What Properties Make Scenarios Useful in Design for Usability?

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Abstract. As described herein, we propose heuristics of scenario for designing usable products. From a structural viewpoint, a similarity exists between the definition of usability in ISO 9241-11 and the concept of scenario for designing a product, which suggests what elements a scenario should include and how designers should incorporate it into a human-centered design process. Particularly, this paper presents the argument that a scenario should include what a user accomplishes, sees, hears, and thinks, and how the user does them so that designers become capable of evaluating the effectiveness, efficiency, and satisfaction of goal achievement from a usability perspective.

Keywords: Guideline, heuristics, human-centered design, scenario, scenario-based design, usability.

1   Introduction

Use of scenarios for system design has been a commonly addressed issue in the field of Human–Computer Interaction (HCI) [1-7]. The HCI community has experienced scenario booms several times during the last three decades [8]. Recently, a new boom in the use of scenarios has occurred because persona-based approaches [9] have attracted the attention of the HCI community. Scenarios are likely to continue their long history of use in design.

Scenario-based design, as a technical term, encompasses a collection of methods that employ scenarios as a fundamental design representation and artifact in its design process and activities. Scenario-based design is not a single approach. Therefore, designers and practitioners in industry are confused about its use for designing a service, system, and product (artifact) with scenario-based design. They hope to have a clear usage guideline of scenarios.

This paper describes an attempt to provide design heuristics for scenarios based on our experience on work with usability and user experience divisions of major Japanese companies. It specifically examines how scenarios designed at the beginning of design process deal with a usability viewpoint. We begin our discussion about properties of scenarios from the definition of usability (ISO 9241-11 [10]). We argue the similarity between the nature of scenarios and the definition of usability.

2   Components of the Scenario Concept and Usability Definition

To begin with, we clarify the properties of scenario concept and the definition of usability, which have similarities in their components. Analyzing those similarities and differences, we derive effective elements specified in scenarios from a usability viewpoint.

2.1   Scenario for Design

A scenario is a story. When it is used for designing an artifact such as a service, system, or product (artifact), a scenario might contain a description of its use. For example, scenarios for designing a mobile phone might include information about who is the user, what is the mobile phone, in what situation it is used, what goal or expectation the user wishes to achieve, and how it is done. To summarize, a scenario is a description that includes actors, their background information, and assumptions about the environment, actors' goals, objectives or expectations, and sequences of actions and events. Some applications might omit one element or might express it implicitly.

Scenarios can be of different forms such as narrative texts, graphics, images, videos, and prototypes [11]. For example, a typical scenario form is a narrative text in natural language like a novel. If it is prepared as a digital document, it can be shared easily with others. Another form is a storyboard used in movie production. The combination of a drawing or picture and its caption makes a story easier to understand.

Figure 1 presents a typical narrative scenario. In the scenario, the user Ichiro's sequence of actions is specified. The scenario is a command level scenario: its granularity of description is low and it specifies minute details of a user's action and response.

Ichiro double clicks on the cashbook icon on desktop to initiate its application program. A new window shows up on the screen. It contains a record entry; the last line represents the current funds remaining as 12,800 yen. Ichiro clicks on the empty entry at the bottom of the last record entry and types in 9,500 yen as the wages of his part-time job at a pizza restaurant.

Fig. 1. Typical narrative scenario in natural language

The scenario concept in general can be represented as a 4-tuple: (actors, goals and expectations, sequence of actions and events, and context of use). When the scenario concept is applied for envisioning a product, it might be extended to include the representation of a product idea. With the product, the main class of actors is that of users. They have goals to achieve. They work and act with the product or simply use it to achieve the goal under the circumstance of use. Consequently, scenario concept for designing a product can be represented as a 5-tuple:

(product, users, goals, sequence of actions and events, context of use).   (1)

2.2   Usability

Designers and practitioners in industry might employ the definition of usability in ISO9241-11 as a standard discipline. It defines usability as "*extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.*" In addition, the effectiveness, efficiency, satisfaction and context of use in the description are defined as follows.

- **Effectiveness:** Accuracy and completeness with which users achieve specified goals
- **Efficiency:** Resources expended in relation to the accuracy and completeness with which users achieve goals
- **Satisfaction:** Freedom from discomfort, and positive attitudes towards the use of the product
- **Context of use:** Users, goals, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used

The specified elements of the usability definition can be represented as a 7-tuple:

$$(product, users, goals, effectiveness, efficiency, satisfaction, context of use). \qquad (2)$$

In a traditional development scene, a target artifact (which can be expressed as a product in formula (2)) is generally envisioned or assigned as a theme at the initial phase of development. Furthermore, users' goals might be assigned usually as target functions for the artifact. The remaining elements in the usability definition include users, effectiveness, efficiency, satisfaction, and context of use. They are categorized into two groups: subjects for research (users and context of use) and subjects for evaluation (effectiveness, efficiency, and satisfaction).

