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Interpreting Scenario-Based Design from an Information Systems Perspective

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ABSTRACT

To facilitate the evolution of and to better understand human centered technology development in context of business, managerial, organizational, and cultural contexts, the study of HCI in the MIS discipline is becoming increasingly important. In this paper, we attempt to conflate analytical and design methodologies from the Information Systems and Human Computer Interaction literature. HCI literature acknowledges that people will generally envision scenarios in different ways based on implicit assumptions that orient their interpretations. These assumptions can lead to different design consequences. We propose the use of scenario metadata with scenarios as a method for making these assumptions explicit so that stakeholders, including designers, are more aware of their design assumptions. We structure scenario metadata by leveraging three major constructs from the Information Systems literature: technology, information, and people.

Keywords

Scenario-based design, information systems, design rationale.

INTRODUCTION

HCI can be viewed from different lenses depending on the particular domain. The panel discussion on the multi-disciplinary nature of HCI (Galletta, Lazar, Olson, Te'eni, and Tremaine, 2003) acknowledges at least four different disciplinary views: business, computer science, information science, and psychology. Computer scientists have traditionally focused more on developing technologies for the computer interface, psychologists concentrate more on individual issues, and MIS researchers attempt to bring together the technology with the individuals (Galletta et al. 2003). Specifically in this paper, we propose a way to bridge analytical techniques from MIS and Information Systems with design methodologies in the traditional view of HCI.

HCI research has progressively integrated its scientific concerns with the engineering goal of improving usability of computer systems and applications, and continues to provide a challenging domain for applying and developing psychology and social science in the context of technology development and use (Carroll, 1997). Grudin (1994) discusses the evolution of HCI by mentioning that systems designed to support organizations achieved prominence first, and these research activities have now been labeled as data processing (DP), information systems (IS), management information systems (MIS), and information technology (IT). In the early 1980s, the spread of interactive and personal computing created large markets for applications designed for individuals and groups (Grudin, 1994). In the mid-1980s, the terms groupware and CSCW were coined because of conditions such as inexpensive computational resources, increasingly familiarity with computers, and change in workplace infrastructures (Grudin, 1994). As a result, HCI research seeped into MIS/IT communities.

Generally, in MIS, researchers in HCI are concerned with the ways humans interact with information technologies and tasks, especially in business, managerial, organizational, and cultural contexts (Zhang, Benbasat, Carey, David, Galletta, and Strong, 2002). MIS/HCI research should direct more effort to interact with research in other HCI-related disciplines or associations to facilitate better exchanges of ideas, benefit from each other's research results, and promote the advancement of the entire Human-Computer Interaction field (Zhang et al. 2002). We attempt to further the inter-disciplinary nature of HCI by dovetailing theories, research techniques, and methodologies from both MIS and HCI.

In this paper, we apply analytical constructs from MIS to refine scenario-based design in HCI. Scenarios are stories about people and their activities (Carroll, 2000). Scenarios have a plot; they include sequences of actions and events, things that actors do, things that happen to them, and so forth (Carroll, 2000). Scenarios are now widely employed in the design and development of computer systems and applications (Carroll, 1995). The use of scenarios is increasingly becoming common to the many disciplinary views of HCI. Since MIS/HCI research focuses on human attitudes, intentions, and behaviors in real

work place settings with current IT (Zhang et al. 2002), it is essential to unfold scenarios for understanding the implicit assumptions made when formulating such descriptions. The use of scenarios in MIS-oriented HCI research should provide context to the comprehension of people, their tasks, the technologies they use and the interplay among them.

MOTIVATION: NATURE OF SCENARIOS AND DESIGN RATIONALE

Authorities in HCI (Carroll, 2002; Diaper, 2002; Pruitt and Grudin, 2003) have recognized that when scenarios are envisioned, people are not conscious of many of the underlying assumptions. Quizzical essays by Carroll and Diaper (Carroll, 2002; Diaper, 2002) have highlighted the importance of divergence in interpretations of scenarios. Carroll believes in maintaining uncertainty within scenarios for evoking fluidity and novelty. He asserts that the deviation in interpretations provides ground for innovation and considers it a resource for collaborators. Diaper, on the other hand, regards this as a concern that may lead to communication problems during design within a team working on a scenario.

In this paper, we seek to curb potential miscommunication about scenarios emanating from implicit assumptions without championing a specific position advocated by the authors above. We propose a refinement to the scenario-based design process proposed by Rosson and Carroll (Rosson and Carroll, 2002) by using scenario metadata to encourage a more conscious and nuanced use of scenarios as a pedestal for design. Scenario metadata do not intend to add structure to or over-specify a scenario. While acknowledging that over-specifying scenarios is a potential pitfall (Diaper, 2002), metadata has the function of placing scenarios in their context of interpretation.

