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Design Support Method for Implementing Benefits of Inconvenience inspired by TRIZ

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Abstract

In most cases, system design develops products for reducing human work based on the assumption that the more convenient life is, the richer it is. This assumption has yielded technical developments and outcomes that we generally appreciate. However, such development is not always the best for users or human-machine systems. Solely pursuing convenience causes such problems as excluding users, limiting their ability, and depriving the pleasure of using the systems. On the other hand, inconvenient systems or methods sometimes provide users with such benefits as enhanced awareness, increased creative contributions, and a fostering of affirmative feelings. We call such benefits of inconvenience fuben-eki: Further BENEfit of a Kind of Inconvenience.

The present paper proposes a systematic way to implement such benefits. By focusing on the contradiction between convenience and such benefits, this study introduces the Contradiction Matrix of TRIZ. By analyzing many inconvenient tools and methods, principles, which relate inconveniences to their benefits, are derived and placed in what we call a fuben-eki matrix. This paper demonstrates how to utilize the matrix, which resembles the Contradiction Matrix of TRIZ, to support the idea generation for implementing the benefits of inconvenience.

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Keywords: TRIZ, Design Support, FUBEN-EKI, System Design;

1. Introducing fuben-eki

In contrast with the notion that "the more convenient life is, the richer it is," fuben-eki is a way of designing new tools or systems by finding and evaluating the benefits of convenience [1, 2]. This section briefly introduces fuben-eki with examples.

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1.1. Convenience and inconvenience

Convenience is a very ambiguous word [3]. Even though people use a system in the same way, whether they feel that it is convenient depends on subjective aspects, such as lifestyle and personality. However, we decide the meaning of the word to discuss benefits of inconvenience. We define convenient as follows:

convenient ≡ saving labor to attain a specific task

Here, attaining a specific task implies that we are focusing not only on the result but also on the process, and the meaning of labor is classified as follows:

physical labor: physical operation in a time course,

mental labor: one that requires specific skills, including such mental load as memorization, cerebration, and consumption of cognitive resources.

In this paper, we assume that inconvenient equals not convenient in the above sense: it requires more effort than other means to achieve a specific task, based on the above definition.

1.2. Fuben-eki characteristics

Fuben-eki appreciates what has been overlooked in the pursuit of convenience and builds design guidelines by evaluating the benefit obtained from inconvenience. We have collected the following benefits of inconvenience from many examples:

fostering affirmative feelings / providing motivation for tasks / personalization [4] / putting users at their ease. These benefits were obtained not from the output (the purpose) of the system but from the process of using it.

1.3. Examples of fuben-eki

As a good example of fuben-eki, manual transmission (MT) cars are often cited. It is inconvenient to drive them because drivers have to time the transmission and operate the clutch by themselves, in contrast with automatic transmission (AT) cars that shift automatically. However, there is room for an active device that users can shift by themselves at the appropriate time if their skill gradually improves. In addition, it is possible to obtain a sense of accomplishment and self-affirmation by deepening understanding of the driving system of a car by this device, which is difficult to obtain by driving AT cars.

Examples of fuben-eki systems that have been identified so far are excerpted in Table 1. Most of these examples, which are compared with convenient systems, suggest that something is lost as a result of becoming convenient. However, if we label all the benefits obtained from inconvenient systems or methods fuben-eki, our assertion may become little more than a civil movement or a life-style since it is difficult to distinguish fuben-eki from positive thinking, nostalgia, or ecology.

2. Evaluation of existing fuben-eki systems

In this section, following the methodology of TRIZ, we evaluate the existing examples with the benefits of inconvenience to get principles to design fuben-eki systems.

Table 1. Examples of fuben-eki

Inconvenient tools	Convenient tools
Manual transmission	Automatic transmission
Paper dictionary	Electronic dictionary
Manual lock	Remote lock
Knife	Electric pencil sharpener
Mechanical camera	Digital camera
Dial controller	Push-button controller
Public phone	Cell phone

Inconvenient methods	Convenient methods
Hand writing	Word processor
Home cooking	Catering
Shopping street	Super market
Walk	Bicycle
Letter	E-mail
Cell production	Assembly-line system
Bumpy road	Paved road

2.1. Design of fuben-eki systems and its problem

Inventions that produce convenient systems are often evaluated in a one-dimensional axis as either convenient or inconvenient, or in terms of labor (Fig. 1). In such cases, convenience can be quantified as shorter working hours or fewer steps. In the theory of fuben-eki systems, we add another axis, which is independent of the traditional axis, to index such subjective feelings as self-affirmation and security.

