

Life Cycle and Creation of Attractive Quality

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ABSTRACT

Kano et. al.(1984) proposed the theory of Attractive Quality as a method describing the relationship between two aspects such as an objective aspect like physical sufficiency and a subjective aspect like customer satisfaction from a two-dimensional viewpoint based on the philosophers' idea such as Aristotle's and John Locke's. According to this theory, one can classify the relationship into such categories as Attractive Quality, One-Dimensional Quality, Must-Be Quality, Indifferent Quality, etc.

In this paper, we first empirically demonstrate that this categorization is not absolutely invariable but that it changes with time. Second, we propose a hypothesis that this change follows a life cycle such as:

Indifferent quality => Attractive Quality
=> One-Dimensional Quality => Must-Be Quality

In addition, we discuss the method of Attractive Quality Creation (AQC). AQC can be applied to revive a matured product that has aged and whose quality is evaluated as Must-Be Quality, into a renewed product with Attractive Quality. We show a case study of the application of AQC to a matured commodity.

1. Introduction

1.1 Philosophers' Views On Quality

Historically speaking, Aristotle (384-322 B.C.) may have been the first to talk on the subject of quality in any systematic way. In the Chapter V of his book *Metaphysics* [1], he summed the quality up into the following two:

- (1) The difference of substance
- (2) Differences of motions

In addition, he referred to "Virtue and vice" as a certain portion of the latter.

Later, John Locke (1632-1704), a representative philosopher of British empiricism, defined the quality of a subject in his book *On Human Understanding* [2] by saying that

the "power to produce ideas in people's minds is the quality of the subject in which this power exists." He then divided it into "primary quality" which is "such as are utterly inseparable from the body, in what state soever " and "secondary quality" which is "such qualities which in truth are nothing in the objects themselves but power to produce various sensations in us by their primary qualities." [2]

It was W. A. Shewhart (1931)[4] who had dealt with the meaning of quality in present day industrial society in a manner similar to both Aristotle's and Locke's thoughts on quality. He has pointed out that:

“... there are two common aspects of quality. One of these has to do with the consideration of the quality of a thing as an *objective* reality independent of the existence of man. The other has to do with what we think, feel, or sense as a result of the objective reality. In other words, there is a *subjective* side of quality.” [3]

To sum up the discussion in the above, we can learn a lesson that quality has two aspects such as objective and subjective. Based on this lesson, N. Kano et al. discusses the relation between the two aspects and proposes the Attractive Quality Theory [6].

1.2 Objectives of This Article

In this article the objectives are

- (1) Review the theory of Attractive Quality
- (2) Point out the life cycle of Attractive Quality that starts with Indifferent Quality, moves to Attractive Quality, followed by One-Dimensional Quality, and ends at Must-Be Quality.
- (3) Discuss Attractive Quality Creation (AQC) as a method to revive a product that has aged and whose quality elements are evaluated as Must-Be Quality, into a renewed product with Attractive Quality through the life cycle process.
- (4) Show a case study of the application of AQC to a matured commodity.

Incidentally, as the items (1) and (2) in the above are a matter of epistemology while (3) and (4) are a matter of engineering. Therefore, this article could be called engineering based on philosophy. In the 20th century, mathematics was brilliantly performed as applied mathematics. I believe that the application of philosophy under the name of *Applied Philosophy* will become very important in the 21st century.

2. Theory of Attractive Quality

2.1. Traditional Thinking for Quality Element as One-Dimensional Recognition

Although the term of quality is frequently found out in quality-related literatures, this word often is used as a generic term. But if somebody want to use this word specifically for a certain product and service, it is common to refer to its quality elements. For example, quality elements of a color TV set in 1980s are shown in Figure 1.

Fig. 1. Quality Elements of A Color TV Set, 1983

Although from early times philosophers discussed the meaning of quality as described in Section 1.1, many of today's quality specialists have not considered this topic. Rather quality specialists of today are developing engineering methods for how to eliminate current quality problems and meet customer requirements. Many of them have no time enough to think about and advance the concept of quality in the world of quality control, management, and engineering. Therefore, we could not find any references in the literature that discussed the relationship between objective and subjective sides of quality. But, it seemed that the objective side and the subjective side of quality were considered in practical, industrial world synonymously or as one dimension. Let us call this thinking as One-Dimensional recognition and think about the following two examples:

- For "power consumption", one of the quality elements of a TV set, people are satisfied if the power consumption is small while they are dissatisfied if it is large.
- For a quality element like safety, people are not dissatisfied or satisfied when a TV set is safe to operate because this must be the case. It is expected. However, people are dissatisfied if a short circuit or an electric shock is a possible worry.