The structural complexity underlying design makes it difficult to track assumptions made during a design process (Moran and Carroll, 1996). Moreover, many of these assumptions are implicit (Moran and Carroll, 1996). Even in the face of uncertainty, designers move forward by making their assumptions that can later prove to be unfounded (Moran and Carroll, 1990). We propose the use of scenario metadata to support a more systematic articulation of design rationale. In general, design rationale is an explanation of why an artifact is designed the way it is (Moran and Carroll, 1996). Design rationale can be used in many ways: a historical record of reasons for the choice of an artifact (Burgess-Yakemovic and Conklin, 1990), a set of psychological claims embodied by an artifact (Carroll and Rosson, 1990), or a description of the design space (MacLean, Young, and Moran, 1989). The use of scenario metadata can help keep track of the underlying assumptions that contributed to such rationale by making them explicit. Given the elusive nature of design, implicit assumptions about technology, information, and people should be grounded as early as possible to avoid later misconceptions that may be detrimental to stakeholders (including end users and designers).

Design is a communication-intensive collaborative activity (Moran and Carroll, 1996). The communication problem is heightened by the fact that the various stakeholders speak different disciplinary languages, are motivated by different values, see different issues while looking at the same design problem, and have different interests (Moran and Carroll, 1996). In this context, the use of scenario metadata has the purpose of reducing this communication gap by highlighting assumptions about three inherent, universally understood constituents of scenarios: technology, information, and people. Scenario metadata can assist the explication of design rationale between different stakeholders by establishing common ground (Clark and Brennan, 1991). This common ground is achieved by explicitly communicating and negotiating assumptions about scenarios (which we reduce to technology, information, and people). Designers are also historically aware, often building on previous designs (Moran and Carroll, 1996). This process of making metadata explicit may decrease such historical biases that designers have by leveling their knowledge with other stakeholders.

ADOPTING FROM THE INFORMATION SYSTEMS LITERATURE

We define scenario metadata as revolving around three interdependent constructs: *technology*, *information*, and *people*. The use of technology (T), information (I) and people (P) constructs (which we call the TIP constructs) has been adopted from Sawyer and Chen's analysis (Sawyer and Chen, 2002) of the Information Systems (IS) literature. Scenarios, as they currently stand in HCI literature, can be rethought as a structure involving interrelations among three constructs:

1. *Technology*: different forms of information and communication systems.
2. *Information*: characterization of data in an organized context for use.
3. *People*: characterizations of stakeholders, their structures, and their actions.

Scenarios inherently—directly or indirectly—speak about these TIP constructs since they are narrations about people using or affected by technology. However, scenarios are not just about people and technology; they are also about how information is transferred, transformed, and used in context. Different design consequences can result if different perspectives on the TIP

constructs are taken. Our goal in this paper, as a broader objective for HCI designers, is to realize these differences by making these perspectives explicit as scenario metadata.

The meanings of these three constructs are often implicit and even underdeveloped in current IS research (Sawyer and Chen, 2002). Sawyer and Chen (2002) provide initial working definitions of these constructs that we have adopted for endorsing our view of using scenario metadata.

Sawyer and Chen have adopted the technology construct from the characterizations of information and communication technologies as developed empirically by Orlikowski and Iacono (2001). According to them, there are five generalized approaches to representing the scholarly discourse in IS of what is meant by technology.

- *Tool view.* Technology is characterized to operate as it was designed to behave. The roles of technology and its features are seen as primarily technical in nature and direct in their effect.
- *Proxy view.* This view endorses that critical aspects of technology can be captured by surrogate (usually quantitative) measures, such as individual perceptions, diffusion rates, or dollars spent. Proxy views of technology focus on making clear the ways in which the measure highlights the value of technology.
- *Ensemble view.* This characterization of technology is one where specific artifacts and people are interdependently connected through roles, uses of information, and actions. This view draws explicit attention on the ways of using a particular technology, emphasizing the role of socio-technical arrangements.
- *Proof of concept view.* This view highlights the construction of computational artifacts, where the artifacts instantiate ideas or theories of information processing. The focus of this view is on providing evidence of a concept by developing a computational artifact, be it in an algorithm or model form.
- *Nominal view.* In this view, the characterization of technology is implicit. Often the particular technology is named, but the features, functions, model, or proxy are not defined.

In order to define information, one must consider the debate in explicating differences between data, information, knowledge, and wisdom (e.g. Cornelius, 2002). Refraining from such debates, we simply characterize information as having the following views (Sawyer and Chen, 2002).

