Chapter 1
Fuben-Eki: Japanese for "Benefit of Inconvenience" that Illustrates a New Value Orthogonal to Efficiency and Functionality

Hiroshi Kawakami

Abstract Fuben-eki is Japanese. Fuben means inconvenience and Eki means benefits. Fuben-eki means benefits that are gained only by inconvenience. Pursuing benefits employing not convenience but inconvenience sounds like one of the old Buddhist teachings, but in fact, it is relatively new. Providing Fuben-eki to users is one of the principles of system design, especially human–machine systems. This principle is effective in several design fields. They are not just confined to designing physical systems, e.g., product design but spread to service and business designs. As the general introduction of this book, this chapter introduced a definition of Fuben-eki (benefit of inconvenience: BoI) and discussed the common properties of design fields that are effective to introduce Fuben-eki. The property was elucidated as having a value axis orthogonal to efficiency and functionality. In the second half of this chapter, design fields were introduced. They contribute commentary and case studies to this book. The relationships between these fields and Fuben-eki were explained in short. They will help readers of this book to find an overlap between their interests and this book.

Keywords Benefit of inconvenience · System design · Human machine systems · Design thinking

1.1 Introduction

There are things and matters that are inconvenient in the sense that they require users and others involved to spend time and effort and use their brains, but that provide benefits because of that inconvenience. In general, inconvenience should be eliminated when it is said that "necessity is the mother of invention," and

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H. Kawakami (ed.), *Systems Design Based on the Benefits of Inconvenience*,
Translational Systems Sciences 31, https://doi.org/10.1007/978-981-19-9588-0_1

avoiding inconvenience can be a motive force for new technological development. On the other hand, there are such research areas as human–machine systems, human interfaces, and human-centered design, where interaction between humans and artificial systems is the essence. In these areas, human interaction with the artificial system should not be avoided as an inconvenience. Automated systems that eliminate human operations are no longer human–machine systems, and their human interfaces are no longer anything more than display devices. The operator is no longer the observer. This argument is valid not only in the design of physical systems, but also in the design of services, businesses, and policies. In the first place, the essence of services and business is that people are included in the system.

In 2012, "Journal of the Society of Instrument and Control Engineers (ISSN 0453-4662)" featured an issue titled "System Design based on Further Benefit of a Kind of Inconvenience" that attempts to actively utilize the benefits of inconvenience in a variety of fields in Japanese (Kawakami et al., 2012). Since then, the discussion of "benefits of inconvenience (BoI)" has not only spread to various research fields but also jumped over the boundaries of research. The same journal summarized the trends of "systems that give users benefits of inconvenience" in various fields in 2021 in Japanese (Kawakami et al., 2021).

1.2 Benefits of Inconvenience (BoI): Values Orthogonal to Efficiency and Functionality

This book is a collection of commentaries and case studies related to BoI. Because the term BoI is unfamiliar, in recent years it has sometimes been misused as "the counterpart of convenience." It is also sometimes mistakenly thought to be an old Buddhist term, but in fact, it is relatively new.

Each chapter of this book consists of studies in research areas where BoI is a keyword. Those areas are either directly related to the "Society of Instrument and Control Engineers (SICE)" (The Society of Instrument and Control Engineers, 2022) or are slightly related to SICE even though they may not usually be included in the scope of discussion. Authors of each chapter of this book examined the common denominator of all those studies and found that the research areas are concerning systems that have a value axis that is orthogonal to efficiency and functionality. We usually tend to think that it is good enough to endorse the improvement of efficiency and functionality. On the other hand, each chapter of this book presents a different (not contrary, but independent) axis of value.

From an engineering standpoint, BoI is considered when focusing on "systems that include human." Generally speaking, it is safe to assume that engineering is for the pursuit of convenience. In contrast, this book is oriented to actively let users experience inconvenience.

1.3 Rethinking Convenient and Affluent Society

The phrase “convenient and affluent society” sounds familiar, and even grating. It is a catchy and frequently used phrase for B to C, and as of 2021, a keyword search will find 150,000 hits on Japanese pages. However, when I look inside myself, who accepted this phrase without any thought, I realize that my deep psychology assumed the relationship shown in Fig. 1.1.