The One-Dimensional recognition can explain the case of power consumption but not for safety. N. Kano et. al. proposed a theory that can universally handle these extreme cases. In their theory, a pattern classification of quality evaluation is discussed on the basis of the Two-Dimensional recognition that the above-mentioned philosophers advocated (refer to Figure 2(a)).

2. 2. Attractive Quality versus Must-Be Quality as Two-Dimensional Recognition

The method which are proposed by N. Kano et al. [6] is summarized as follows:

- (1) The physical sufficiency of a quality element is taken along the horizontal axis, and the user's perception is taken along the vertical axis.
- (2) The physical sufficiency of the product or service is expressed with the two levels:
 - Insufficient
 - Sufficient.
- (3) The user's perception is expressed with the following three levels (Refer to Figure 2(b)):
 - Satisfied,
 - Neutral (not satisfied nor dissatisfied),
 - Dissatisfied.

Note: Considering the nuances of the Japanese language, the user's perception was classified into five levels in the original paper [6]. But as we understand that the three levels as described above can essentially interpret the theory.

- (4) For each quality element, assume the two states for physical state such as insufficient and sufficient as described in the above (2). Then, ask a user how the user perceives the quality element for each state: satisfied, neutral(neither satisfied, nor dissatisfied) or dissatisfied. Nine possible evaluation cases are obtained by combining the three evaluation levels for each physical state and categorized them into six patterns. Each of the six patterns are defined and named based on the feature of each pattern as shown in Figure 3 and are illustrated in Figure 4.

Fig. 2 Recognition of Quality

Fig. 3 Classification of Quality Elements into Six Patterns Based on Two Dimensional Recognition

- (5) Based on Two-Dimensional Recognition the main four patterns for four cases out of the nine cases are explained as follows:
 - Attractive Quality:
The name was selected because this quality element is considered very attractive.
 - One-Dimensional Quality:

This case is equivalent to the content based on the One-Dimensional recognition method shown in Figure 2 that explains the origin of the name.

- Must-Be Quality:

This type of quality implies that the sufficient physical state is a must, hence the name.

- Indifferent Quality:

This case is recognized as a neutral feeling either for the sufficient or insufficient physical state, which means people are indifferent about the physical state.

(6) Although it does not frequently occur in practice, there are two more patterns for five more cases that may be produced theoretically: reverse quality and skeptical quality.

- Reverse Quality:

There are three cases in Figure 3 in which users feel opposite to the direction of efforts of producers. This is the reason why the category is called Reverse Quality”.

- Skeptical Quality:

There are two cases in Figure 3 in which the occurrence of such combinations is very skeptical because such combination of the evaluation could be realistic or not.

(7) Furthermore, the survey style shown as Figure 5 is proposed based on the classification shown in Figure 3. Hereafter, let us call this style Attractive Quality Questionnaire as well as this survey an Attractive Quality Survey.

**Fig. 4 Evaluation Patterns of Quality
Based on Two Dimensional Recognition of Quality**

Fig. 5 Attractive Quality Questionnaire for “Picture” of A TV Set

2. 3 Discussion

(1) Option of “Others” in the Questionnaire:

We have been frequently asked whether the choice of “Others” in the questionnaire is necessary (refer to Figure 5). The answer is “Yes.” This choice should be kept in the questionnaire because it has very important roles as follows:

- (a) How to arrange and express a question in the questionnaire is very important for any survey. One of the most important keys for developing not only a successful Attractive Quality Survey but also any other survey is to put the option of “Others” into a questionnaire. This option is used to check in pilot survey whether the statements or questions in the questionnaire are appropriate or not. If the number of respondents choosing the option of " Others” is over 10% of the entire pilot sample for a statement or a question, this should be investigated before proceeding.
- (b) To leave "Others" as choice for a question also is recommended for the full-scale survey, because the total number of respondents to "others" can be used as a confidence measure for the survey. If the number of "Others" responses does not exceed 1% for every survey item, it can be certified that the survey results are extremely confident.

Incidentally, let me point out that the percentage of the number of response to the "Others" bears a role similar to error variance in ANOVA or multiple regression analysis.

(2) Relation with Herzberg’s Theory

It is a fact that we were influenced by Herzberg’s Motivator-Hygiene Theory (M-H Theory) in behavioral science to develop the Attractive Quality Theory. That is, the Attractive Quality and Must-Be Quality in our theory correspond to Motivator and Hygienic factor in M-H theory [5].