- *Object view.* Information is a discrete entity that can be passed from sender to receiver with no loss of value, something that can be stored for later retrieval, or something that can exist and be understood on its own.
- *Embedded view.* Information is part of a larger entity. In this way, information is considered tacit (Brown and Duguid, 2000), co-constructed through discussion and embedded into the design of organizational structures.
- *Naïve view.* In this view, the meaning of information is never made explicit or there are multiple inferred meanings with no over-arching discussion of the conceptual issues with a pluralist approach to depicting information.

People can be conceptualized in the following ways (Sawyer and Chen, 2002).

- *Individuals.* This is typically a psychological perspective. This view engenders the traditional view of people in HCI where individual users interact with their computers in isolation of other entities.
- *Social agents.* This view characterizes people as aggregations and not as individuals. In this view, collective attributes and behaviors are the focus and individual variance is not central.
- *Naïve view.* This view of people is not grounded in theory. The difference from the first two characterizations of people is that it does not presuppose individual differences and/or aggregate/collective characteristics and behaviors, just the absence of a credible theoretical base.

By adopting different combinations of views on technology, information, and people, scenarios will evolve into different designs. Note that TIP constructs are not orthogonal—choosing a specific view on one of the constructs will generally have logical implications for the views adopted for the other two constructs. For example, if information is discrete data, people are likely to be thought as individuals processing data, using technology as a tool to facilitate this process.

Consider the following combination of views on the TIP constructs. A tool view of technology results in a differently designed system as opposed to an ensemble view, since the former will focus more on features of the artifact and the latter on interdependence of artifacts and people connected through roles and actions (Sawyer and Chen, 2002).

Another combination of the TIP constructs could be a proxy view that conceives technology in terms of individuals' perceptions. In this case, information is embedded in the interaction between the people seen as individuals interacting with the technology. This perspective will likely emphasize issues about system usability, users' reactions to interface features, and quality of the interaction.

We refer to the different perspectives on the TIP constructs as *scenario metadata*. By realizing or communicating scenario metadata in addition to just the scenario, designers and end users can better negotiate design requirements. Moreover, this will enable designers and end users to clarify their own interpretations of scenarios and design rationale. Scenario metadata can also influence how claims are generated and analyzed. The following section gives an example of how scenario metadata can be used in a scenario-based design process.

USING SCENARIO METADATA

In their book, Rosson and Carroll (2002) take the example of students putting a science fair online. This example was used as a case study throughout the book to explain the scenario-based design process. For illustrating the use of scenario metadata, we consider an abridged scenario of the science fair case study describing the situation in which the student (Sally) is designing her online science project.

Sally plans to transform her poster board science project on black holes into an online exhibit. This year she wants to use new methods, such as simulations, to make her scientific explanation about black holes easier to understand and more engaging than last year. When Sally goes online to the exhibit construction area, she finds templates of simulations with ready-to-use visualization components (e.g., videos, animations, etc) that she can adapt to illustrate her theory.

Figure 1. Scenario of putting Sally's science project online.

While interpreting the above scenario, different stakeholders can adopt divergent perspectives based on their assumptions about technology, information, and people. To exemplify this, we describe two sets of scenario metadata underlying contrasting assumptions. One set of metadata could be the following, as illustrated in Table 1. A *tool* view of technology is taken where the focus is on the artifact as a means of improving productivity and processing information. The adoption of a tool view affects the perspectives on the other two constructs (information and people). In this case, information is likely to be characterized as an *object* and a discrete entity: something that can be exchanged between sender and receiver with no loss of value, something that can be stored for later retrieval, or something that can exist and be understood on its own (Sawyer and Chen, 2002). Since the primary concern of putting the science project online in this scenario metadata is improving performance, people are characterized as *individual* performers and information processors (Card, Moran, and Newell, 1983).

Construct	Construct View
Technology	<i>Tool view</i> : focus on improving productivity and information processing. Online exhibition simply has features that should be efficient and usable.
Information	<i>Object view</i> : information is a discrete entity. Information is something that can be simply exchanged between the user and the computer.
People	<i>Individual view</i> : people are performers and information processors. They act alone without any social context.

Table 1. First set of scenario metadata as a tool-object-individual perspective.

Consider the following contrasting set of metadata, depicted in Table 2. An *ensemble* view of technology does not focus on the features of the artifact; rather, it emphasizes that artifacts and people are interdependently connected through roles and the relationships between these roles. An ensemble view of technology highlights the social context as the milieu in which the artifact exists. This characterization leads to an *embedded* view of information where information is distributed, co-constructed through discussion, and embodied into the design of organizational structures (Hutchins, 1995; Sawyer and Chen, 2002). Consequently, people are *social* agents and the focus is on collective attributes and behaviors while individual variance is not central (Sawyer and Chen, 2002).