In general, the pursuit of convenience reduces the subjective benefit as indicated by the dashed arrow in Fig. 1(b). A fuben-eki design aims to rebuild systems to increase their subjective benefits, even though the convenience may decrease, as indicated by the solid arrow in Fig. 1(b). Fuben-eki puts more emphasizes on the subjective benefit (the vertical axis direction) than horizontal axis direction.

Conversing on the lower left corner of Fig. 1(b) does not make sense, i.e., making a system inconvenient does not immediately lead to a fuben-eki system. One of its causes is that the benefits of inconvenience are subjective indices and we cannot easily quantify the extent of their benefit.

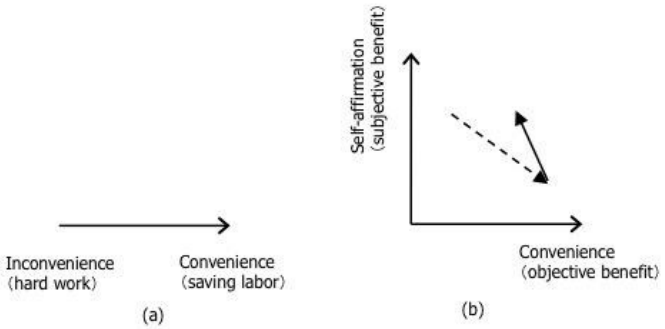

Fig. 1. One- or two-dimensional axes for evaluation

One way to design fuben-eki systems is brainstorming. We confirmed that this technique could produce a certain design that utilizes fuben-eki [1]. Participants enumerated the benefits of inconvenience from their experience and compared inconvenient and convenient systems, such as AT and MT cars. Then, to create new systems, they determine one theme and let part of its element become inconvenient one by one, like its shape, color, and function, and verified whether a new benefit appears. However, such good ideas depend on the inspiration of the participants. Therefore, systematic guidance, i.e., a design support method for fuben-eki systems, is desired. In this study, we incorporate the TRIZ approach that can solve problems by not completely relying on inspiration [5, 6]. We describe such a trade-off as "I want to shorten my working hours but I also want to leave the room for a devise," just like technical contradictions in TRIZ. By capturing the technical contradiction, we support new designs without getting into a trade-off.

3. Design support for fuben-eki system

In this section, following the contradiction matrix of TRIZ, we propose a design support method for fuben-eki systems.

3.1. Support for designing fuben-eki systems

Modeled after the process flow of the contradiction matrix shown in Fig. 2(a), our design support method for fuben-eki is shown in Fig. 2(b). Our solution is a new one that is not a compromise, because the system users are no longer inconvenienced by the devise and their progress, even if inconvenient at first. We also expect improvement of quantitative efficiency.

3.2. Principles of fuben-eki and fuben-eki matrix

We derived the principles of fuben-eki and the fuben-eki matrix from analyses of the examples in the previous section. Table 2 shows a fuben-eki matrix that contains convenience in the rows and the benefits of inconvenience in the columns. The IDs of the principles (1, 2 …, 12) are placed at the intersections of the relevant convenience and benefit. The corresponding principles of the IDs in the matrix are shown in Table 3.

The fuben-eki matrix corresponds to the contradiction matrix in TRIZ, and the problem-solving process using the matrix also resembles TRIZ, as shown in Fig. 2.

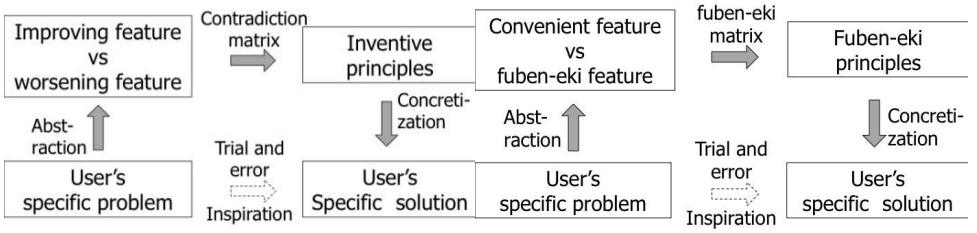

Fig. 2. Problem solving using TRIZ and the fuben-eki matrix

Given a problem, as shown in the lower left of the figure, a user does not rely on trial and error or inspiration, as indicated by the right pointing arrow at the bottom of the figure. The process of problem solving is as follows:

1- specify two parameters, i.e., the main convenience of the given system and what would be lost as a result of the convenience,
2- interpret the two parameters specified in step 1 into the terms of the matrix shown in Table 2,
3- specify the principles shown in the intersection of the two terms, derived in step 2, at the matrix,
4- apply the principles specified in the previous step to the problem in question.

