and extended through the experience of

the researcher. The notion of kernel theories is taken from Walls et al (1992), but in the latter framework, kernel theories are natural science or social science theories that "govern design requirements", and they distinguish these kernel theories from design theory as such (the former can be part of the latter, but they are distinct in nature). So in Walls' view, kernel theories are *not* theories extended by IS researchers, only applied.

*Question1*: Should IS design research produce theory? If so, what kind of theory?

There has been quite some discussion on the role of the IT artifact. March and Smith (1995) identified 4 types: constructs, models, methods and instantiations. Benbasat & Zmud (2003) firmly state that the IT artifact should be at the core of the IS discipline. Not that the IS discipline only involves the study of the IT artifact as such; at least as important is how IT artifacts impact the contexts in which they are embedded. However, focusing on the IT artifact can help to delineate IS studies from social science research in general, and to avoid research that is better left to other disciplines, such as cognitive science or computer science. In general, the proposal of Benbasat & Zmud has been received positively, but not by all. McKay (2005) criticizes the focus on "creating things". IS is a socio-technical discipline. Hevner et al state that "artifacts are rarely full-grown information systems that are used in practice", which suggests that technical artifacts can be separated from the organizational context. In contrast, McKay posits that the task of IS researchers is to understand practices with respect to transforming situations by the application of artifacts into more desired states, taking into account the context and use.

*Question2*: Should IS design research produce artifacts? If so, what kind of artifacts?

The recognition of design research in IS raises the question of how it relates to other research methods or paradigms in the field. Many authors plead for pluralism or a multi-method approach in which design science, positivistic empirical methods as well as interpretative approaches each have their own role. However, pluralism has its costs. According to (Klein & Hirschheim, 2003), the effects of conflicting paradigms and commitments to incompatible visions of the nature of IS have fragmented the IS research community along several dimensions to the point that it has reached the so-called "fragmented adhocracy". The article pleads for a communicative approach and the development of a common Body of Knowledge, which includes technical, ethical, applicative and theoretical knowledge.

An interesting proposal on how to integrate design research and behavioral science paradigms has been put forward by Goldkuhl (2004) under the label "pragmatism". Pragmatism was originally introduced by Peirce, James, Dewey and others as a philosophical alternative to abstract and rationalistic science. Pragmatism does not contend itself with observing a given reality, as it wants to acknowledge the role of purposeful human action in changing reality. One of the foundational ideas within pragmatism is that the meaning of an idea is the practical consequences of that idea. Therefore, IS research should focus on knowledge that makes a positive difference, i.e. knowledge which contributes to improvement of IS practices. So pragmatism provides a framework in which empirical research and design research can support each other and in fact need each other.

*Question3*: Should IS endorse multiple research paradigms? If so, what is unifying IS?

Following the seminal work of AI researcher Herbert Simon, Hevner et al use the term "design science". However, there is still quite some debate about the nature of design (is it a search process?), whether there can be something like design science, and what the relationship would be between the two. Another question is to what extent designing activities are domain-specific.

*Question4*: What is, in the field of IS, the nature of design?

In this paper, I want to explore answers to the questions above from a communicative perspective on the IS discipline, that is, in the tradition of the Language/Action Perspective (Weigand, 2006). I will do that in two steps. First, in a critical reflection on the work of Hevner et al we aim at a better understanding of "design research". Secondly, we use the communicative perspective to achieve a better understanding of "design" itself.

# 2 Design research in IS

In this section, we consider two objections against Hevner et al (2004 – in the following we will skip the year indication), and related current work on design research in IS. Although I support the main message that design research, if properly conducted, should be fully recognized in the IS discipline, I think that this can only work if the nature of design research in general, and in the IS field in particular, is clear.

The main objections are the following:

1. The focus on the "IT artifact" as research output is problematic. The focus of IS should be on information and communication processes in organizations. Moreover, the notion of artifact is not used consistently.
2. The uncritical use of the word "science" in "design science" or "science of the artificial" is problematic. The scientific character of design and/or design research needs to be clarified.