3. Life Cycle of Attractive Quality [14]

Figure 6 (a) shows the result of the Attractive Quality Survey for remote control of a color television set. In 1983, the majority of the people evaluated it as attractive while one third evaluated it as indifferent. But in 1989, the number of people who rated the remote control for Attractive Quality decreased to one third while the number rating it One-Dimensional Quality increased to nearly half. In 1998, although the number rating the TV remote control as One-Dimensional Quality decreased to one third, the number rating it Must-Be Quality exceeded the majority. This is a typical case of the life cycle of a quality element: Attractive Quality at the beginning changes to One-Dimensional Quality and later to Must-Be Quality. In this section, let us discuss the change of

people's evaluation for quality as the lifetime of the product or service changes.

There exist a cellular phone that can connect with Internet as well as transmit and receive E-mails. This product has expanded its share of the market of the cellular phones very quickly in Japan. It is called as "I-mode." When Attractive Quality Survey was conducted for this I-mode product, it received remarkably high Attractive Quality Evaluation from the young people like students although most of the middle-aged people evaluated this as Indifferent Quality. This phenomenon is very common not only for I-mode but also for any other epoch-making goods with a new function. Let us theoretically discuss of this phenomenon.

We occasionally encounter goods and services with:

- A completely new function that has never existed before,
- Performance that has been enhanced by leaps and bounds,
- User-friendliness that has been remarkably improved by introducing a new mechanism which was not seen nor was even considered,
- A very new style
- Etc.

The evaluation provided by most of the people to these goods and services with an Attractive Quality Survey might be fundamentally Indifferent Quality because even if such goods and services include a completely new idea, people cannot understand which part is new and what it means. Then, it takes a relatively long time for people to understand the meaning of new goods and services and to get pleased with them.

Suppose a manufacturer strongly advertises this new product or service with a new quality element, or, powerfully conducts public relations through mass media. In this case, may try using the product or service and some of them may be pleased with it and then are proud to recommend it to their friends. Then, as the number of its users increases, people feel satisfied with this product or service if they have it, but feel neutral even if they do not have it. That is, its quality element is recognized as Attractive Quality. Further, if people repeatedly using the product or service know the value of the quality element, they will have a strong dissatisfaction without it. Then, their evaluation changes to One-Dimensional Quality. Furthermore, as the goods and services are widely disseminated so as to be considered as matured products, people evaluate its existence as it must be, but they feel dissatisfied without it. In this stage, the evaluation for its quality element changes to Must-Be Quality.

The above discussion leads us to propose a hypothesis that evaluation of a quality element changes from its birth to being matured and the change of the evaluation follows the life cycle such as:

Indifferent => Attractive => One-Dimensional => Must-Be.

If there is a product or service with the quality element that follows such a life cycle, it is called an example of a success because there are so many goods that are released to the market with a new quality element but most people's evaluation remains only at Indifferent Quality. Remote control in Figure 6(a) can be said as a typical case where this hypothesis is backed up. Moreover, the voice multiplex in Figure 6(b) changed in such a way as:

Indifferent => One-Dimensional => Indifferent

during 15 years from 1983 to 1998 through 1989. The hypothesis in the above would be supported if we had a time when Attractive Quality got a large number between 1983 and 1989. However, the hypothesis cannot explain the return from One-Dimensional to an Indifferent Quality evaluation during the period between 1989 and 1998. Is this something very special for this quality element or universal? We need more observation for various other products in order to get an answer for this.

Moreover, failure in Figure 6(c) obtained the same level of percentage for both One-Dimensional Quality and Must-Be Quality at any survey time. It is thought that in this case Attractive Quality was experienced before 1983. In addition, we could interpret the fact that the category mix remained at the almost same level during the 15 years, if we could assume that various Attractive Quality elements were continually introduced and these attractive elements carried new failure problems. Then, this made people continually experience failures and let them appreciate non-failure products, if any. In this way the One-Dimensional Quality evaluation might have been maintained.

Fig. 6 Life Cycle of Quality Elements for A TV Set; 1983, 1989 and 1998

4. Theory of Creation of Attractive Quality [10], [11]

4. 1 What Is Attractive Quality Creation?