Let us consider what convenience/inconvenience is. It is a question that is difficult to answer when faced squarely. The answer to this question is attempted in other commentaries in this book, but for now, in this section, the answer is given in terms of objectively observable phenomena that can be treated in an engineering manner. Namely, “less effort required to accomplish a task” is called “convenience” in this chapter and “effort” here is defined as the following two types (Sawaragi, 2018).

- Physical effort: Often time-consuming, but not exclusively.
- Mental effort: Consuming cognitive resources (attention, memory, thinking, etc.)

In this way, at least when designing systems that include humans, it seems too cheap for the creators to think that all they have to do is provide convenience.

I conducted thought experiments with students and researchers. The following is a selection of the imaginary services obtained by the experiments.

- Assembling plastic model instead of you.
- Beating the last boss of computer games instead of you.
- Kneading “Neruneruneru” instead of you.
- Carrying you to the top of “Mt. Fuji” by escalator.

“Neruneruneru” is a famous Japanese snack, and kids enjoy kneading it into candy by themselves. “Mt. Fuji” is the highest mountain in Japan and many people enjoy climbing it.

All these services are superfluous to the user. Other examples, such as a drone that detects four-leaf clovers (Ozaki et al., 2018), also suggest the existence of tasks that lose their meaning when “hassle-free and convenient” is provided.

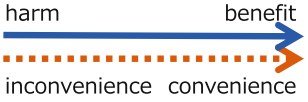

Fig. 1.1 The dependent relationship between convenience and benefit. Schematic representation of the assumptions behind the statement that convenience is always beneficial. Given that an axis representing “convenience/inconvenience” and an axis representing “benefit/harm” can be set up, these two axes can be considered to point in the same direction or to be identical. Note that this is only a schematic of a conceptual relationship. Strictly speaking, it is difficult to imagine that an interval or ratio scale can be introduced for “convenience/inconvenience” (i.e., an absolute value of “inconvenience” cannot be set), and it seems impossible to define an axis or a point where they intersect

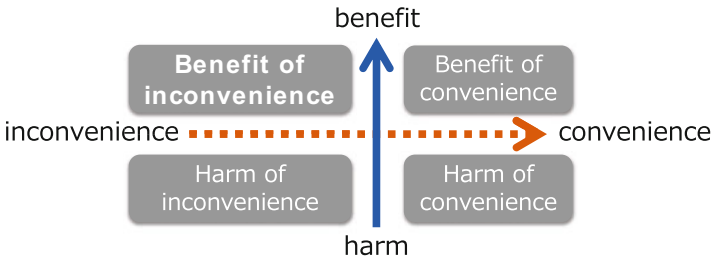

Fig. 1.2 The orthogonal relationship between convenience and benefit. Different from the relationship shown in Fig. 1.1, where convenience is always beneficial, this figure shows that convenience can be sometimes beneficial, and in some cases harmful. In this case, the axes representing "convenience/inconvenience" and "benefit/harm" are orthogonal, and four quadrants can be defined. Same as in Fig. 1.1, this figure only schematically represents a conceptual relationship, and the intersections of the axes do not represent such zeros as on a ratio scale

Once the existence of such tasks is acknowledged, the relationship between the two axes shown in Fig. 1.1 is altered as shown in Fig. 1.2.

Namely, convenience and benefit are considered to be independent and are represented schematically by orthogonal axes. Furthermore, the four quadrants defined by the two axes are named as shown in Fig. 1.2. We can plot the "events in which the convenience of saving time and effort causes harm," as described in the previous thought experiment examples, in the quadrant named "harm of convenience" (lower right space). The quadrants named "benefit of convenience" and "harm of inconvenience" (upper right and lower left) were originally placed on the left and right sides, respectively, of Fig. 1.1, and are nothing new. The remaining quadrant is the "benefit of inconvenience" (upper left). In this quadrant, events that provide users with experiences that are beneficial only because they are inconvenient are placed.

1.4 Benefit of Inconvenience in Manufacturing

This book features commentaries and case studies from areas that are closely related to and surrounding SICE. The most relevant of these is the area of manufacturing. Concerning this area, this book includes a commentary from the viewpoint of value engineering, and the Kano model (Kano et al., 1984) referred to therein provides a more general viewpoint of manufacturing. Therefore, with some overlap permitted, this chapter refers to it as well.

The Kano model classifies product quality based on the assumption that physical fulfillment and customer satisfaction are independent, as shown by the orthogonal axes in Fig. 1.3.

