



# Complex System HCI as a Triangle of Interface, Content, and Person Interaction

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**Abstract.** For complex systems, the human-system interaction alone should not be the focus of the design problem. Complex system HCI needs to move well beyond human-interface concerns and consider how the triangle formed by interface, content, and person interact within the situational context. Complicating the design of the triangle is that reality implies not a single person, but many people (different audiences) each with varying information needs, which implies dynamic content and may require varying interactions.

**Keywords:** Complex information · Information creation · Content  
HCI

## 1 Introduction

Traditionally, both design teams and researchers relied on a reductionist approach to problem solving. Break the situation into simpler and simpler parts until each one is understandable. This might be a good goal, but applied to complex problems it risks failing to consider interactions or information relationships. Back in 2007, Redish pointed out that the usability of complex systems is not the same as usability of simple systems, but a fundamentally different beast. Assuming a complex system is a sum of its parts at best redefines it as a complicated system. But worse, it typically redefines it as a collection of simple systems that can be completely described. Unfortunately, this redefinition ignores the deeper interactions between the parts; the user interactions with the system and the content yield a final result that is more than the sum of the parts. [Very brief definition: I define simple systems as those that have a correct answer and which can be fully described. However, complex systems have no single or correct answer and the full information needs cannot be described (Albers 2004)].

A fundamental design disconnect is that the backend operates according to clean physical laws. Complex IT systems are assembled from smaller systems. With the reductionist nature of software, it works to break any problem into individual components. But between the screen and the human, the reductionist logic gets replaced with human psychology. The interaction of essentially all non-trivial programs and informational websites becomes complex. So, we need to consider the cognitive complexity of the interaction and presentation (Endsley and Jones 2012).

Information complexity comes into play when the user needs involve complex information and when the user has open-ended questions. HCI answers these needs

requires addressing the complexity of the entire contextual situation. Therefore, as Mirel (2002) states, “people’s actual approaches to complex tasks and problems... are contextually conditioned, emergent, opportunistic, and contingent. Therefore, complex work cannot be formalized into formulaic, rule-driven, context-free procedures” (p. 259). A basic question that often gets lost in the reduction process is “How much can the problem be reduced before the problem itself starts to be changed?” I’m previously addressed the inherent problems in taking a complex situation and transforming it into a simple one (Albers 2004).

Textbooks state a technical communicator translates information for an audience. However, complex information requires more than simply translation, but requires a fundamental transformation to form an integrated synthesis of information that fits the situational context. All of the information flowing into the content must be reshaped (transformed) into a form that supports a person’s strategies for comprehension and decision making.

Developing complex information requires considerations of the interactions of audience with the information and the information flow. As such, the complexities of developing the information and ensuring (testing) it communicates effectively is a much bigger problem than the sum of the parts—with parts defined here as context, content, person, and interface. An interesting question that often does not seem to be explicitly mentioned with regards to information analysis is “What should be communicated?” With open-ended, complex texts, this becomes a much deeper question than one of directly moving information from the source to the reader.

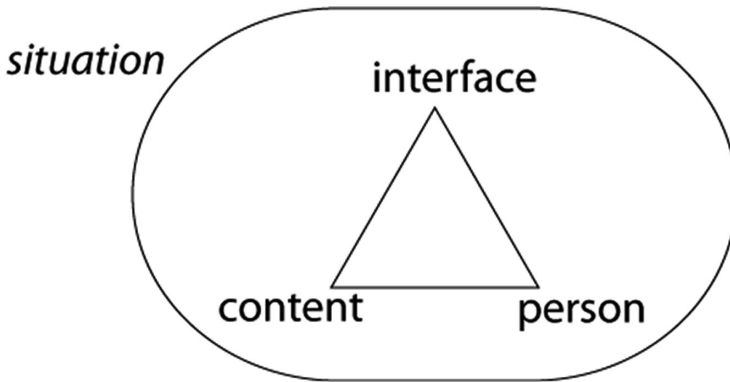
Fundamental design issues with complex information stem from the dynamic interactions of content and situation (context); they are tightly coupled in a non-linear relationship. As a result, changing situations mean that good information and decisions today may be bad information and decisions tomorrow. Human psychology and the socio-technical issues/processes inherent within the situation interact non-linearly with the information. How well the content gets communicated depends on how well those issues are handled within the information development process.

One factor contributing to the complexity is that the writer and/or usability tester must ensure a dynamic combination of information merges into a coherence flow. But more than just merging together, the information must be transformed to fit the reader’s needs.

## 2 Triangle Formed by Interface, Content, and Person

At a high level, the HCI of complex systems can be considered as a triangle with the sides formed by: interface, content, and person, with all three embedded in the situation (Fig. 1). Considering complex situation HCI as a triangle embedded within the situation can help emphasize the design issues.