The life cycle hypothesis for quality described in the previous section brings about the wish for a method to rejuvenate the matured product to a product with Attractive

Quality. The concept and methodology to realize this wish will be discussed under the name of Attractive Quality Creation in this section. Attractive Quality Creation is defined as follows:

Create a new product with a quality that cannot only be distinguished from the qualities of the current products but also is attractive for customers.

4. 2 KONICA Model---Product Planning Based on Latent Requirements---

(1) The Konica Case [8]

I started to feel the necessity of Attractive Quality Creation when I had an opportunity to personally listen to Takanori Yoneyama's talk about how Konica created such a user-friendly camera with a built-in flash and an auto focus feature in the middle of 1970s. The following is the summary of Yoneyama's talk:

In 1970s, camera development had progressed markedly. So, at the beginning of the 1970s, it was regarded as matured product. At that time, the competition was so intense that Konica initiated a project that was to create a completely new camera. For this project, the members were very familiar with the necessity of listening to the consumers' "voices," because Konica had implemented company-wide quality activities for so many years. Therefore, at the beginning of this project, the members from R&D and Marketing jointly interviewed the consumers to try to find out what kind of *camera* they wanted. Although a tremendous quantity of "voices" were collected from consumers and various market channels including retailers, information extracted from them would only lead to minor changes in the existing camera design rather than a major breakthrough.

Then, Konica engineers got very dissatisfied with this results and became aware of how to change their survey method identify the problems and wants of people *taking photographs*. After all, people bought cameras for taking pictures not just for the sake of owning a camera. So, the engineers visited a photo-processing laboratory to examine the prints and negative films taken by consumers and to evaluate the quality of prints and developed films. This work at the laboratory revealed that there were many failures as shown in Figure 7 that the engineers did not expect such as::

- Under-exposures because people left the flash at home when the pictures were taken.
- Out-of-focus because people were still unable to handle the interlocking

mechanism

- Etc.

To solve these problems, Konica developed and released cameras with auto focus and a built-in flash as well as auto film loading and winding functions from the middle to the end of 1970s. This prompted consumers to buy a second and even a third camera. Thereafter, Konica's business considerably grew and completely changed the history of camera development in the world.

Note: Incidentally, Mr. Yoneyama promoted to President & CEO (1990) and Chairman of the Board (1996) later and is now an Advisory Director of the Board (2001) for Konica Corporation

Fig. 7 Photo-Taking Failures Found in Lab

(2) Extraction of Latent Requirements

One can learn the following lesson from the talk of Yoneyama:

For a matured product, the information obtained from a survey based on questions about the product itself is apt to indicate only minor modifications but does not necessarily bring about hints for breakthrough.

Incidentally, this is what I call "Konica Model."

Let's generalize the lessons in the above. We can survey people about a current product (for example a camera) using the following questions:

- What kind of **camera** do you want?
- What kind of problems do you have with a **camera**?
- What kind of **camera** improvement do you want?
- What kind of **camera** breakthrough do you want?
- Etc.

The replies to these questions are explicit "voices" of the people for a product (camera) so that they can be generically called ***expressed requirements*** of the people to the product. These expressed requirements can be classified by their content into the following two categories:

- Due to dissatisfactions with the current product and its incidental things.
- Due to new requests beyond the current product and its incidental things.

Konica Model suggests the need for another type of the survey. In this survey, questions are not designed for the product itself but for the various situations related to product usage. The questions could address people's sense of values, interest, concern, behavior, use environment related to the product and its usage. The method of this survey includes observations about the people's behavior while the questions in the survey above only asked directly about the product itself. Even though a questionnaire survey is conducted, a question neither asks about dissatisfaction, nor requests for the product itself, but it asks indirectly about the circumstantial issues related to the product. Then, it is important to find facts, phenomenon, "voices" that imply the people's dissatisfaction or requests related to the usage of the product. For example, the facts found out by lab survey conducted by Konica were as follows:

- Many photos with underexposure are taken
- Many photos out of focus are taken
- Many blank films found after film development

These facts could have been interpreted as a photographer's carelessness, or unskilled handling of the camera. However, it was interpreted that the observations above imply the existence of requirements such that:

Even if a photographer were careless and unskilled, there could exist a camera with which he/she can do a good job for taking photographs.

In this way, from the indirect survey, one can extract the requirements that are not explicitly recognized even by people. Let us generically call these *latent requirements*.

(3) Product Planning based on Latent Requirements

It is predicted that a new quality element which is planned based on dissatisfaction among the expressed requirements might be evaluated as One-Dimensional or Must-Be Quality in many cases. On the other hand, another quality element that is planned based on requests or proposals among the explicit requirements might be evaluated as Attractive Quality. Such an evaluation is very powerful for a product in a growth phase, although the engineers can identify many of such expressed requirements without a special survey.