In the Kano model, "one-dimensional quality" is a relationship implicitly assumed by most people during the period of rapid economic growth, in which

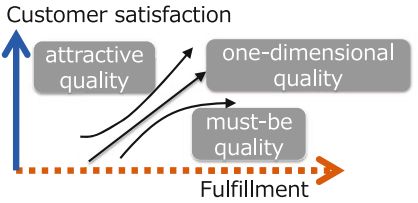

Fig. 1.3 Classification of product quality by the Kano model (ref. (Sawaguchi, 2020) partially abbreviated). The Kano model classifies product quality using a plane stretched on two axes: physical fulfillment and customer satisfaction. Three of them are named attractive quality, one-dimensional quality (performance quality), and must-be quality (basic quality), all of which are represented in the figure by monotonically increasing arrows

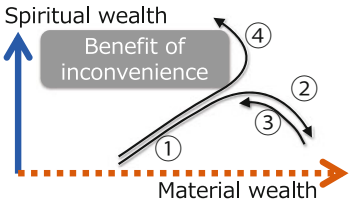

Fig. 1.4 Schematic explanation of BoI with the aid of the two axes of the Kano Model (Reference Sawaguchi (2020), p.33). This plane is defined by interpreted two axes in the Kano model. In this plane, a conceptual explanation of BoI is going to the upper left. A partial revision of this diagram will be included in the section on Value Engineering Perspective in this book

customer satisfaction increases almost linearly with improvement in the physical fulfillment of the product, and is represented by a straight line in Fig. 1.3. Other qualities include “attractiveness quality,” which does not cause dissatisfaction even when physical fulfillment is low, and “must-be quality,” which does not improve satisfaction much even when physical fulfillment increases. These three categories of quality are consistent with our intuition when we interpret “higher functionality” as an increase in physical fulfillment.

It is noteworthy that all three qualities are monotonically increasing (Δsatisfaction/Δfulfillment >0), and schematically they all rise steadily as shown in Fig. 1.3. Here, it can be seen that in the field of manufacturing, it is assumed that higher functionality will always satisfy customers (to varying degrees).

Let us interpret each axis in the Kano model as follows: the horizontal axis means material wealth (physical fulfillment: objective) and the vertical axis means spiritual wealth (customer satisfaction: subjective). This interpretation emphasizes the contrast between physically objective and spiritually subjective wealth and allows us to consider a plane defined by the axes as shown in Fig. 1.4.

The arrows labeled ① through ④ in the figure represent the following matters. First, ① when moving from a state, which is inconvenient at the beginning and is in itself a hindrance to life, to a more convenient and efficient state, material wealth and spiritual wealth have a monotonically increasing relationship (Δspiritual_wealth

/ Δmaterial_wealth >0). However, when ② the relationship breaks down, in other words, when the user is no longer satisfied despite physical fulfillment (Δspiritual_wealth / Δmaterial_wealth <0), then ③ going back in time may be one way to regain spiritual wealth. On the other hand, one can also be oriented toward gaining spiritual wealth (moving to the upper side) by ④ more actively reducing physical fulfillment and introducing inconvenience (moving to the left side).

1.5 Tracing Changes in Commentary in the Special Issue on the BoI

The previous chapter focuses on manufacturing in the close interest of the Society, which published the first and the second issues about BoI, and positioned BoI in that context. Starting from this position and tracing the relational networks, the fields that share the "value axis orthogonal to efficiency and functionality" spread in various directions.

1.5.1 Commentaries of BoI in 2012

"Journal of the society of instrument and control engineers" featured a special issue on "Systems that Utilize the Benefits of Inconvenience" in its August 2012 issue (the first issue in 2012) (Kawakami et al., 2012). The first issue consists of topics that are associated with the keyword "inconvenience" at that time, and that are on the periphery of systems engineering.

Among those topics, "the relationality-oriented systems design" (Shimohara, 2021) is explained. As is now well known, in many systems, people, objects, and matters are related (interdependent) and function in coordination and interlocking. Without realizing the perspective from which systems are viewed in this relationality, there was a trend in the past to view individual objects as closed systems, and to aim for higher functionality and efficiency of the system itself. This tendency, in turn, alienates the function of the entire system, which is composed of people, things, and matters. Considering this situation, the perspective of "viewing the system from the perspective of relationships" was reemphasized, and a system design based on this perspective was proposed.