Construct	Construct View
Technology	<i>Ensemble view</i> : artifacts and people are interdependently connected. Online exhibition affects people's behaviors and should be structured according to different roles.
Information	<i>Embedded view</i> : information is distributed across people and artifacts. Information is co-created within the larger context of the online exhibition and other involved people.
People	<i>Social view</i> : focus on collective attributes, roles (e.g., students, teachers, visitors), and their relationships. People are social entities that learn in situ and in context of their environment.

Table 2. Second set of scenario metadata as an ensemble-embedded-social perspective.

We now compare the two sets of scenario metadata from a design perspective. In the first set of scenario metadata (tool-object-individual perspective on the TIP constructs), the primary goal of the designer is to improve artifact features and user performance. Therefore, the design of the system should ensure optimal computational power for executing the tasks. The system should support optimal data storage, retrieval, and sequential processing where data is conceived as a discrete entity. In this case, the system can simplify and guide Sally's exhibit planning process using templates. However, adopting the second set of scenario metadata (ensemble-embedded-social perspective on the TIP constructs), the design of the system is focused on socio-technical issues and relationships between roles. In this second case, Sally could envision personalization of her presentation to different audiences. Since information was characterized in context of roles and environment, the design may facilitate interaction between online users (using chat, forums, etc). The use of the system is embedded in the social fabric of interaction between users. The primary goal of this design would then be on communication support between people and not on individual performance.

There is substantial difference in how the system will be designed depending on the assumptions that we represent through scenario metadata. Such metadata drive the process of claims analysis. In scenario-based design, this process represents the transformation of scenarios into design requirements by using claims to identify design features. Claims identify fundamental tradeoffs (pros and cons) with respect to design decisions. We argue that differences in scenario metadata affect the types of claims elicited in the design. Consider the divergence in claims while interpreting the same scenario (in Figure 1) based on different scenario metadata (see Table 3). For example, the requirement of making the presentation "easier to understand" can be translated into different design features. By choosing the first set of scenario metadata (tool-object-individual perspective), designers would be likely to focus on making the presentation gradual in content and sequential in structure, whereas if the second (ensemble-embedded-social perspective) is chosen, the focus would be on making the presentation adaptive to the specific audience. Similarly, making the presentation "more engaging" is designed in two different ways: providing special effects in the first instance and using communication mechanisms in the second.

Design features and claims as pros (+) and cons (–)	
<u>Tool-object-individual perspective</u>	<u>Ensemble-embedded-social perspective</u>
<i>Use templates for sequential explanation</i> + Allows audience to gradually process data + Guides Sally in how to prepare presentation – Discourages inventive and creative presentations <i>Use fancy video animations and special effects</i> + Presentation is more engaging + Affords transfer of large amount of information in a short period of time – Requires large amount of computational resources	<i>Use adaptive and customized presentations</i> + Supports personalization of collective audience + Supports customized learning – Requires implementation of complex user models <i>Use multiple communication tools (e.g., chat, forum, etc)</i> + Engages audience using communication support + Promotes opportunistic learning and communication between people – Communication support may distract learning goals

Table 3. Claims analysis according to two different sets of scenario metadata in tables 1 and 2.

Scenario-based design assumes constant iteration: as soon as design ideas emerge, they are tried out as prototypes, elaborated, and refined through scenarios and claims analysis (Rosson and Carroll, 2002). Making scenario metadata explicit increases the value of a scenario by putting it in its context of interpretation. This provides a common base for negotiating critical design decisions among stakeholders. Using scenario metadata, a greater control on design is exercised without altering the scenario itself. While preserving fluidity and creativity of a scenario, scenario metadata clarifies how scenarios are interpreted and redesigned, and reduces ambiguities that may result from different perspectives.

DISCUSSION AND FUTURE WORK

We have proposed the application of analytical constructs from IS literature to the scenario-based design process in HCI with the goal of refining the latter using scenario metadata. We restricted scenario metadata to the already-defined views on TIP constructs as outlined by Sawyer and Chen (2002). We acknowledge that these views are not exhaustive and only serve as a nascent scaffold for our purposes in this paper. Further, the TIP constructs have the characteristic of being commonly used as vocabulary in the everyday life of people. Therefore, they are likely to be understood by any stakeholder.