However, in case of matured products, many expressed requirements might be obvious by the past surveys and the information available through various marketing and servicing channels. Indeed, some if not all of these requirements might be obvious also to the competitors. Therefore, most of such expressed requirements for a matured product could be considered as such requirements whose contents might contain technical or

economical difficulties to be realized and which remain as obvious. For example, the noise of a ventilation fan and the heat problem inside the shoes are example of these obvious but technically difficult requirements. On the other hand, if we find some requirements that are technically realizable but still remain requirements, this is because most of them may tend to turn into minor impact to a market.

By the reasons in the above, product planning based on latent requirements becomes important. The latent requirements may help a company make a plan for the new product with a quality element that surprises people if it is technically realizable and its impact to a market also is strong.

4.3 Process for Attractive Quality Creation

The process of Attractive Quality Creation consists of three blocks. One block is the extraction of latent requirements and confirmation of their generality. Another block is planning the product toward realizing latent requirements. The last block is the Attractive Quality Survey.

The first block is composed of the three steps. First is to survey the usage situation. Second is to extract of latent requirements from the observations in the survey of the usage situation. Then, the third is to confirm whether or not the latent requirements are general or not because the survey of usage situations is conducted at a small-scale rather than at large-scale. Therefore, the latent requirements extracted may not be generally accepted. We conduct a rather small scale survey for the following reasons:

- It is more effective to deeply investigate a relatively small number of objects rather than many objects so as to find meaningful latent requirements.
- Care should be taken to protect the company confidentiality for any surveys related to planning a new product.

Since we need to simply check “yes-no” answers to the itemized questions for a survey to confirm the generality of latent requirements, we can keep confidentiality even though it is to some extent at large scale.

The second block focuses on realizing the latent requirements that are confirmed as general. This corresponds to developing a new process instead of solving a problem so that we can use the method proposed as *Task-Achieving QC Story Procedure(TA Procedure)* which is differentiated from *Problem Solving QC Story Procedure(PS*

Procedure) [12]. Here, we are defining a task as planning a new product toward realizing the latent requirements. According to TA procedure, what we should do is to *focus the task* as the first step.

Let us discuss this step with a simulation based on the case of Konica camera. Here, our task is to develop a completely new camera based on the latent requirements. Suppose we have the following three latent requirements the generality of which are confirmed:

- Many photos with underexposure are taken
- Many photos out of focus are taken
- Many blank films are found after film development

It is generally too much work if we try to do the above three at once. We need to narrow down which requirement should be the primary focus with evaluation criteria such as impact to market, technology, resources, speed and so forth. Suppose we select underexposure.

Second, after focusing the task, we need to find a method on to achieve the focused task. This step consists of *listing and evaluating all the possible alternatives* for the task to find the one at which to aim. Then, investigate the details in order to achieve the method and prepare a *scenario* that includes the details to achieve the focused task. For example of underexposure, we list the alternative ideas as follows:

- Develop a camera that sounds an alarm when people leave a flash at home.
- Develop a camera that cannot work without sufficient light
- Develop a camera within which a flash is built in
- Etc.

Then, we select the flash-built-in alternative because of impact to market and technology and prepare the scenario that includes: how to reduce the size of a flash while providing sufficient light, the design of the built-in mechanism, scheme for battery, etc.

Third, we need to *predict and prevent risks*, if any, that the method may cause. For a built-in flash camera, we could predict and prevent risks, for example, such as life of battery, any malfunction of the photo-taking mechanism, and so on.

Finally, we need the Attractive Quality Survey to confirm that the product plan developed will provide Attractive Quality. Taking into account the three blocks with seven steps, we can arrange the process flow as shown in Figure 8.

Fig. 8 Process for Attractive Quality Creation

4.4 Discussion

(1) Three Approaches for Attractive Quality Creation

There are three approaches for generating a theme for AQC:

- Technology approach due to epoch-making new technology development.
- Genius approach due to the flashes of genius
- Market approach due to comprehensive studies on product usage and customers' behavior

The first and second approaches are popularly implemented. The first is useful especially for a product in an area where technology is rapidly developing, while the second is useful any places we have geniuses. Of course one should be careful of the genius approach with a non-genius. It is terrible. The third approach, on the other hand, can be theoretically applied anywhere and anytime. However, the third approach can only generate ideas for new products or features but cannot even imply technological feasibility. On the other hand, the first and second approaches may do so. For this reason, unlike the first two approaches, the ideas by the third approach may not be always feasible. It is therefore suggested that the third approach should be taken when the first two approaches are not applicable, which is mostly for matured products.

