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The Social Role of Design Representation

Susan Keller
School of Information Systems, Deakin University, susan.keller@deakin.edu.au

Jennie Carroll
School of Property, Construction & Project Management, RMIT University, jennie.carroll@rmit.edu.au

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Dr Susan Keller
School of Information Systems
Deakin University
Melbourne, Australia
Email: susan.keller@deakin.edu.au

Associate Professor Jennie Carroll
School of Property, Construction & Project Management
RMIT University
Melbourne, Australia
Email: jennie.carroll@rmit.edu.au

Abstract

Design representation is a crucial part of all design activity. Representations provide a vehicle through which design ideas and decisions are explored, communicated and recorded. Since representation is so fundamental to design, it follows that a deep understanding of the nature and use of representation has the potential to improve current design practice. While there is recognition in the IS literature of the importance of representation, previous IS research has focused almost entirely on the functional aspects of representation, in particular modelling to support various methodologies or particular aspects of design such as database, object-oriented or process modelling. Since the development of an information system is a socio-technical process, this paper argues that we need to understand how representations can facilitate both the specification of the artefact, and the social aspects of design. This paper explores the use of design representation by real-world practitioners. It identifies two hitherto neglected social purposes of representation employed by designers when interacting with clients or users: selective focus, and promotion. The paper concludes by noting that as IS faces increasingly complex design challenges it is timely to examine our understanding of all aspects of design representation including its role in facilitating the social aspects of design.

Keywords

Design, representations, design practice, case study, interpretive research

INTRODUCTION

Representations play a key role in the design process, allowing designers and other stakeholders to give form to their ideas and to reason about the various aspects of the design (Suchman 1994). They also provide a focal point for discussion, express temporary agreements and record design decisions (Perry and Sanderson 1998). Yet, despite the importance of design representation and nearly forty years of research on various modelling techniques, many aspects of the use of representation in Information Systems (IS) remain relatively unexplored. The functional aspects of IS representation, related directly to the specification of the IS artefact, have received much attention. However, there is surprisingly little understanding of the role that representations play in facilitating the important social aspects of design and indeed very little research on how practising designers work with a variety of representations, especially in innovative IS design. This paper argues that, as the development of an information system is a socio-technical process (Avison and Fitzgerald 2003), it is important to examine the ways in which design representations facilitate or hinder the intrinsic social aspects of design. This social view of design representations presents a very different perspective to the functional view of representation encountered in much of the IS literature.

The paper is organised as follows. The background of the research is discussed first. This includes defining design representation and reviewing existing IS research into representation. Next, the research design and selection of three cases is described. The cases are discussed individually, then a cross case analysis is performed. Two findings (selective focus and promotion) relating to the social role of representation are discussed using a communication theory lens. Two sets of heuristics to assist designers of innovative information systems are presented. The first focuses on lessening the misinterpretation of representations. The second may be useful for promoting the design. The paper concludes by noting that as IS faces increasingly innovative and complex design challenges it is timely to examine our understanding of all aspects of design representation including its role in facilitating the social aspects of representation.

BACKGROUND

Representation defined

How we identify and define a phenomenon limits what we will discover about that phenomenon (Sansone et al. 2004:6). In IS, representation is defined very narrowly. Typically, only formal models are classified as representations, so most IS research on representation is focused on formal models such as Entity-Relationship, process and object-oriented models. Other work has described the use of models as part of particular methodologies (see for example Avison and Wood-Harper 1990; Checkland and Scholes 1990). A few researchers have viewed representation more broadly: Sarkkinen and Karsten (2005) acknowledge the importance of verbal representations to the design process and, in the HCI literature, Bodker (1998) includes prototypes, scenarios and mock-ups in her description of representations.