## 2.1 The IT artifact and the focus of IS research

According to Hevner's guideline 1, "the result of design-science research in IS is by definition, a purposeful IT artifact created to address an important organizational problem". One objection is that this focus makes it hard to distinguish IS from Computer Science. By this statement, we do not want to separate the two disciplines completely, as they are evidently closely related. But related is not identical. We concur with the critique of McKay above that the focus of IS should not be on the automated system as such (cf. also Alter, 2003). From a communicative perspective, the primary research object of IS consists of the information and communication processes in organizations (Klein & Hirschheim, 2003). This set of processes can be

called the organizational Information System. Nowadays, most processes are supported by IT, and hence the IT support of the processes should be taken into consideration as well, but the latter is secondary, not primary. The objection is not a strong one. Guideline 1 could be repaired by putting more emphasis on the second part (as this part is typically out of the scope of Computer Science) and by refining it to a transformation in the Information System. So then we get: "the result of design-science research in IS is (..) a purposeful IT artifact *created to transform a state of the organizational Information System into a more desired state*".

A second problem with Hevner's guideline 1 is that the relationship between organizational problems and IS (design) research is not as direct as it suggests. Many organizational problems (e.g. finance, marketing) are out of the scope of IS. The main focus of IS in the Information System of the organization. Moreover, problems occurring in this Information System are usually dealt with by the IT professionals in the organization, possibly with the help of IT consultants or solutions offered by IT vendors. In contrast, IS researchers typically address a certain problem *class* (Walls et al, 1992), and the results of their research is an abstract solution at best. It is up to the IT professionals to translate this abstract solution to their context and apply it. Interestingly, Hevner et al recognize that design-science research in IT often addresses problems related to some aspect of the design of an information system (rather than the organization). If that is true, then guideline 1 is too strict, or the notion "organizational problem" too vague. It seems that Hevner et al confuse the organization and the organizational Information System as well as the role of the IS professional (including the IS engineer) and the role of IS researcher.

Related to the latter confusion, and perhaps the biggest problem with Hevner's guideline is the notion of artifact itself. The underlying idea seems to be that design research has something to do with design, and by definition, design produces something - let us call this "artifact". So the output of design research consists of artifacts. The logical fallacy in this reasoning is evident. If this line of reasoning is pursued, then "theories" may be classified as artifact as well (Purao, 2003; Missi & Klein, 2002), since these are also an output (sometimes) – although March & Smith (1995) explicitly excluded them because they had already accommodated for theories in another part of their IS research discipline. And we could extend our scope to behavioral research, and add surveys and experiments as artifact types. Or journal papers. The point is that design research has something to do with (IS) design, but that does not mean that design research *is* design (it is research), and so the output of IS design is not necessarily the same as the output of IS design research. Journal papers are produced by all researchers, not only design researchers. In these papers, researchers of all kinds develop and test theories, based on *constructs* and often expressed in *models*. This is not specific for design research. However, positivist researchers typically refrain from developing *methods*, and seldom produce an *instantiation* (working system). IS developers, on the other hand, as designers do develop instantiations. For some of them, this is their main result. IS design researchers sometimes produce proof-of-concept instantiations in the course of their research, but not as their main result. As Hevner et al state themselves: "Artifact instantiation demonstrates feasibility". It may have other functions as well, for instance, to communicate the research to colleagues and practitioners, but anyway, its function is instrumental.

Design is not the same thing as design research, and their respective outputs cannot be lumped together. Even if the same artifact type can be identified in the output

of a designer and the output of a design researcher, we need to be careful about the differences. For instance, Hevner et al state that a designer may produce an ER *model* of a certain business situation. However, an ER model of a specific business situation cannot be viewed as an output of design research. In contrast, the output of design research (rather than a designer's activity) could be a conceptual modeling approach such as ER. More in detail, "the" ER approach is a set of constructs plus a number of statements that express relationships among constructs plus a couple of prescriptions, e.g. to extract entities and relationships from text, or to transform an instantiated ER model to a relational model. The second part is a model in the definition of March & Smith, and the third part a method.