(2) Attractive Quality versus Addition of a Function

Some people exist who claim that adding a remote control to a TV set is not a quality problem but a matter of adding a new function. This question is easily answered by the quality concept of Aristotle described in Section 1. Here it was pointed out that quality is characterized by the difference of items. If we take any two items, for example overhead and slide projectors, each of the attributes such as screen size, film size and flexibility in Figure 9 distinguishes the two items, respectively. Hence, these three attributes can be called as quality. Similarly, we can distinguish TV sets with and without remote control. Therefore, we can consider adding a remote control also as a quality problem. In other word, function is one element of quality.

Fig. 9 Comparison of the Qualities between Slide and Overhead Projectors

(3) Attractive Quality versus Attractive Products

Some people exist who insist that the process for Attractive Quality Creation in Figure 9 is not for creating Attractive Quality but for creating an attractive product. And they also mention that the latter is not a problem of quality but a problem of items.

To answer this question, we must clarify the relationship between quality and items. For this purpose, we can use the multi-dimensional quality space (MDQS) by Shewhart [4] based on Aristotle's concept in the above. Relative to the difference between two items such as slide and overhead projectors, we can organize the MDQS, where each quality characteristic represents a dimension. In this space, each of the two items is represented as a point plotted. Then, the vector between the two points shows the difference of quality and its distance between the two represents similarity in quality. Since this distance is shorter, the two are more similar in quality and since it is longer, the two are more different in quality. By ascertaining this space, we can clarify the relationship between quality and items as shown in Figure 10.

Fig. 10 Items and Qualities On Multi-Dimensional Quality Space

Begin by developing a space for each quality characteristic dimension that shows the difference between each two of all current items. Let this denote the current item space. Since quality creation is defined as "generating an item whose plot is an outlier from the current product space", the next step is to generate quality that clearly distinguishes a new item from current items as shown in Figure 11.

Fig. 11 Concept of Quality Creation On Multi-Dimensional Quality Space

5. Case of Attractive Quality Creation [15]

In this section, we select rain gear as an example of a matured commodity, and plan a product for new rain gear with Attractive Quality along with the process as shown in Figure 8.

(1) Observe the People In Towns On Rainy Days

We observed pedestrians in towns on rainy days compared with those on fine days and recorded some outstanding behavior on the observation records. For example, the following was an outstanding behavior:

Since a woman changes her wear or personal effects by the purpose of her activity

such as shopping, work, or accompanying children, it is easy for an observer to identify her objective just at a glance. On the other hand, it is not as easy to identify the objective of a man because he wears a suit with a tie or a casual wear. Thus, we must distinguish his situation only by this.

The most serious situation that we observed was for female pedestrians as follows. Most babies are carried by women and the activities of women with babies are checked by their babies and hand baggage even in the calm, fine weather. Their difficulties are aggravated in bad weather. Therefore, we decided to focus on " Baby-Carrying Housewife" as our object for creating rain gear with Attractive Quality.

A survey focusing on housewives with babies clarified the following points:

- Compared with an ordinary person, women have remarkably more hand baggage including a stroller etc. because of a baby.
- In addition to the baby, women are accompanied by another child in many cases, and always need to be cautious of active children and a demand of a child. There is no margin for error when children are active in order to keep them safe.
- Even on a rainy day there are more women who hold their babies in their arms rather than carry their babies on their backs.

(2) Extract Latent Requirements

The most important points aimed at Attractive Quality for a baby-carrying housewife were as follow:

- How to secure the safety of babies
- How to prevent babies from getting wet
- How to prevent mothers from getting wet

From these aim points, the following latent requirement was implied:

- A woman with a baby wishes to have her hands free but prevent both herself and her baby from getting wet.

As this latent requirement was so obvious, we skipped the process of "Confirm Their Generality."

(3) Product Planning and Prototyping for Realizing Latent Requirements

(a) Alternatives for Latent Requirement to Release Hands from Umbrella

Two alternatives were proposed to realize the latent requirement to release hands from

rain gear:

- Usage of a rain coat
- Hands-free umbrella

Among these two alternatives, we focused on the hands-free umbrella because more mothers seemed to feel an umbrella was easier to deal with than a raincoat.