Even within the broader design literature there is no agreed definition of what constitutes a design representation. In fact, few scholars have attempted a definition. Petersen (1996) defines a representation as 'a notation together with an interpretation' which highlights the important point that representations are interpreted. However, as a definition it is too narrow because 'notation' suggests only physical representations, yet the importance of verbal utterances and gestures in exchanging and developing design ideas is well established (Brereton 2004). Saddler (2001) offers the following broad definition: 'a perceptible expression of a design idea, proposal, or fact'. This definition suggests that design representation is broader than models and also that representations must be perceptible, in other words, exist outside the designer's head.

Design representation in IS

In IS, the functional role of representation that relates to the development of an IT artefact dominates both textbooks and the academic literature. As an indicative survey of the lens through which representation is viewed in Information Systems, the top six analysis and design textbooks held in Australian libraries as well as the seminal IS methodologies book by Avison and Fitzgerald (2003) were examined. The results are detailed in Table 1 below:

Author	Treatment of representation
Shelly, Cashman, Rosenblatt (2008)	Representation not explicitly addressed but modelling and prototyping mentioned as techniques analysts can use to describe and simplify an information system. Business, data, object, network and processes can be modelled.
Kendall and Kendall (2005)	Representation not explicitly addressed but models including DFDs, ERD and OO models are discussed as part of the treatment given to various approaches and phases in the systems life cycle.
Whitten, Bentley & Dittman (2004)	Representation not addressed in detail, although there is a glossary entry on model which reads 'A representation of either reality or vision. Most models use pictures to represent the reality or vision'. A chapter introduces model-driven analysis (such as structured and OO analysis) as an approach that 'uses pictures to communicate business problems, requirements, and solutions'.
Hoffer, George & Valacich (2004)	Representation not explicitly addressed but the book contains sections on conceptual data modelling, logic modelling and process modelling.
Avison and Fitzgerald (2003)	In discussing process and data modelling, makes the point that graphical models facilitate user involvement. Points to one advantage of OO modelling as improving the analyst-user relationship because the 'approach can be understood equally well by both'.
Hawryszkiewycz, I (2001).	Includes a section on the importance of models as tools to develop understanding of the system and for communicating it in a precise way. Makes the point that different models are required for different purposes and stages in developing an IS.
Senn (1989)	Not explicitly addressed but representations such as decision trees, DFDs, ER diagrams etc are listed as tools as part of the treatment given to the various phases of the system life cycle.

Table 1: Treatment of representation in IS textbooks (most recent texts first).

Of the six most popular textbooks, only Hawryskiewycz explicitly covers representation and then only in terms of models. Overall, models are introduced as tools in the context of various modelling tasks. While these analysis and design textbooks acknowledge the importance of the social aspects of designing and implementing

information systems, the role that design representations play in these social aspects of design is hardly mentioned.

The same emphasis on the functional role of design representation is also reflected in the IS literature. The earliest studies on representation appeared in the late fifties and were concerned with notations to assist in the specification of computer artefacts (Bubenko 2007). Research efforts were focused on representing data, and operations on data. This work continued through the sixties and laid the foundation for the modelling notations of the seventies when the database community was very active in data modelling research fuelled by Codd's (1970) seminal paper on the relational model (Bubenko 2007). During this period there was also a mushrooming of more or less similar modelling languages and concepts, but dataflow diagrams (e.g. DeMarco 1979) and the Entity-Relationship diagram (Chen 1976) were important developments. The eighties saw the rise of the Object-Oriented (OO) paradigm and various competing OO modelling techniques. That is, the emphasis of this work was on representation for specifying the IT artefact.