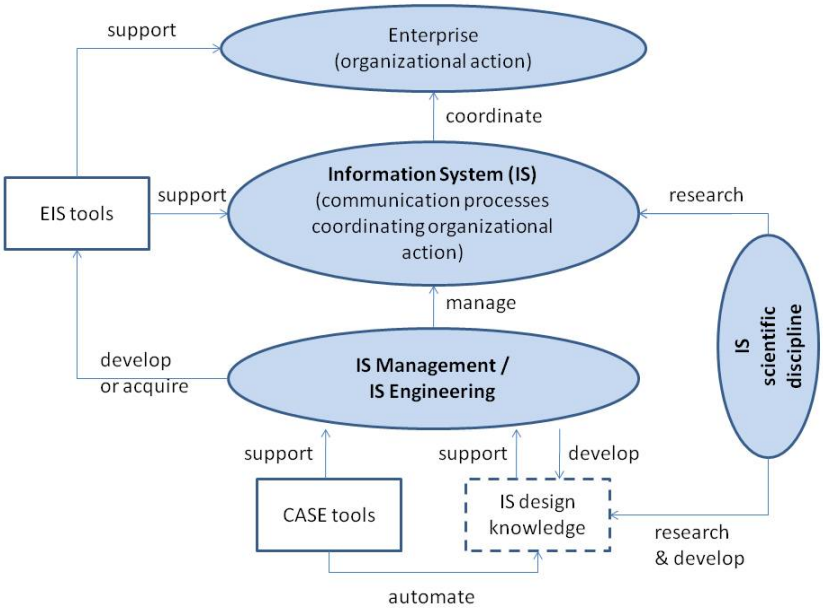


Figure 1: IS, IS management, and the IS discipline

Figure 1 depicts the role of IS research discipline with respect to "organizational problems". It positions the Information System as that aspect system of the organization that contains the information and communication processes coordinating organizational action in the enterprise. This aspect system is the primary object of IS research, in the same way as the well-functioning of the human body is the primary object of medical research. The Information System is managed (that is, problems are solved and processes are innovated and optimized) by the "IT department" who achieves its goals partially by developing and applying EIS (Enterprise Information System) tools, for instance, an ERP system. "IT department" should be taken in an abstract sense; in practice, this activity may be divided over several departments. Continuing the medical analogy, the IT department corresponds to medical professionals such as general practitioners. New therapies and medicines, as invented/discovered and tested by the medical research, can help the medical professional in his task. Similarly, the IS discipline can provide design knowledge to improve IS engineering practice, for example in the form of a conceptual modeling method. Often, but not necessarily so,

there is some component that can be automated, for example in the form of model drawing support in a CASE tool. Although some have questioned the usefulness of "methods" and "plans for action" on theoretical grounds, practice clearly shows they are (Schmidt & Simone, 1996).

Some additional remarks should be made about the figure. I have pictured EIS tools supporting the Information System. It could be argued that there are automated systems that do support the enterprise but not the Information System, for example, a manufacturing machine. I agree, but then I don't think these systems are in the scope of IS research. Secondly, some would draw an arrow between IS discipline and IS Management. Is IS management not a relevant object of IS research? However, it should be kept in mind that IS management as a function and "the IT department" as an organizational unit are part of the enterprise. In principle, questions regarding the alignment of this department with other departments or overall business strategy are a matter of organizational research, not IS research. These questions should be distinguished from the problem of matching available IT means (EIS tools) with business goals. This is precisely what is at stake in the Information System, and so core to the IS research. Thirdly, in the bottom of the figure we have concentrated on the IS design role of "IS Management" and that is why we refer to CASE tools and design knowledge. However, the intention is to cover all of IS management, not only IS design.

So what is the role of the IT artifact in IS research? General research outputs such as models and constructs should be distinguished from design-research specific artifacts. As far as *methods* are concerned that incorporate design knowledge ("the use of X is a solution to problem Y"), then they are indeed an important product of R&D activity in the IS discipline. The other types are to be considered instrumental.

## 2.2 Design science in IS research

Hevner et al make a rather uncritical use of the term "design science". However, as Nigel Cross has made clear in several publications, this is a controversial concept (Cross, 2001). For Cross the notion of "design science" is based on the assumption that ultimately the act of designing can be turned into a scientific activity (the words stem from Grant, and I interpret them as meaning that the activity is completely formalized) and it comprises the effort to develop systematic knowledge of design processes and methodologies, as well as the scientific underpinnings of the design of artifacts. This assumption is most often touted in the AI field. Hevner et al make a step into that direction when envisioning a "knowledge base" of methodologies and artifacts that is developed by researchers and used by practitioners in what they call "routine design". However, routine design is not necessarily fully formalized. Hevner et al do not make that claim. Note also that they admit that the theory of design in IS is in a constant state of scientific revolution. If that is the case, and if we agree that scientific revolution can hardly be called science itself, then the term "design science" is not the most appropriate one for the development of this knowledge base. Cross prefers to talk about design as a discipline. Scientists have their discipline, but so do monks, medical doctors and military. If we want to avoid the interpretation of design science above, it is better to avoid the term.