Creating an umbrella with hands-free function became the objective. As we had no technology for floating an umbrella in the air, we had to adopt a method to fix an umbrella to the mother's body by introducing a waist belt and metallic fixture.

(b) Risk Avoiding and Product Planning

We predicted the weaknesses (risks) that a hands-free umbrella with the above mechanism might bring about:

- Cost increase due to waist belt and metallic fixture
- Not nice to look at
- Have something extra even when it stops raining

Each weakness in the above was examined using the following process..

First, we listed the following alternatives as probable actions against increased costs.:

- Do the best to minimize the increase in cost by selecting cheaper belt and metallic fixture
- Strong appeal for the added function that balances the increase of cost
- Add any function other than hands-free in which a waist belt and/or metallic fixture can be shared. If this can be done, it will help to make people feel the increased cost is not excessive.

Next, we considered the point of "not nice to look at:

- Improve the style of a waist belt and metallic fixture
- The combination of an umbrella, a waist belt, and a metallic fixture might provide a sense of incongruity and worsen the appearance.

The appearance may be improved if another function that has a feeling of an affinity with a waist belt and/or a metallic fixture is introduced. In the third place, we investigated how to overcome the weakness of people's feeling about something extra when it stops raining. This feeling comes out because the hands-free umbrella is recognized as rain gear. If it is recognized as a thing necessary also in fine weather, this will be completely eradicated.

The above examination of the three weaknesses showed us that they may be able to be avoided, if we can find other functions necessary/favorable for a housewife with a baby and tie in this into the hands-free umbrella. Then, we rechecked the observations of our baby-carrying housewife and found the following two requirements:

- Wish to reduce the load of hand baggage
- Wish to carry the baby in front rather than on her back.

For these requirements, we listed up the following ideas.

- Introduce a knapsack
- Introduction of a hug strap

By weaving these ideas into the concept of a hands-free umbrella, when it stops raining the umbrella can be put into a knapsack. Moreover, the knapsack also is useful in fine weather and a raincoat can also be used in addition to an umbrella. That is, the task was expanded from the original idea and became "development of an all weather knapsack for a mother with a baby."

(c) Prototyping and Evaluation

Based on the plan in the above, a quality table was prepared, the feasibility for each function was checked, the required parts were arranged, and then a prototype was made. We asked six housewives with two to four children to evaluate the prototype.. Overall, the evaluation of the prototype was very positively. The followings were some examples of the comments with unanimity:

- The combination of a knapsack and a hug strap is very convenient as nothing like this existed.
- A sheet too can be carried in a knapsack, which is a good idea. I can use it to cover myself while giving breast milk to my baby even outside.

Moreover, those participating in the evaluation of the prototype gave the following advice for further improvement to the product.

- The arm of hands-free umbrella is heavy. this must be so, a hood and a rain hat are better than it (anonymous).
- An umbrella can not be raised properly by a child. The hands-free umbrella may be more appropriate for a child.
- Protection against the cold should be considered.

Based on these suggestions, a secondary prototype was made as shown in Figure 12.

Fig. 12 All Weather Knapsack For Mother with Baby

(d) Attractive Quality Survey

After showing the secondary prototype to several groups of housewives, we conducted an Attractive Quality Survey. There were 141 housewives who participated in the survey. 52% of them evaluated the overall quality of the all weather knapsack for a mother with a baby as Attractive Quality as shown in Figure 13. Then, the survey results were stratified into two groups. In the first group were housewives (106 persons) with children from 0 years to 3 years old. The housewives (35 persons) in the second group were without the children. We compared the two groups and found a remarkable difference between them as shown in Figure 14. It turned out that the evaluation rate of Attractive Quality increased to 59% for the first group while it was 31% for the second group as shown in Figure 14. Additionally, the results were stratified by the element functions and then it turned out that "a built-in raincoat" was especially highly evaluated as shown in Figure 15.

Fig. 13 Overall Evaluation of Attractive Quality Survey

**Fig. 14 Contrast of Overall Evaluation for AWKMB
by Mothers with/without 0-3 Years Old Children**

Fig. 15 Evaluation for AWKMB by Added Functions

(4) Discussion

(a) Above we showed that, even for a matured product with a simple structure to which it seemed that not any more newness could not be added a new product with Attractive Quality by applying the process of Attractive Quality Creation. The following four points might be the success factors for this example:

- Narrowing down the object to a mother with a baby based on the observation in towns in rainy days.
- Extraction of the latent requirements from the observations.
- Creating Attractive Quality by combining the other functions into a single function in order to cover the weaknesses of the original plan
- Evaluation by the housewives of a prototype and the prototype's improvement based on their comments

(b) The "Confirm their Generality" step in Figure 8 was not applied because, as the rainy gear was very matured commodity, we were very confident that our observations were so general that this could be omitted. It is thought that there might be something that

could be treated like the rainy gear.