One of the methods used is "subtraction." The method is that, although some functions seem to be subtracted when viewing an object alone, the subtraction conversely draws out the abilities and motivation of people, and harmonizes the whole that consists of people, objects, and matters. From the user's point of view, a single object looks (superficially) inconvenient. A study group on relational systems has been established in our society. Since the research trend is described in the materials of the study group, there is no contribution to this book.

In the first issue, we also received contributions on Shikakeology (Matsumura et al., 2015) that attempts to solve social problems through "mechanisms" (Shikake in Japanese) that change people's awareness and behavior. Even before the Nobel Prize in Economics was awarded to nudge theory in behavioral economics in 2017, attempts were being made to solve social problems in general, without being confined to economics, using mechanisms (including nudges) to induce human behavior. Even in recent years, we routinely see devices such as dolls placed on chairs in waiting rooms and footprint marks on the floor in front of supermarket checkout counters to induce COVID-19 infection prevention behavior.

By the way, we have all experienced that when we are told not to do something, we want to do it, and when we know something is hidden, we want to see it. People are sometimes motivated to do something induced by the inconvenience of being restricted. Here is the overlap of BoI and Shikakeology. Making something inconvenient is used to be a mechanism to motivate people to act. From the viewpoint of BoI, one of several categories of benefits is "motivation" and from the viewpoint of Shikakeology, one of several categories of mechanism is "making it inconvenient." This book has not received any contribution from Shikakeology. It has already gone beyond the academic framework and is in the phase of practical social implementation, which is well known to us without the need for contributions.

Other commentary included contributions from safety engineering, a field that has been studied extensively for some time, and media biotopes (Suto, 2011), an emerging field at the time. In a nutshell, the touchpoint of safety engineering and BoI is that "safety and security are incompatible." Risk-homeostasis (Wilde, 2001) is a well-known theory that homeostasis found in nature also manifests itself in the human psyche. We have all experienced the temptation to take risky actions when we feel safe, and to take safe actions when we feel insecure. In other words, although it is convenient for humans to improve the safety of a single object, it makes them feel secure and shifts their own behavior to the side of danger, and the safety of the human-machine system as a whole does not change (homeostasis), but rather the nature of danger transforms.

1.5.2 Commentaries of BoI in 2021

The above commentaries were contributed from different fields, but they essentially have something in common. They gave us viewpoints from which we recognize things and matters when we start a new discussion. Since then, these viewpoints have been used in a variety of ways, but the focus of this book is on their use in designing and producing new things. This is also consistent with engineering in the sense that the main concern is to create (design) new things that have never existed before. The commentary part of the special issue on "Journal of the society of instrument and control engineers" in 2021 (the second issue in 2021) (Kawakami et al., 2021) consists of the following contributions.

First, a set of the necessary conditions to be systems with BoI are examined from the standpoint of systems engineering. This set of conditions can be used to check the design results. Experiences that the design results give the user can be analyzed by the set of conditions whether the user's inconvenience yields the user's benefits. It can also be used in the form of designing a new system in the direction of satisfying the conditions without omission. This is like Lean Canvas (Maurya, 2012) for planning (designing) a business model.

Next, design in engineering is generally considered to be a field of technology. In this case, the design of products is implicitly oriented toward increasing functionality and reducing production costs. In this sense, designing something that forces users to experience inconvenience seems out of the question. On the contrary, if we broaden the perspective a little and look at the design of things that provide value to users, the design of things that provide value in the form of "inconvenience" is also an object of engineering. From the field of value engineering (VE), which has conventionally defined "value = function/cost" and provided on-site technology, a commentary is given that provides the framework for understanding inconvenience as a new value.

As described above, in engineering, the design target is often a thing (product). On the other hand, in academia, the design target is not confined to products but also includes businesses and services. In this book, the case of service design is explained as an example of the design of matters. Here, too, the idea that there is a value axis orthogonal to efficiency and functionality works well.

Design studies are known as an academic field that encompasses the design of things and the design of matters described above. Engineering and design share the aspect of conceiving and creating new things that have never existed before. In this sense, engineering and design studies should be adjacent. From an engineering perspective, design studies can be considered a peripheral area. However, perhaps because the design has not been recognized as an academic discipline for so long, the term "design studies" seems to be rarely seen in the societies of engineering in Japan. In contrast, this book explains the position of inconvenience in design studies for engineers.