There is another interpretation of design science for which Cross uses the term "science of design". Here the assumption is that design as an activity can be the subject of scientific investigation, and that such a scientific (systematic, rigorous) inves-

tigation has certain advantages over other forms of investigation (e.g. self-reflection). This may seem to be a rather uncontroversial assumption, but I think it is not. The point is that a scientific investigation is more than a systematic investigation, but takes place in a certain scientific discipline (e.g. psychology, or economics) with a certain view on the nature of its object and the laws thereof. So if there is a science of design that is more than systematic investigation of design activities (e.g. more than just using rigorous statistical methods) and that is not included yet in any traditional scientific discipline, then the assumption must be that design is something with its own ontological status (not reducible to social action, for instance) and its own laws. This assumption seems to bring us pretty close to the idea of design science that Cross dismissed. Personally, I don't see sufficient reason for making this assumption. To the contrary, it seems much better that design activities are studied from multiple scientific disciplines. Cognitive psychology is an important one, but so I think is IS (see section 4).

Yet another interpretation of design science is found in Hevner et al, where it is seen as a research *paradigm*, in contrast to e.g. the positivist research paradigm. Research following this paradigm is commonly called design research. As we have seen above, Hevner et al claim design research to be equally valid as other types of research, and their guidelines are aimed to give substance to this paradigm. This interpretation of design science is not discussed by Cross, as far as I know. Recent work of Lee & Hubona (2009) has made a strong claim that as long as the basic principles of logical rigor are followed, design research is as valid as any other research paradigm. In their view, the central statements that design research should try to verify or falsify are of the form "design theory X solves problem class Y". It is important to note that this approach puts positivist and design researchers in the same boat as far as the development of theories is concerned. There is not a principal distinction between developing a design theory (e.g. the Entity-Relationship Modeling approach) and developing a positivist theory (e.g. the Technology Acceptance Model in IS, or the Transaction-Cost theory in economics). It is not the case that the positivist researcher is just testing, and the design researcher is just developing. They both develop theory. In both cases, the theory can never be verified, but it can be falsified if a situation can be found where the theory makes a wrong prediction, or where the application of the theory does not solve the problem, respectively. Both may declare the theory valid if it withstands falsification, but this status is always tentative. One note to be made is that Lee & Hubona focus on empirical research (for validation), and do not consider formal verification. If a theory is formalized (and design theories in IS often are, or at least they contain formal components), then validation may be based on verification as well.

In line with Lee & Hubona (2009), we define a design theory as a coherent set of claims about "solutions". The solutions are *methods* that are claimed to solve certain problem classes related to the Information System (in an abstract sense). The problem classes include design problems that IT developers are facing. The two might even be said to be equivalent: by definition, the problem classes related to the Information System and the design problems of the IT developer are two sides of the same coin. The solutions have to be formulated rigorously, of course, before meaningful claims can be made. An instantiation can be instrumental in *testing the design theory* - to falsify or validate the claims it makes. For instance, a GDSS can help to test the claim that anonymous brainstorming is more efficient than non-anonymous brainstorming

(Nunamaker et al, 1991), although in principle the same test could be set up without IT. It also occurs quite often that the "solution part" in the theoretical claim is about the use of an automated tool, or the use of a certain modeling language. For instance, the performance of a group with GDSS system is compared to the performance of a group without GDSS. In this case the instantiation is a *necessary part of the proposed solution*, and if the instantiation in question does not exist yet, it has to be built first.

Summarizing, we can say that "design" and IS are related in many ways. There is design of the Information System. There is design of EIS tools. For the design practice, we can talk about a design discipline, and it may make use of scientific knowledge (such as computer science, economics, psychology, and IS). Design research is one of the research paradigms in IS that aims to develop design theories – theories that define a certain method and make a claim about the problem classes that the methods can help to solve.