We propose a further articulation of the relationships between technology, information, and people. Information does not exist as an independent entity but it emerges from the interaction between people and work artifacts, of which information technology is a specific constituent. Information is relational in nature and its existence is functional to the existence of people and technology. This ontological dependence of the former on the latter suggests that the definition of information is generally a natural derivation of the combined definitions of people and technology. For example, people as information processors and technology as tools that support data processing imply information as discrete data. Realizing this distinction in the design practice means that designers and end users can clarify their assumptions about people and technology, and obtain as a result their view of information. Vice versa, starting from a specific definition of information would imply specific ways of defining people and technology embodied in it. This is consistent with the evolution of HCI research that has been driven by innovative ways of considering people in the design (e.g. participatory design movement (Greenbaum and Kyng, 1991)) and technology in the context of use (e.g. Suchman's emphasis on situated work practice (Suchman, 1987)).

The TIP constructs represent a minimal set of key terms for expressing implicit assumptions affecting the design. We expect that as the design process advances, more terms would be added as constructs. For example, the term "context" may represent another construct that would help to clarify what technology, information, and people are and how they co-exist within a particular setting.

Scenarios are descriptive in nature whereas their metadata are interpretive. Scenarios describe actors, goals, events and settings (Rosson and Carroll, 2002) whereas their metadata represent their interpretations. Scenarios are *extensional* in nature (they are referents of what the actors, goals, events, and settings are), whereas their metadata are *intensional* (they represent assumptions about properties of actors, goals, events, and settings) (Rapaport, 2004). Therefore, scenarios with their metadata define not only narrations of technology, information, and people, but also the context of interpretation of these narrations, which will orient the future refinement of scenarios and claims.

A key challenge in design is to ensure that the right requirements for the proposed system are specified (a.k.a. validation) (Pressman, 2000). By adding metadata to scenarios, additional checkpoints are presented early on to designers and end users for eliciting their interpretations of scenarios and preventing them from moving on in the design process with inconsistencies in their interpretations. Scenario metadata facilitates the validation process of design requirements at an early stage by engaging stakeholders to reflect on different perspectives underlying the envisioned design.

Another approach using descriptive techniques to do design is personas (Pruitt and Grudin, 2003). Personas are a design technique that gives precise descriptions of users and what they wish to accomplish with technology (Cooper, 1999). Similar to our idea of scenario metadata, the greatest value of personas is in providing a shared basis for communication (Pruitt and Grudin, 2003). However, whereas personas remain like scenarios on a descriptive level and describe prescriptions of user profiles, scenario metadata are interpretive in nature and entail explicit assumptions about not only people but also technology and information. Scenario metadata not only improve the chance that designers will more deliberately manage the causal schemas they embody in their work (Carroll, Kellogg, and Rosson, 1992), but also entail meaning-making of scenarios and the effect of this meaning-making on design. In this paper, we have proposed scenario metadata not as a contrast but as a rapprochement between existing design techniques for ameliorating communication of scenarios between stakeholders.

We propose a design practice in which metadata are systematically related to their design consequences. Since designers tend not to start design from scratch and borrow from previous or others' experiences (Moran and Carroll, 1996), specifying causal schemas for design based on assumptions of technology, information, and people can reveal patterns of how these assumptions affect design choices. The long term effects of such a design practice would allow us to leverage the knowledge

derived from previous design practices in the form of thematic bundles that logically connect specific assumptions about technology, information, and people with the implied design choices.

Further investigation is needed in this area. Currently, we conjecture that scenario metadata could affect the evolution of design for the better—this needs to be empirically verified. In this paper, we presented two contrasting examples of scenario metadata as informal characterizations of the TIP constructs. As future work, a standardized, semantic representation to express scenario metadata should be developed as a common vocabulary for designers and end users. Moving beyond scenarios, the perspectives on TIP constructs can be applied to other design methods such as the above mentioned personas or use cases in software engineering. Applying TIP constructs to other methods opens new ways to approach complexity in the design process. We believe that the use of scenario metadata to orient and inform the design practice can promote advancement of HCI as a science of design and study of technology in use.

CONCLUSION

In an effort to apply analytical constructs from IS literature to the scenario-based design process in HCI, we have proposed the use of scenario metadata for allowing stakeholders, including designers, to have greater control over the evolution of design. We refrained from elucidating thorough definitions of “technology”, “information”, and “people” because it was not as important as characterizing them for comprehending how design is affected by implicit assumptions about these constructs. It is imperative for designers and end users to acknowledge the variation in design consequences when different perspectives on scenarios are adopted. Scenario metadata using TIP constructs is one such way to express these concerns early on in the scenario-based design process.

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