When designers discuss the usability of a product, on the one hand, the subject for research in the usability definition is the users and context of use. For example, questions such as who are the users of a target product and in which context it is used should be answered if we conduct studies. For such studies, we can use several existing techniques including focus groups, interviews, observations, surveys, and so forth.

On the other hand, the subjects for evaluation in the usability definition include the effectiveness, efficiency, and satisfaction. For example, whether users reach at a specified goal is investigated from the effectiveness viewpoint. How long it takes and what the error rate is are investigated from the efficiency viewpoint. Then how the user felt is investigated from the satisfaction viewpoint. For an evaluation, we can use several existing techniques including usability testing with a prototype.

3   Scenario Heuristics

We specifically examine the usability definition and propose a scenario description from a usability viewpoint.

3.1   Similarity of the Scenario Concept and the Usability Definition

As described earlier, a scenario for designing a product consists of a 5-tuple (product, users, goals, sequence of actions and events, context of use) and its element based on

the usability definition is expressed with a 7-tuple (product, users, goals, effective-ness, efficiency, satisfaction, context of use). A similarity is readily apparent between the scenario concept and the usability definition. They share the elements: product, users, goals, and context of use (Fig. 2). In addition, the sequence of actions and events in the scenario concept corresponds to the three elements: effectiveness, effi-ciency, and satisfaction. The rationale behind this is that the sequence of actions and events specified in the scenario is the target for evaluation and its evaluation aspect includes effectiveness, efficiency, and satisfaction.
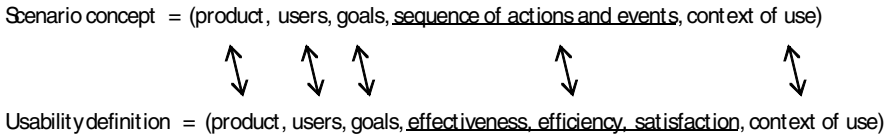
Scenario concept = (product, users, goals, <u>sequence of actions and events</u>, context of use)

Usability definition = (product, users, goals, <u>effectiveness, efficiency, satisfaction</u>, context of use)

Fig. 2. Correspondence relation between the scenario concept and the usability definition

This formulation enables us to understand what and how we describe in a good scenario from a usability viewpoint. A scenario that is suitable for discussion of its usability should have its elements clarified.

Heuristic 1. Elements of scenario for designing a product should be written clearly.

To be precise, a scenario suitable for discussing usability should have its elements clearly defined, and the sequence of actions and events is specified so that it will be able to evaluate effectiveness, efficiency, and satisfaction. If designers take this heu-ristics and create scenarios, they could start a discussion of usability at the beginning of design process even when they have a product itself or prototypes for the target product to conduct usability tests.

3.2 Effectiveness in Scenario

When we have a clear goal description in a scenario, we can discuss its effectiveness. From an effectiveness viewpoint, there are scenarios of two types: a success scenario and a failure scenario. In a success scenario, the sequence of actions and events speci-fied that the user reaches the goal in the scenario. A success scenario means that it is effective. It fundamentally specifies a scene that illustrates user's desirable activities with the product. Designers and developers often envision a success scenario for a product at the initial phase of design and expect that the actual user of the product will behave in such a manner in the future.

By comparison, in the failure scenario, the sequence of actions and events specified that the user does not reach the goal in the scenario. The failure scenario means that it is ineffective. It fundamentally specifies a scene that illustrates a user's undesirable activi-ties with the product. It is not common to envision failure scenario in the design process, yet it would become an important description if designers and developers could share a boundary condition or edge case for developing the product. In addition, that description is necessary if the target product is categorized as a safe critical system.

To summarize, a heuristic for a scenario for designing a product is derived as follows.

Heuristic 2. Reachability to the goal of scenario should be clearly described to evaluate its effectiveness.

In the sample scenario portrayed in Fig. 1, the user goal is described implicitly. Consequently, the current version of the scenario is unclear in its presentation of whether the user reaches at the goal or not through the sequence of actions and events. Figure 3 portrays a modification of Fig. 1 with the added description of the goal as the first paragraph. With the description, the reader of the scenario would be able to evaluate the reachability of the goal.

Ichiro keeps his cash record with an application on his PC. He has just received the wages of his part-time job at a pizza restaurant. Therefore, he wants to record it with the application as usual.

Ichiro double clicks on the cashbook icon on desktop to initiate its application program. A new window shows up on the screen. It contains a record entry and the last line represents the current funds left as 12,800 yen. Ichiro clicks on the empty entry at the bottom of the last record entry and types in 9,500 yen as the wages of his part-time job at a pizza restaurant.