# 3 Communication-based design

Hevner et al follow Simon in viewing design "essentially" as a search process and even turn this view into a prescriptive guideline. Simon should be fully credited for his defense of design disciplines against the imperialism of natural and social sciences, and his initial thoughts on how a design science could be taught. His conceptualization of design as search makes it possible to apply existing heuristic methods from the AI field. But it has some drawbacks as well. In the first place, it underestimates the difficulty of defining the problem in the kind of problems addressed by IS. For instance, he states (1996, p.132) that "solving a problem simply means representing it so as to make the solution transparent". As the inventor of the term "bounded rationality", Simon should have known that there is nothing simple at all on representing a diffuse problem with many stakeholders involved. As argued at length by Visser (1995), Simon's view applies to "simple", well-defined problems and to their processing, but does not represent the ill-defined problems that professional designers have to solve. Ironically, it was by reference to Simon's idea of limited capacities leading to bounded rationality that Schön and Wiggins came up with an alternative account of design (Situated Action) and qualified designing as possessing "the conversational structure of seeing-moving-seeing" (1992, p. 143). Although Simon does recognize the intrinsic iterative nature of design, and Hevner et al recognize that IS problems are typically ill-defined, they still stick to the search metaphor.

Besides, the metaphor of a solution space being searched through does not square with the creativity in design. Sometimes, design involves a systematic exploration and comparison of the possible alternatives, but at other times, this does not lead to results and a redefinition of the solution space is necessary. New solution spaces are often opened up as a result of cross-fertilization between different communities (Spinosa, Flores, Dreyfus, 1997).

## 3.1 A communicative perspective

If design is not search, then what is it? The alternative that Visser offers, on the basis of an extensive survey of design literature is, that of "transforming representations":

> The activity of design thus consists in *transforming representations*. Design indeed starts with a representation and has to come up with another represen-

> tation. The initial representation can be very diverse, i.e. composed of elements of various levels, from different sources, made up of contradictory and/or incomplete constraints, or implying such elements. The final representation has to be very precise and detailed, i.e. composed of elements that are all at the same level of abstraction: it has to be so specific that the implementation of the artifact is completely specified.

This view of design accords very well with a communicative perspective on design. To see what that is we first go back to the basics of semiotic theory. According to the OED, a design is “a plan or drawing produced to show the look and function or workings of something before it is built or made”. As a verb, "to design" refers to the intentional process of originating such a plan. Although design is sometimes used in a broader sense of “creating something new”, it particularly denotes the first phase of the creation process where a plan is conceived. The word “design” comes from Latin “designare” that contains the root “sign”. This is not accidental. What is characteristic for a sign is that it refers to something else. In the way humans use signs, the referent need not be present in place or time. On a very basic level, design of something yet to be realized (“before it is built or made”) presupposes the ability to manipulate signs: no designs without signs. On a basic level, the reverse is true as well. The use of a sign can be viewed as design (v): it creates a design (n) that triggers some action of the listener. For example, the raw directive act “water!” in some context is an instruction to realize water in that context. The raw referential act “wolf” in some context can be seen as an instruction to identify a wolf in the context, e.g. to recognize that weak high sound in the background as belonging to a wolf. In the first case, the expectation is a physical action of the listener, in the second case a cognitive action, but both actions are preceded by the “sign”, ”designed”. “Pragmatics” is defined commonly as the relation between signs and the effect on the people using them. The very idea of pragmatics is that signs do not only have an internal structure (syntax) and a meaning (semantics), but also an effect.

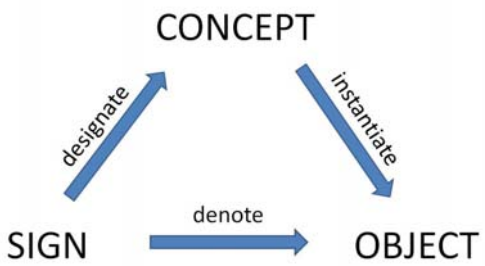


Figure 2: The semiotic meaning triangle adapted from (Ogden & Richards, 1923)

We can get a bit more precise when considering the well-known meaning triangle (Figure 2). A sign *denotes* an object (in a context), and *designates* a concept. Linguists say that a sign *evokes* a concept. We call the relationship between concept and object “extension” or “instantiation” (originally, this relationship is called “reference”). When a Speaker denotes an object by means of a sign, then the Addressee is triggered to make the link between the concept evoked and the object denoted. The