In addition, ideation support was positioned as one of the application cases of BoI in the first issue, but in recent years when the term "innovation" has become overused, idea support has become an important topic of engineering interest. Therefore, the second issue adds a commentary on the position of BoI in ideation support.

1.6 The Transition of Case Studies in the First to Second Issues on BoI

In the first issue in 2012, the followings are introduced as examples of systems that take advantage of the benefits of inconvenience. Namely, An event called

"BiblioBattle" is an example of community design, a mobile terminal for sightseeing navigation is an example of designing matters through designing things, an artificial hand and a stick-type metronome are examples of designing things, an automobile driving support system and a dysarthria support system are examples of interface design, a trash can robot is an example of relational system design, and extreme thinking is an example of idea support.

Weak robots (Okada, 2012) and tourism engineering were included in the second issue, following the first issue. The authors explain with concrete examples how they provide users with "value independent of efficiency and high functionality." In addition, the following case studies have been added to the second issue.

First, systems that support human activity by interacting with them is described with its relation to inconvenience. Although it may sound intuitively contradictory that obstructing can lead to support, each of the examples presented is certainly convincing.

Next, as an example of service design, a service of travel commerce inspired by BoI is presented. The app developed for this service has been downloaded as many as 150,000 times in the first year after its release.

Finally, as a concrete example of experience design that provides users with BoI, a chapter of this book presents works submitted to the student design competition sponsored by the "Japan Industrial Design Association (JIDA)" (Japan Industrial Design Association, 2022). JIDA is the only national organization of industrial designers in Japan, and BoI has been adopted as the theme of the Student Design Award organized by its Kansai block, with many students applying every year.

1.7 Conclusion

As a general introduction to this book, this chapter first defined the term "benefit of inconvenience." It also attempted to explain that related commentaries and examples commonly have a "value axis orthogonal to efficiency and functionality" and its image by several diagrams in which the two axes are orthogonal to each other. I hope these diagrams support readers to find some overlap between their interests and this book.

References

Japan Industrial Design Association (2022). https://www.jida.or.jp/, last accessed 2022/11/22.

Kano, N., et al. (1984). Attractive quality and must-be quality. *Quality, 14*(2), 147–156. https://doi.org/10.20684/quality.14.2_147

Kawakami, H., et al. (2012). Special issue: System design based on further benefit of a kind of inconvenience. *Journal of the Society of Instrument and Control Engineers*. (ISSN 0453-4662), *51*(8), 699–770.

Kawakami, H., et al. (2021). Special issue: Systems that give users benefits of inconvenience. *Journal of the Society of Instrument and Control Engineers*. (ISSN 0453-4662)„ *60*(12), 831–879.

Matsumura, N., et al. (2015). Shikakeology: designing triggers for behavior change. *AI & SOCIETY, 30*, 419–429.

Maurya, A. (2012). *Running lean: Iterate from plan a to a plan that works*. O'Reilly Media.

Okada, M. (2012). *Weak robot (ISBN 978-4-260-01673-5)*. Igaku-Shoin Ltd.

Ozaki, M. Y., et al. (2018), Dest-logy—A drone in search for the four-leaf clover, https://www.youtube.com/watch?v=GFlyESz0wOg, last accessed 2022/9/25.

Sawaguchi, M. (eds.) (2020). Implementation of Benefits of Inconvenience (ISBN978-4-7649-6011-4). Kindai kagaku sha co., ltd., Tokyo, p.33.

Sawaragi, T. (Ed.). (2018). *Artifact design (ISBN 978-4-320-00602-7)* (p. 246). Kyoritsu Shuppan co., ltd..

Shimohara, K. (2021). Relationality Design and Relationality-oriented Systems Design, Advances in Knowledge-Based and Intelligent Information and Engineering Systems (DOI 10.3233/978-1-61499-105-2-1962), 1962-1971.

Suto, H. (2011). Media biotope: Media designing analogous with biotope. *International Journal of Computer Information Systems and Industrial Management Applications*. (ISSN 2150-7988)*, 3*, 264–270.

The Society of Instrument and Control Engineers (2022). https://www.sice.jp/english/, last accessed 2022/11/22.

Wilde, G. J. S. (2001). *Target Risk 2*. (ISBN 978-0969912439). Pde Pubns.

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