Fig. 3. An exemplary scenario specifying clear user's goal

The description of the effectiveness in a scenario enables us to analyze the other two properties of scenario: efficiency and satisfaction.

3.3 Efficiency Scenario

When we have an effective scenario, we can discuss its efficiency. Viewed from an efficiency viewpoint, two types of scenario exist: efficient and inefficient. In the efficient scenario, the sequence of actions and events specifies that the user reaches the goal in the scenario and that it takes a short time and less action. An efficient scenario means that the user reaches the goal with less effort with no mistakes. It fundamentally specifies a scene that illustrates a user's desirable activities with the product. Designers and developers often envision an efficient scenario for a product at the initial phase of design and expect that the actual user of the product behaves similarly in the future.

On the other hand, in the inefficient scenario, the sequence of actions and events specified in the scenario might take a long time and much action even though the user reaches the goal. An inefficient scenario means that it is not efficient. A typical inefficient scenario includes an error scenario in which the user makes mistakes and reattempts a task. It fundamentally specifies a scene illustrating users' undesirable activities with the product. As described in the discussion of effective scenarios, it is not common to envision inefficient scenarios in the design process.

To summarize, a heuristic for scenario for designing a product is derived as follows.

Heuristic 3. The sequence of actions and events in an effective scenario should be described sufficiently to evaluate its efficiency.

Ichiro keeps his cash record with an application on his PC. He has just received the wages of his part-time job at a pizza restaurant, so he wants to record their amount with the application as usual.

Ichiro double clicks on the cashbook icon on the desktop to initiate its application program. A new window shows up on the screen. It contains a record entry and the last line represents the current money left as 12,800 yen. Ichiro tries to click on the empty entry at the bottom of the last record entry, but he accidentally clicks outside of the application window. The window behind the application window comes to the front. Ichiro clicks carefully on the Close button at the top right corner of the window, which brings the application window to the front. At this moment, Ichiro carefully and slowly clicks on the empty entry at the bottom of the last record entry and types in 9,500 yen as the wages of his part-time job at a pizza restaurant.

Fig. 4. Example of an inefficient scenario

The scenario presented in Fig. 3 is an example of an efficient scenario, whereas Fig. 4 portrays an inefficient scenario. In Fig. 4, the user Ichiro makes a mistake and conducts redundant actions to return to the original sequence of actions. The scenario might not derive the specification of the target artifact, but it obtains the readers' attention for usability. The readers of the scenario description can vividly understand the importance of usability for designing the target artifact.

In addition to the discussion of the efficiency scenario, we progress to a discussion of the satisfaction scenario.

3.4   Satisfaction Scenario

Along with the efficiency scenario, we can discuss satisfaction when we have an effective scenario. From a satisfaction viewpoint, scenarios of two types exist: satisfactory and unsatisfactory. In the satisfactory scenario, the sequence of actions and events specified that the user reaches the goal in the scenario and it satisfies the user. The satisfactory scenario means that the user reaches the goal and finds satisfaction in his or her use of the product. That information is not easy to illustrate as a user's behavior; in satisfactory scenario. Therefore, a user's mental representation is more focused and described. For example, it specifies what the user sees, feels, and thinks during the course of actions and events. Designers and developers who specifically examine outside representation and functions might tend to avoid specifying a user's mental representation into scenarios. Even if they specify one, it would become a simple favorable response as a happy ending.

In contrast, in the unsatisfactory scenario, the sequence of actions and events specified in the scenario might frustrate the user even if the user reaches the goal. A typical unsatisfactory scenario includes an inefficient scenario in which the user takes a long time and/or has many steps that must be done to reach the goal. An error scenario also frustrates a user if no mechanism exists for recovering from the error with the product. Similarly to the insufficient scenario, the unsatisfactory scenario specifies a scene, which illustrates a user's undesirable activities with the product. As described in the discussion on effective scenarios, it is not common to envision unsatisfactory scenarios during the design process.

To summarize, a heuristic for a scenario for designing a product is derived as follows.

Heuristic 4. Users' mental representations should be described clearly in scenarios to evaluate users' satisfaction.

Figure 5 presents an unsatisfactory scenario, in which the user Ichiro becomes aware that he has been doing a redundant action with the application. Consequently, we might conclude that this satisfactory level is not high.

4   Scenario Properties for Usability Discussion

As described in Heuristic 1, elements of scenario for designing a product should be written clearly. In a practical development scene, the information of two elements, product and goals, might be assigned usually as a project theme and target functions for the product, respectively. The information of the two elements, users and context of use, might come from field research because they are subjects for research as discussed in 2.2. The information of sequence of actions and events might set as a hypothesis in the initial phase of design because designers and practitioners do not have the actual product. Hence, the key to make use of scenario as design for usability is what and how to specify the sequence of actions and events.