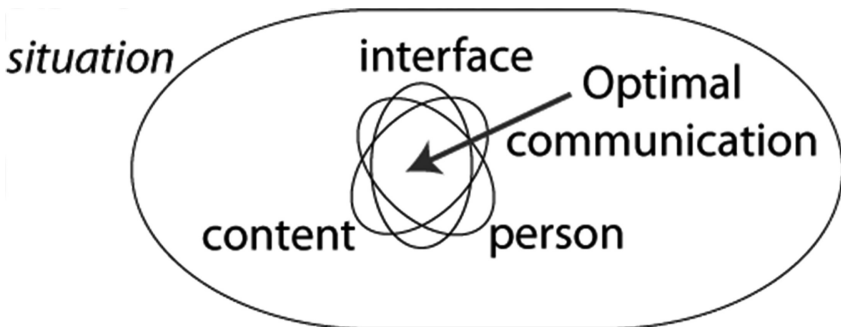
When interacting with complex information, people strive to use the available information and make good decisions. The real problem is often not the information availability, but that it is poorly presented. In other words, the person could not effectively use the relevant information to reduce their uncertainty of the situation (Albers 2012).



**Fig. 1.** Triangle for communicating complex information.

Writers and/or usability testers must ensure a dynamic combination of different information elements merge into a coherence flow. But more than just merging together, the information must be transformed to fit the reader's needs. The transformation aspect complicates the issues of content strategy by bringing to the forefront issues of the dynamic natures of information and situations, changing information needs, and different audience needs. Designing complex information that meets these multiple needs requires considerations of the interactions of audience with the information and the information flow.

As a workable model, the triangle in Fig. 1 fails to convey the dynamic nature needed to visualize communication issues. Converting the triangle to a Venn diagram helps with the visualization (Fig. 2). The maximum communication occurs when the overlap of the content, person needs, and interaction are maximized.



**Fig. 2.** Forming the area of optimal communication.

The overlapping nature of the three factors helps to visualize communication successes or failures. If effective communication only happens within the overlapping area, communication problems occur with any one factor gets shifted out of the mix

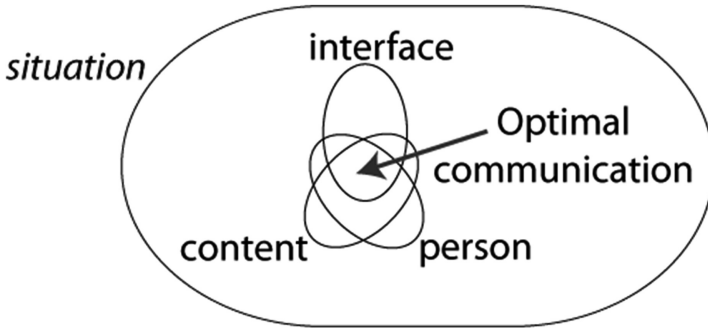


Fig. 3. Mismatched areas impair communication.

(Fig. 3). A poor interface impairs the ability of a person to access and interact with the content. Perhaps it was too complicated or too simplistic to provide the information in an effective manner. Likewise, superficial audience analysis can pull the person oval out since the content/interface fail to fit the audience needs. Or content that is technically correct but not relevant to the situation pulls the content oval away from optimal positioning.

The system of ovals work well for understanding simple systems, but it still lacks a good visualization of the dynamic nature of a complex system. I earlier explored this idea with determining content needs (Albers 2003), but now look at it within the overall situation. The changing natures of the content and information needs are difficult to convey with ovals. A graph structure works better (Fig. 4).

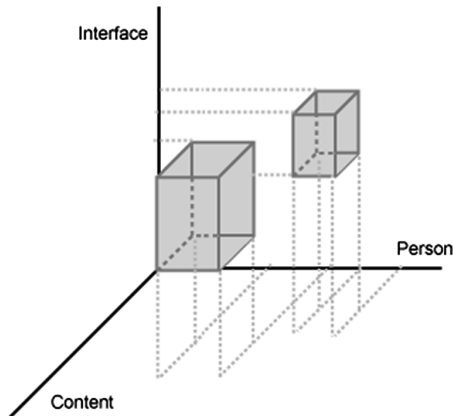
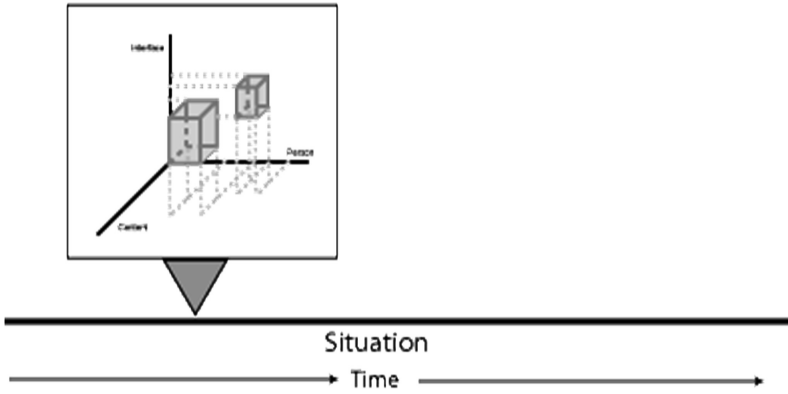


Fig. 4. Areas to design to support communication. The communication requirements for the situation focus on the shaded areas. Areas outside of the shaded areas are irrelevant to the current situation. In reality, the area edges would show a gradient as it spreads outward.