It is also important to note that most of the work on representation in IS is prescriptive in nature; studies of how practitioners actually work with representation in the field are scarce (Rittgen 2007). Indeed, an extensive review of the literature surfaced only five field studies focusing *specifically* on design representation over a thirty year period although several other field studies comment on representational use (see for instance Walz et al. 1993). Of the five studies focusing *specifically* on representation, three (Beynon-Davies et al. 1999; Bryan-Kinns and Hamilton 2002; O'Neill et al. 1999) were motivated by furthering user-centred design. The other two studies (Cherubini et al. 2007; Freeman 1978) took a designer/developer perspective. While these studies contribute valuable understanding of representation, they are all limited in scope. Freeman (1978) and Cherubini et al. (2007) focus on the technical aspects of design from the designer or developer's perspective. Although both acknowledge the role representations play in communication, the role representations play in supporting designer thinking predominates. In contrast, O'Neill et al. (1999), and Bryan-Kinns et al. (2002) focus on user-centred design. O'Neill et al.'s (1999) study looked at the strengths and weaknesses of task models and paper prototypes in facilitating cooperative development with users. Bryan-Kinns et al (2002) looked at the use of prototypes in user-centred design and theorised a relationship between the fidelity of the prototype, target audience and the stage of the design activity. Benyon-Davies et al. (1999) found that prototyping (especially of the GUI using 4GL development environments) was used in most projects and offered both benefits and drawbacks. Although all researchers defined representation in broader terms than formal models, only Freeman included non-physical representations such as discussions. What we do know definitively from these field studies is that the representations that become part of the formal specification of the IT artefact make up only the smallest fraction of the representations that designers create.

RESEARCH METHOD

Since the use of representation in innovative practice is poorly understood, an interpretive case study approach was employed. Interpretive studies are valuable in illuminating 'human thought and action in social and organization contexts' and providing 'deep insights into information system phenomena' (Klein and Myers 1999). The research focus was on understanding representational use by IS designers working in professional contexts. Multiple cases were studied to allow comparison, provide depth to the research and ensure that theorising was not based on the characteristics of one site or set of designers (Glaser and Strauss 1967). Cases were selected using a purposeful sampling approach called heterogeneity sampling, or maximum variation sampling (Patton 2002:235). The strength of heterogeneity sampling is that themes that arise out of variation 'are of particular interest and value in capturing the core experiences and central, shared dimensions of a setting or phenomenon' (Patton 2002:235). Since the research aim was to investigate the full range of design representations used by designers, we used Saddler's broad ranging definition of representation ('a perceptible expression of a design idea, proposal, or fact'). Heterogeneity sampling was ideal for this study because we were focusing on all the different types of representations used across the design process (rather than focusing on a particular type for one purpose, for instance ER modelling). Since the research focus was on innovative IS in particular, the cases were selected on the basis of the novelty of the systems that designers produced.

Data gathering involved interview and document analysis. All interviews were conducted at participants' business premises where there was ready access to examples of design representations. This was an important means of triggering recollection of the process of representation use. Interviews were guided by a semi-structured interview schedule which focused on issues about the organisation, the participant, the design process, and the use of representation throughout the design process. Interviewees were asked to walk through representational use for both a particular project and more generally. These interviews were tape-recorded with the consent of the participants and transcribed verbatim. Notes were also taken; these included interesting comments for follow-up, impressions, insights, and the inevitable important comment made by participants after the tape-recorder was turned off.

The hermeneutic cycle was used as the basic high-level analytical technique for this study. The data from all cases were analysed using standard inductive techniques including coding and thematic analysis (Miles and Huberman 1994). Where possible, member checking was used to verify findings with participants after the research was conducted.

SOCIAL LIFE OF REPRESENTATIONS: INDIVIDUAL CASE ANALYSIS

In this section, the individual case studies are analysed. The organisation, designers and data collection method are briefly described first. Then, in the context of their respective design process, the details of how and why designers use particular representations is explained, focusing especially on the social aspects of design. All the names of organisations and people discussed in this paper are pseudonyms.

Cobblestone Designs

Cobblestone Designs is an award-winning design company specialising in the design of large multi-sensory exhibits which incorporate an IS component. The company undertakes projects such as museum exhibits, which may incorporate visual elements, physical elements and interactive elements; interactive CD ROM design; websites; and audio visual productions. Their work blurs the boundary between IS and other types of design. Data collection included examination of design representations and a two-hour interview with Graham, the co-owner of Cobblestone Designs. Graham is a highly regarded designer with over 20 years of experience in interactive design.