maxim of relevance dictates that this action only makes sense when this leads to something new. It may be that both Speaker and Addressee already had made the triangle complete for themselves, but not as mutual knowledge. For instance, when two people are standing in the rain and one says: "It is raining" to start contact. The new thing may also be that the triangle was not complete yet. Several subclasses of this case can be distinguished. It may be that the object is missing and yet to be identified, as in the water example above. This is a very common case; the object may be something not present in the context, or not existing yet at all, for instance, a certain event to be realized: "Tomorrow we meet in the park". Another subclass occurs when the object is present, but not linked to the concept, as in the wolf example. We call this a case of *assigning*. This includes cases where a person is assigned a certain role: "Alice is our new secretary", and also the prototypical declarative "I declare you husband and wife", and instances of collective blaming: "*He* is the problem!". The result is that the object *counts as* an extension of the concept, represented by the sign (in the examples, the predicate used). The third major subclass is where object and concept are both present, but the sign is missing – the case of *expressing* that lies at the bottom of knowledge externalization efforts.A fourth subclass occurs when there are objects for which both the concept and the designating sign is missing – this is the case of *explaining* that lies at the bottom of scientific research. In general, it appears that human beings have an intrinsic drive to complete incomplete meaning triangles. Together with the mimetic drive towards mutual knowledge, this is perhaps one of the most fundamental laws of communication.

## 3.2 Conversations

*The conversational structure of design*. Coming back on our definition of design, we say that designing is some activity that results in a sign/concept pair in which the object is missing, and in fact non-existent yet. If the design is a good one, then it is feasible to instantiate the object on the basis of the sign (the representation of the concept), so as to complete the triangle. Usually, but not necessarily, the design has to satisfy pre-specified requirements and constraints. Refering to Visser's characterization of design as transforming representations, we can say that during the design process, sign and concept are co-evolving. This co-evolution is what Schön called "the conversational structure of seeing-moving-seeing", a cycle of interpretation and transformation. Perhaps the most thorough elaboration of this view is found in the work of Goldschmidt who carefully analyzed protocols of design sessions involving architectural designers (Purcell & Gero, 1998; Goldschmidt, 1991). She divides the design process in "moves" and "arguments". *Moves* are the smallest chunks of reasoning, defined as "a coherent proposition pertaining to an entity that is being designed". *Arguments* within moves can be of two types: seeing that and seeing as. Note that these two types correspond with the above-mentioned *express* and *assign* cases, where some representation/sign is made the object of a meaning triangle and a new representation/sign is introduced that assigns new meaning to the first sign or expresses some existing meaning in it. Being a communicative act, an argument may become a subject of discussion (the discussion layer of Habermasian communicative action, cf. Van Reijswoud, 1996). In the discussion, a list of pros and cons is made (Rittel and Webber, 1973/1984) before deciding to pursue or cancel the act.

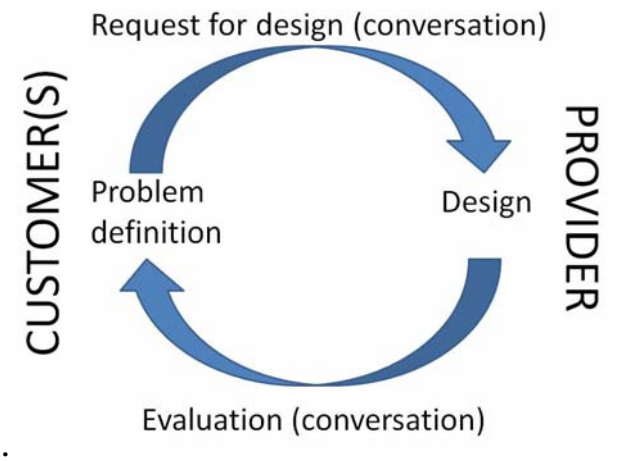


Figure 3 Design activity embedded in conversations: the Conversation for Design pattern

*The Conversation for Design pattern*. There has been a lot of debate between the AI approach (Situated Information Processing, SIP) and the Situated Action approach (SIT) on the ill-defined character of design problems (cf. Vera & Simon, 1993 and the discussion in the same issue). Although I agree with SIT that design problems are typically ill-defined and underspecified, I would argue *against* the SIT position that is better to see the problem formulation as not being part of the design. The design proper is preceded by a communicative process between at least two stakeholders: the customer feeling a need and being willing to pay for a solution, and the designer being able to provide a solution (Figure 3, a variation of the well-known Conversation for Action pattern). In the case of organizational and societal problems, there are usually many more stakeholders involved with conflicting interests. In that case, there is yet another process of problem definition that precedes (logically, not always in time) the conversation with the designer. This problem definition is a *political* process that has nothing to do with the design as such, although there will be a lot of communicative action in it as well. Attempts to solve a political process behind the drawing table are usually futile; the social process has to be gone through.