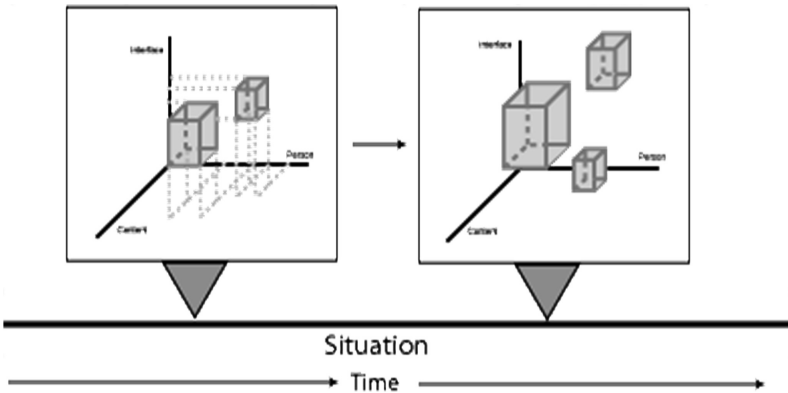


**Fig. 5.** Optimal communication graph embedded within a dynamic situation. A situation evolves over time and the graph moves/evolves with it.

Unfortunately, with the four variables—situation, content, person, and interface—a better method of capturing the idea requires a 4 dimensional graph (Fig. 5). Something that is impossible to create on paper or solid model. However, we can consider the idea of a 3 dimensional graph embedded within the higher dimensional situation space.

The situation evolves over time and the shape of the 3D graph changes along with that evolution (Fig. 6). Just like a slider changes sound or light intensity, moving the graph along the situation axis imparts changes to all three dimensions making it up.

Because of the non-linear aspects of complex information systems, the situation must always move forward. It cannot move backwards, and even if it could, the changes could not be undone. Moving from A to B and back to A would not result in the same graph at A both times.



**Fig. 6.** Changes to the interface-content-person graph as the situation changes. As the situation evolves the information needs change. In this example, a new area has appeared and the size/position of the initial two areas has changed.

### 3 HCI Implications for Complex Information Presentation

A fundamental design issue with complex information stems from its dynamic aspects; changing situations means that high quality information and decisions today may be low quality information and poor decisions tomorrow. Human psychology and the socio-technical issues/processes inherent within the situation interact non-linearly with the information. How well the content gets communicated depends on how well those issues are handled within the information development process. The situation changes, which changes the relevant content, which changes the person's priorities for content and the relationships within that content, which has the potential to change the interface.

The design analysis's job is to understand how the situation will change and how the three factors change relevant to the situation change. Once those factors are understood, then the individual factors of content and interface can be defined to fit the changing person's information needs.

Previously, I pointed out that the interesting question that often does not seem to be explicitly mentioned with regards to information analysis is "What should be communicated?" In a traditional task analysis, this question doesn't make sense since it's the correct steps that are being communicated. With open-ended text, this becomes a much deeper and vital question. Audience analysis as normally practiced, if actually practiced at all, doesn't help since demographics don't explain information needs.

Another design issue to avoid is HCI that focuses too much on the button pushing, ignoring the socio-technical issues, and trying to achieve a no-fail at a trivial level. The result is an "accurate" system that no one wants to use because it doesn't really meet their needs.

### 4 Conclusion

Effective communication within complex situations requires understanding the audience information needs and providing that content in an effective manner. This paper looked at a four part model for understanding how to define and mentally connect the four parts.

- Situation The interactions between interface and person are the standard HCI approach. The situation (context) in which interface, person and content interact is too often ignored as a significant player. Complex situations are dynamic and evolve over time and/or based on user interactions.
- Interface The interface controls how the person accesses and interacts with the content. In other words, that interaction controls (filters) the content and subsequent information relationships and understanding they form of the situation. It can never be one-size-fits all and should change to fit the interaction changes driven by the evolving situation. A focus on buttons or screens fails to capture how the user interacts with and obtains information relevant to the situation.
- Content Content presentation cannot be ignored for complex information. Content is often discounted with claims of "we can't control that." Yet, understanding

a complex situation depends on both the content presentation and how effectively relationships are formed within the information (Albers 2010). When those relationships are not formed, the person does not understand the situation and can make poor decisions.

Person A “user” or “reader” is too often a made-up audience constructed in the writer/designer/tester’s head to conform to how she views the reader. With such a reader, their comprehension and decision strategies play a minimal part. Yet, understanding the strategies used by different parts of the audience as they use the information form the foundation for creating high quality complex information. All of the information flowing into the content must be reshaped (transformed) into a form that supports those strategies for comprehension and decision making.

Together the four factors can be considered as interacting as part of a 4-dimensional graph with the areas of information needs being plotted on that graph.

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