The design process employed by Cobblestone Designs does not follow a standard methodology; rather, it is an informal process that is adapted to fit individual design situations. Many jobs are won by tender. A competitive tender must be able to excite the potential client. Representations play an important role in this. The characteristics of the representations that Graham believes add to this excitement are: *'colour, movement, a sense of style, a sense of the unusual, the new, the different'*. Graham believes too much detail at this stage is counter-productive but on the other hand *'... you really need to go into enough detail to convince the client that you can do the job'*.

Regardless of how a job is secured, initial client meetings consist of verbal discussions, supplemented with whiteboarding. Graham described the importance of whiteboarding to the process: *"It's so easy to sketch up an idea, erase it, throw up another idea, all in a brainstorming session where everyone can see it and contribute. The 'hi-tech' whiteboards let you print off what has been drawn, and these printouts can become the basis for design documents"*. From this initial meeting, the designers take away an agreed direction and then produce concrete design representations to present back to the client. These will include textual descriptions summarising what was discussed, and a detailed account of how the company plans to approach the design. Next, designers produce a variety of other diagrams such as storyboards, navigational flowcharts, ER diagrams, textual content of interactive components of the design, and preliminary graphic designs. Storyboards are used to focus attention on functionality. These may take the form of a series of PowerPoint slides or a series of screens drawn on paper. Graham describes how he creates the storyboards: *"it's just like plain text and plain rectangles and little rectangles with words in them that represent the buttons or the touch points and so on, but completely absent of any graphic design or content. That's a very conscious decision. I try to keep my storyboards completely free of any graphic design look because what you don't want is the client to pick up on graphic design work at that stage, you want them to concentrate on the functionality"*.

Preliminary graphic designs for each screen of the interactive are prepared for the client. Textual elements on each screen are represented using Lorem Ipsum (a dummy text). Graham describes the use of Lorem Ipsum: *"Again it's a very deliberately abstract thing. You don't want them saying 'Oh, they've spelt my name wrong', you want them to say 'Oh yeah, there's going to be some text here'. So it is a process ... it's interesting to talk to you about this because I haven't thought about it before, but you're kind of focusing the client on the particular issue at hand at that time, and so with Lorem Ipsum they say 'Oh yes, I like that font' but they can't say 'Oh no, that's not correct, we actually have 2000 employees not 200'."*.

In data-driven projects, ER diagrams are used to reason about the structure of the data. These are shared with clients for two reasons. Firstly, because: *"it is due documentation and again it's a comfort factor for them. Even if they may not thoroughly understand, they can see that you are making progress and you've got something for them"*. Secondly, it is often a useful exercise to work through technical documents with clients to uncover erroneous assumptions and hidden requirements.

Face-to-face presentation of representations is preferred, but sometimes this is too difficult if the client is not located in the same city. However, Graham believes the final system presentation should be face-to-face because*: 'Again it's the completion of the social contract. They have given you their trust and you're now handing over the final thing'*.

Leading Light

Leading Light is a very successful multi-media company with an emphasis on educational software and websites. It employs a pre-determined development process and tends to have projects of short duration. Data collection consisted of an examination of representations; over two hours of interviews with Stan the project manager and interaction designer; and a one hour interview with Jack, the graphic designer. Stan has over 18 years experience in IS in a variety of roles and Jack has 9 years experience as a graphic designer.

Leading Light specialises in multi-media systems. The focal project involved the design of an interactive system for an existing public exhibition which was being extensively redeveloped. The scope of the project was small because the client provided a very detailed description of the screens required. The project began with the client passing onto Leading Light a reasonably complete proposal and storyboard. This storyboard contained a screen-by-screen description of the client's requirements. These storyboards are different from the storyboards created at Cobblestone Designs, in that they include a textual description of required functionality and imagery. The storyboards created at Cobblestone Designs only contain plain text and rectangles to represent buttons or touch points.