*The conversational context of design*. If design is put in the broader context of innovation, various conversation types (communicative practices) can be distinguished and need to be cared for in order to achieve success (Denning & Dunham, 2006), for instance, "stimulating adoption". The advantage of identifying these various conversations is that the term "design" can keep a focused meaning The embedding of design (and design research, for that matter) in conversations subsumes several of Hevner's guidelines (problem relevance; design evaluation (partially); communication of research).

## 3.3 Evaluation

It can be concluded that a communicative perspective on design is not only possible but also provides a rather faithful account of what designers actually do. It is hard to foresee all consequences of adopting this perspective in a prescriptive way, but I want to mention the following possible benefits:

- First of all, the perspective accounts fully for the *creative* nature of design. Just like speech acts do things with words, so designing is doing something, a form of productive action. This creativity is something that should be encouraged and appreciated in its own right, especially in IS curricula.
- The design process is a co-evolution of signs and concepts. Design students should be taught ways of transforming representations in other forms that may provide new insight. Sometimes this form is a formal representation in logic; but it may also be a simulation, or a graphical composition. For routine design (e.g. a standard data modeling problem), a given set of representations (modeling languages, modeling patterns) can be sufficient. For creative design we can say that the more representations the designer has at his latent disposal the better. Academic IS curricula should aim at providing the students with a broad repertoire.
- Over several decades, the IS community has developed many proven modeling techniques and modeling tools. New modeling tools, e.g. on the basis of software agents or computer gaming, are coming up. It is reasonable to assume that many of these tools and techniques can be applied in other domains (engineering disciplines to start with) as well. This may be an interesting "by-product" of the IS research community (and CS). Although creative design itself is hard to automate, it is possible to support the manipulations of representations by means of IT. This support will only grow the more our world becomes digital.
- The conversations in which the design is embedded should follow Grice's maxims of being relevant, clear, etc (Grice, 1973). Designers should be able to communicate effectively with their (non IT) customers. For design researchers, the main customer is the research community itself, and conversation takes place in articles, review procedures, conference presentations and workshops. The second major customer is the community of practice of IT professionals.
- For the initial sketches and intermediate representations in the design process a certain *ambiguity* is a feature. It allows the designer to move from one meaning assignment to another. For instance, an instantiated ER model is both a descriptive model of entities in the domain, and (subsequently) a prescriptive model of the entity representations in the database. IS students must learn when ambiguity is useful and when it is not.
- Design is not only embedded in conversations, but because of that, it should be seen also as a *social practice*, not just an individual cognitive process. Even if the designer works on her own, at some point her results are submitted to someone: the community of practice, the research community or society as a whole. This gives designers a responsibility to listen to the ongoing conversation in the social environment. It should be acknowledged that design results most often provide parts of the solution, pieces of the puzzle. In the end, all these solution components together may provide a lasting innovation, so it is important that these solution components are published and shared.
- In the perspective developed here, design consists of communicative moves. This suggests that design may very well be realized as a social process. The interpretation-transformation cycle will prosper when different actors can put different in-

terpretations on the table. Some IS researchers are exploring already the idea of setting up the design process as a game (Hoppenbrouwers et al, 2009).

- Last but not least, the communicative perspective may help to do full justice to the *context-dependent* character of design. A speech act is nothing in itself; it is the way it transforms a (largely underspecified) context into a new stage. As a consequence, the value of general rationalistic methods such as pursued in design science is bounded. A communicative perspective appreciates Cross's skepticism in this respect.

# 4 Conclusion

In this paper, we have explored a communicative perspective of design. This perspective makes a difference between design and design research. The primary objective of design research in IS, as research, is to produce theory; in particular, validated statements about the effect of existing or new design methods. New design methods in IS often involve the use of new modeling techniques and/or new automated systems, so designing the latter is an important and often necessary research activity (as designing an experiment is an important research activity in positivist research). The unity of IS is not based on a single research paradigm but on a single object: the Information System.

A communicative perspective on design has certain advantages over other perspectives, such as "design as search". It provides a good understanding of what designers do, and suggests new directions in IS education. The communicative perspective on design, and the modeling tools developed in the IS community, may also be of growing interest to other design disciplines.

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