Ichiro keeps his cash record with an application on his PC. He has just received the wages of his part-time job at a pizza restaurant, so he wants to record it with the application as usual.

Ichiro double clicks on the cashbook icon on desktop to initiate its application program. A new window shows up on the screen. It contains a record entry; the last line represents the current funds left as 12,800 yen. Ichiro clicks on the empty entry at the bottom of the last record entry and types in 9,500 yen as the wages of his part-time job at a pizza restaurant. He notices that the data input is the first action every time he uses the application, so the cursor should be active in the last record entry without clicking it on.

Fig. 5. Example of unsatisfactory scenario

Table 1 summarizes scenarios for designing a product with usability. There are two views on scenario: the ideal view and the realistic view. The ideal view includes success scenario, efficient scenario, and satisfactory scenario. The realistic view contains failure scenario, inefficient scenario, and unsatisfactory scenario.

Table 1. Contrasting views on scenario for usability corresponding to scenario property: the ideal view vs. realistic view

Scenario property	Ideal view	Realistic view
Effectiveness	Success scenario	Failure scenario
Efficiency	Efficient scenario	Inefficient scenario
Satisfaction	Satisfactory scenario	Unsatisfactory scenario

What is useful for designing a product for usability? The ideal view and the realistic view are orthogonal and mutually complementary; therefore, both views in scenario contribute to improve the usability of a product. For example, the ideal view might become a useful material for usability specification [12] because it specifies the best task or activity with the product; it might work as a reference value.

From an effectiveness viewpoint, a success scenario is useful to derive specifications; in contrast, a failure scenario is useful to initiate a discussion of usability. From an efficiency viewpoint, an efficient scenario is useful to derive specifications; by comparison, an inefficient scenario is useful to initiate a discussion of usability. From a satisfaction viewpoint, a satisfactory scenario is useful to derive specifications; however, an unsatisfactory scenario is useful to initiate a discussion of usability.

The typology of scenario for usability can be used for usability education. Inexperienced designers and engineers especially who have a narrow focused representation and function of a product tend to write scenarios from the ideal view. They might not be aware of how the user and context of the product are important for usability and the user experience. In this case, to give them an assignment for envisioning scenarios from the realistic view might be significant.

5   Conclusion

As described in this paper, we proposed design heuristics for scenarios for designing a product based on our experiences obtained during collaboration with design, usability, and user experience departments in major Japanese companies. We provided several versions of scenarios.

Scenarios are flexible in form and content. The designers and practitioners in industry might have no idea what to describe as a scenario. The heuristics proposed in the paper provide a good starting point.

References

1. Alexander, I.F., Maiden, N. (eds.): Scenarios, Stories, Use Cases: Through the System Development Life-Cycle. Wiley, Chichester (2004)
2. Carroll, J.M. (ed.): Scenario-Based Design: Envisioning Work and Technology in System Development. John Wiley and Sons, Chichester (1995)
3. Carroll, J.M.: Making Use: Scenario-Based Design of Human-Computer Interactions. MIT Press, Cambridge (2000)
4. Clarke, L.: The use of scenarios by user interface designers. In: Diaper, D., Hammond, N. (eds.) People and Computers VI: Proceedings of the HCI 1991 Conference, pp. 103–115 (1991)
5. Cooper, A.: The Inmates Are Running the Asylum. Sams (2004)
6. Rosson, M.B., Carroll, J.M.: Usability Engineering: Scenario-Based Development of Human-Computer Interaction. Morgan Kaufmann, San Francisco (2002)
7. Weidenhaupt, K., Pohl, K., Jarke, M., Haumer, P.: Scenario Usage in System Development: A report on Current Practice. IEEE Software 15(2), 34–45 (1998)
8. Go, K., Carroll, J.M.: The Blind Men and the Elephant: Views of Scenario-Based Design. Interactions 11(6), 44–53 (2004)
9. Pruitt, J., Tamara, A.: The Persona Lifecycle: Keeping People in Mind throughout Product Design. Morgan Kaufmann, San Francisco (2006)
10. ISO: ISO9241-11 Ergonomic requirements for office work with visual display terminals. Part 11: Guidance on Usability (1998)
11. Rolland, C., Achour, C.B., Cauvet, C., Ralyte, J., Sutcliffe, A., Maiden, N., Jarke, M., Haumer, P., Pohl, K., Dubois, E., Heymans, P.: A proposal for a scenario classification framework. Requirements Engineering 3(1), 23–47 (1998)
12. Hix, D., Hartson, H.R.: Developing user interfaces: ensuring usability through product and process. John Wiley and Sons, Chichester (1993)