Tom (one of the designers) first created an interaction map from the client's proposal. The interaction map consists of rectangles to represent screens, and arrows that show the flow and pathways between the screens. This representation was used to determine if there were any gaps in the logic of the storyboards. Next, as a way into thinking about the design, Stan used the storyboard information to create an initial version of the wireframes. Wireframes show the wording, functionality, and what is on each screen but do not include layout. That is, wireframes are not meant to imply the position of any element on the screen, or any visual design. The reason the visual layout and functionality are separated is because it is easier to change business rules and functionality than it is to change the visual design. Stan explained that wireframes often present difficulties because people become confused about their meaning, but the problem becomes even worse if the wireframes are more screen-like. He described the difficulty like this: *"The worst thing you can do is present something that has colour and style to it. It is the same when they look at prototypes, or we sometimes create what we call a 'whitesite' which is the wireframes actually working, just to show functionality. You say 'these are not the finished art-work they are just a rough representation so you can see the functionality, the activity working'. The first thing they will say is 'I don't like the way it looks'. ".*

Usually Jack begins the process by creating a visual concept. From this concept, he then designs at least one of each type of screen before calling a client meeting. The meeting is always face-to-face, and Jack will walk through and explain his design. Stan explained the importance of the face-to-face meeting: *"People need to have it explained to them, to interact with you, to know your reasoning behind things, otherwise people tend to come away with much more negative response than if you walk them through. Same thing with the wireframes, it works much, much better if you can explain your ideas".* He elaborated on the issue of interpretation: *"It is like if you give them a cup they will say 'yeah' but if you give it to them and say the good things about this cup are ... you get a different response because you, as the designer, carry in your head so much more knowledge than you can describe in text or pictures. What you want to do is remove their interpretation and instil your interpretation of it."*

Unique Designs

The third case was Unique Designs, a small software engineering group affliated with a university reseach group. It designs and builds novel software applications often with limited upfront requirements. This case offered the opportunity to investigate the type of representations designers use when requirements are unclear. Data gathering consisted of a total of 5 hours of interviews with four participants (Matthew, Anna, Hugo, Len) in addition to the study of design representations they used.

The group does not employ a standard methodology but they do favour prototyping. Paper-based prototyping is often used by the group to clarify understanding of the requirements. Using paper-based representations to work with the client has two advantages. One, it is quick and easy to make changes; and two, it is less concrete, which emphasises the provisional nature of the proposed design. In other projects, computer-based screen mock-ups are used early in the process to facilitate both elicitation and clarification of requirements. Matthew commented that, for some clients, the computer-based mock-ups work better than paper ones because they enable the client to more accurately envisage how the system will work. Additionally, the concrete nature of a computer mock-up formalises Matthew's understanding of the requirements, making it easier for the client to either confirm or reject the understanding.

Anna described another important purpose of representing screens on the computer rather than paper. The group had just commenced a project for which a third party had developed the requirements. The requirement document included sample screens. Anna translated the paper-based screens to computer-based screens in

conjunction with consulting the provided process flow-diagrams. This exercise surfaced inconsistencies and areas of uncertainty which she was able to discuss in an early meeting with the client. This has parallels with the Leading Light case where Stan created wireframes, from the supplied storyboards, to surface questions he intended to ask the client during the first face-to-face meeting. Both examples highlight the utility of moving between different types and forms of representations to deepen understanding and to surface inconsistencies.

SOCIAL LIFE OF REPRESENTATIONS: CROSS-CASE ANALYSIS

The three cases show that representations are interpreted in diverse ways and that misunderstanding of representation is inherent in the design process. Without exception, every designer interviewed for this study described how representations may be misunderstood by clients and users, and commented that to some extent it was inevitable. Misunderstandings between designer and client can, at worst, result in the client losing confidence in the designer, or at best can result in wasted time and unnecessary frustration. Given the consequences of such misunderstandings, designers took active steps to manage clients' interpretations of their representations. Two approaches to managing the interpretation of representations are discussed here.