Table 2. Fuben-eki matrix

Benefits of inconvenience / Convenience of system	◇enhance awareness	◇devise ways	◇improve	◇understand the system	prevent downskilling	be original
fast	5,7					
quick	1,2,6,7,9,10	3,4,6,1,2,8	3,4,6,8	3,4,6,1,10	3,4,1,6,8,10	3,10,1,4,6,9
small / light	1,5,6	5,6,1,3,4	3,4,5,6	3,4,5,6		3,4,5,6
does not deteriorate	1,2,5,6	1,2,5,6		3,5,10	3,5,10	3,5,10
few types of operations	5,9,10	4,5,6,8,9	4,5,6,8,9	4,6,5,9	5,6,8	4,5,6,9,10
low amount of operations	5,9,10	3,5,8	3,5,8	3	3,5,8	3,5,9,10
homogenization	5,10	3,4,5,6,8	3,4,5,6,8	3,4,6,5	3,4,5,8	3,4,5,6,10

◇ is a model operand that means "you can" or "you are allowed to"

Table 3. Principles of Fuben-eki

1. Degradation	5. Time consumption	9. Disorder
2. Enlargement	6. Continuity (Analog)	10. Constraint
3. Increase the number of operations	7. Fatigue	11. Stimulation
4. Increase the amount of operations	8. Danger	12. Less information

3.3. Simulating the process of devising a fuben-eki system

In this section, we simulate the process of devising a fuben-eki system using our proposed design support method and focus on a navigation system called navi.

Navi, which is a device that provides routes, 1) displays any location in the world immediately, 2) shows the current location, 3) shows the direction of the destination, 4) and has a search function. Navi is more convenient than traditional paper maps, however, problems have been pointed out. Too much dependence on navi prevent users from a) remembering the way and b) becoming familiar with the area [7]. Those interesting effects of navi on the human cognition are discussed in the research field of traffic and transport psychology [8].

We applied the support method described in Section 3.2 to solve this issue. We restate the convenience of navi and a benefit we hope to recover: "we recognized the map *quickly*, but we were deprived of some *ability*." This matched the form of the fuben-eki matrix. The principles stated at the intersection of *quick* and *prevent downskilling* in the matrix shown in Table 3 are No.s 3, 4, 1, 6, 8, and 10. The following ideas sprang from the first three of these principles, but since the solution is not confined to them, the designer's ability is utilized at this stage.

3. Increase the number of operations: ask questions about the landscape and scenery or redesign it so that the map is only displayed when the user stops.

4. Increase the amount of operations: keep the scale relatively large, to urge users to often scroll.

1. Degradation: remove the areas of the map to disappear through which users have passed to facilitate memorization.

The last idea of erasing the map was already in practice as a "degrading navi," and its effectiveness was demonstrated [9]. It is superior to the conventional navi in terms of building a cognitive map and its consistent storage of visual information and its spatial cognitive map.

4. Conclusion

We proposed a methodology that focuses on systems with the utility of inconvenience to support designing such systems. The framework is modeled on the core methodology of TRIZ:

- extract how to get the benefit of inconvenience by analyzing existing examples and abstract them as principles of fuben-eki,
- describe the solution of each example as a trade-off of what has become convenient and the lost benefit as a result of the convenience,
- construct a fuben-eki matrix that specifies the principles of fuben-eki from the above mentioned convenience and lost benefit.

Our design support method gradually influences designer thinking like TRIZ, in contrast with conventional design method that rely exclusively on individual imagination. This method can be used as a remedy to get back from incorrect user eliminations, and also as a preventive tool to avoid them.

In the future, by collecting more examples of fuben-eki, we will enhance our support method to influence designer ideas in a wide range of areas. More detailed analysis and the establishment on evaluation method are also necessary. Another plan of the study is to make "be inconvenient" take its place among the inventive principles.

Acknowledgements

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