Using selective focus to reduce misunderstandings

One tactic to reduce misunderstanding of the meaning of representations is 'selective focus'. The findings indicate that communication, especially for the purpose of requirements elicitation and validation, is enhanced by using this approach. The aim of selective focus is to create and use representations to downplay all aspects of the design except the one of immediate interest. Table 2 lists the representational tactics for selective focus employed by designers at Cobblestone Designs and Leading Light.

Focus	Representational Tactics for Selective Focus
Textual content	Text is represented separately from other elements of the design to allow the client to focus on the actual words, without the distraction of other elements.
Functionality/Navigation	Screen representations should not contain any graphics, colour or style. Words associated with interactive screen elements are included but any detailed textual content is represented in Lorem Ipsum (dummy text).
Graphic design/Layout	Representations of screen graphic designs are presented separately from other elements. Any textual content is represented in Lorem Ipsum (dummy text).

Table 2: Representational tactics for selective focus

It is noteworthy that the designers at Unique Designs did not employ selective focus as the following anecdotes illustrate. Matthew recounted his frustration at presenting a colour screen when aiming to elicit feedback on layout and functionality: *"... you give them the screen mock up and they don't like the colour, and we spend the next 10-15 minutes talking about the colour. And colour is the last thing on my mind, it is more the layout, how you are going to use the application"*. Anna also illustrated the danger of using made-up data rather than using Lorem Ipsum as a place holder when she cautioned a colleague to emphasize to the client: *"Make sure they understand that this is only mock data so they don't say 'but you wouldn't begin that procedure now'"*.

Using representation for promotion

Each of the case-study organisations followed its own unique design process. However, each engaged in some form of client acceptance (or sign-off) meeting at particular points of the design process. One such point was at the beginning of the process where the aim was to have the client sign-off on the overall 'design concept'; another point was after some work on an aspect of the design, such as the graphic design or website layout, was completed. The success of these meetings was critical in either winning a contract or moving the design forward, and designers at both Cobblestone Designs and Leading Light purposefully crafted and used representations in ways that enhanced the chance of successfully promoting their design ideas. The designers at Unique Designs did not report the same level of intentionly in promoting their design, perhaps because the organisation is less commercially focused that the others. However, in the other two organisations, designers strive to influence clients' interpretations of the representations they use for promoting. Indeed, the characteristics of the representations used for this purpose were observed to be markedly different from representations created for other types of communication. The power of representations in this regard is not discussed in the IS literature, but in the broader design literature Saddler (2001) argues that design succeeds only by good communication and designers are, in a sense, paid to 'manipulate the thinking of others' and thus must appreciate what message, both implicit and explicit, a representation carries. The findings from this research suggest that certain representational forms and media are associated with successful promotion of the design. The promotional aim and representational approaches observed in the case studies are summarised in Table 3 here.

Aim	Tactics and characteristics of representations
Promote overall 'design concept'.	Ideally this should be a face-to-face presentation. Desirable characteristics: professional, polished, low on detail (only as much detail as necessary to convince client it is achievable), ambiguous, 'what' not 'how', colour, movement, a sense of style, sense of unusual, the new, the different. No representations distributed ahead of time.
Promote one aspect of the design – such as graphic or web design.	The aim is to instil designers' interpretation, so it is vital that representations are not distributed ahead of time. If handouts are provided, instruct clients not to look at them until invited. This ensures that clients do not have a chance to form their own interpretation.

Table 3: Examples of representational tactics for promoting the design

A key element for successful promotion is controlling the timing through which the representations are revealed to the clients to create the desired impact and impression. It appears that, the initial reaction of the client can be favourably influenced if the designer presents the representation at the same time as offering an interpretation. As Stan from Leading Light explained "*What you want to do is remove their interpretation and instil your interpretation of it*".

The findings from the three cases also highlight the pervasive nature of representational use and the importance of context. Representations are used extensively throughout the design process, and confirm earlier observations in earlier studies that most of the design information is not captured in formal models (see for example Walz et al. 1993). The findings also show that representational use needs to be understood within a context. The same representation can either inhibit or enable the social aspects of design depending on both the context and the properties of a particular representation. For instance, a diagram roughly sketched can imply preliminary ideas, or in another context an unprofessional approach. A representation produced on physically small media may enable individual work but can inhibit group work (O'Neill et al. 1999). A complex representational form may enable communication with a colleague but act as a barrier to shared understanding with clients/users.

DISCUSSION

Perhaps the most surprising observation arising from these case studies is that while the notions of selective focus and promotion are obvious concepts, the literature on design representation has neglected them. Indeed, the role that design representations play in facilitating the social aspects of design has largely been ignored. This may be because most of the research on design representation in IS has not been based on the study of design as it is actually practiced. Without such field studies the more subtle use of representation for social rather than functional purposes may be missed. Another explanation is that IS is a relatively new discipline and hence the discourse has not progressed past the functional role of representation. In more mature disciplines, discussion on the social role of representation is well established. For instance, in the field of engineering design, Perry and Sanderson (1998) observe that representations 'trigger conflicts and collaboration' and are the 'foci of much of the social interaction'.

Selective focus and promotion are techniques used for the benefit of the designer. In the case of selective focus, the aim is to complete the design process in the most cost effective way, and in the case of promotion to win or progress work. For both techniques, designers carefully craft the representations to aid their cause. From this perspective, Saddler's (2001) notion of rhetorical intent is relevant. Saddler argues that successful designers need to be aware of the rhetorical intent of their representations. The rhetorical intent, whether to inform, to persuade, propose, insist or suggest, needs to be supported by appropriate representations. The findings from this research suggest that designers at Leading Light and Cobblestone design did understand the rhetorical intent of their representations and used various means to manage the interpretations of the clients. Designers at Unique Designers did not appear to have the same awareness.

Since selective focus and promotion are special types of communication, the communication literature, in particular Wilbur Schramm's (1954) theories may also provide a useful lens for understanding how design representations can facilitate or hinder communication. Schramm extended earlier work by Lassman (1948) and Shannon and Weaver (1949) to produce several models of communication. Unlike earlier linear models, Schramm envisioned communication as a two-way circular process between sender and receiver (see Figure 1). The sender (in this case the designer) decides what is intended to be communicated then encodes the message and transmits it via a signal (in this case a design representation). As the receiver (client/user) decodes this signal, it is interpreted based on the context and his/her own experience. Both sender (designer) and receiver (client/user) exist in their own fields of experience, and communication can only take place if these fields overlap; the less overlap, the more difficult the communication process. Schramm also included the notion of

noise. Noise can be either physical (telephone, sirens, etc) or semantic noise which arises out of the different meanings people attribute to words, inflections in voice, body language, and in the case of design representation the different meanings people attribute to different representational forms. Since semantic noise is difficult to detect it is a more serious barrier to effective communication than physical noise.
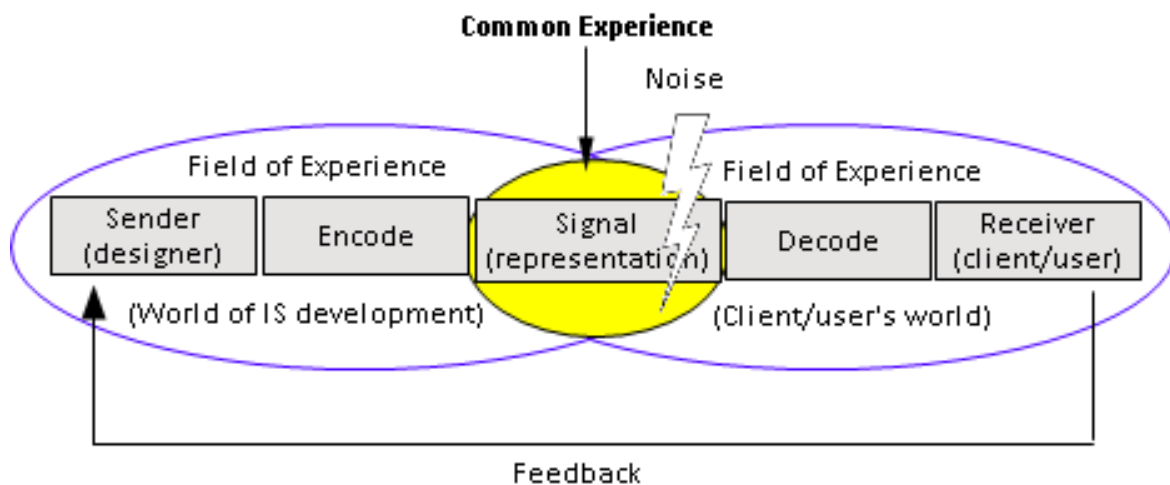

Figure 1: Schramm (1954) communication model

The interpretation of representations was an important theme in the findings. Schramm suggested that interpretation occurs as the receiver decodes the message. This may explain the importance designers placed on talking clients through representations rather than allowing them to 'decode' them independently. However, the findings from this research also show that design representations are easily misinterpreted. Schramm's communication model offers a partial explanation for this with the concept of common experience. A formal model may enable easy communication with a colleague because there is a large overlap in the sphere of common experience with that particular representation. Usually, there is not such a common field of experience between designers and clients/users. Another explanation may be the highly abstract nature of most design representations. There are two main mechanisms for abstraction. The first involves removing detail so that a salient issue is highlighted. The second involves generalisation as a means of identifying the essence of an issue (Kao and Archer 1997). Design representations can use either of these two mechanisms. Abstractions are powerful because they can make the complex simple but in doing so the rich context of the communicators' field of experience is lost. Thus, by their very nature, representations require extensive interpretation.

CONCLUSIONS

To date, the scope of IS research into design representation has focused almost exclusively on the functional role of representation. This paper argues that representations also have an important social role which, as yet, has received little attention in IS research. One such social role is facilitating communication, and this paper focuses on the communication between designer and clients/users. The empirical findings highlight the fact that representations are interpreted and identifies two ways that IS designers seek to manage clients' interpretations; one using selective focus and the other for promotion. The heuristics employed by designers for each, are presented in Tables 2 and 3. In addition, although not the focus of this paper, the findings also point to other social uses of representation such as *'the comfort factor'* and *'completion of the social contract'* as reported by Graham from Cobblestone Designs. Representations are clearly not the simple functional tools that the IS literature suggests.

This paper contributes to IS research and practice in three ways. First, it draws attention to the importance of a wide range of representations, not just models, that are employed in IS design practice especially innovative practice which to date is lacking in the IS literature. It also describes how representations are used throughout the design process, not just at one particular time point (design of the database, for example). Secondly, it demonstrates the important role representations play in the social aspects of design and notes two particular communication purposes of representation in IS design that have received little attention: selective focus and promotion. Third, it suggests a number of heuristics drawn from the case study work. This has implications for improving IS design practice. Typically, in order to improve practice, one of two approaches is suggested. The first approach is to prescribe new practices. The efficacy of this approach is contested possibly because, as van Aken (2005) argues, problems are always context related. The second approach is to understand practice (Humphrey 1989) and use this as a basis for suggesting improvement. Successful designers can be studied with

the aim of producing heuristics which may help other designers. Van Aken (2005) describes this type of heuristic in these terms: 'if you want to achieve Y in situation Z, then something like X will help'. The heuristics are applied by the professional in the field to a specific problem at hand. The heuristics developed from this research are in this tradition and cover suggestions for managing the misunderstandings that inevitably arise in communication using representations.

Design is a complex socio-technical activity in which representation plays a crucial role. As IS moves beyond stationary computers in a single office to meet the challenges of multiple mobile systems accessed 'anytime, anywhere', it is indeed timely to examine and extend our understanding of representation in order to more effectively support the design and development of novel and innovative systems.

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