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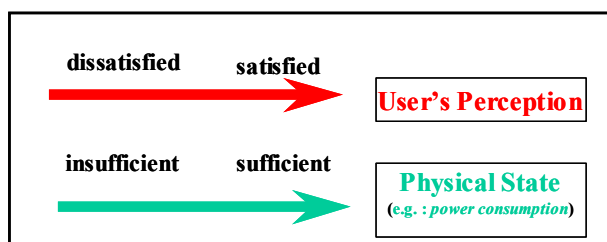
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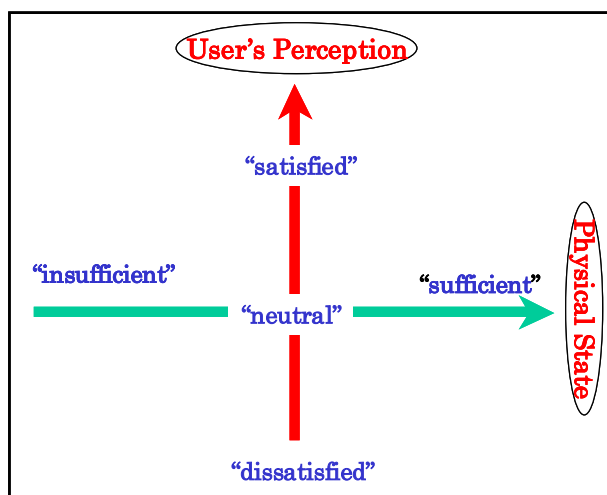
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Picture Quality	Remote Control
User Friendliness	Multiplex
Failure	Feather Touch
Life	Power Consumption
Safety	Space
Style	After Service
Instant Switch	Instruction

Fig. 1. Quality Elements of A Color TV Set, 1983



(a) Traditional, One-Dimensional Recognition



(b) Two Dimensional Recognition
Fig. 2 Recognition of Quality[6]

Phys. State	Sufficient			
Insufficient	Perception	dissatisfied	neutral	satisfied
	dissatisfied	<i>skeptical</i>	<i>must-be</i>	<i>one-dimensional</i>
	neutral	<i>reverse</i>	<i>indifferent</i>	<i>attractive</i>
	satisfied	<i>reverse</i>	<i>reverse</i>	<i>skeptical</i>

Fig. 3 Classification of Quality Elements into Six Patterns Based on Two Dimensional Recognition[6]

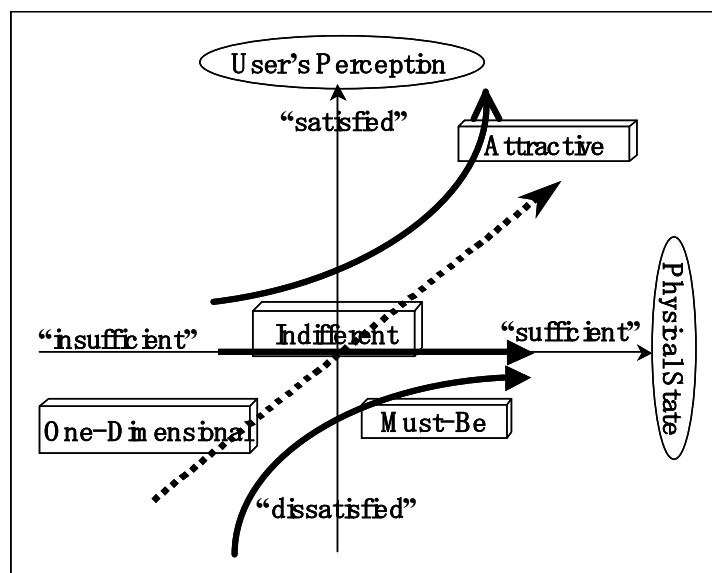


Fig. 4 Evaluation Patterns of Quality Based on Two Dimensional Recognition of Quality[6]

If the picture of your TV is in ***good condition***, how do you feel it?

1. Satisfied
2. Neutral(neither satisfied nor dissatisfied)
3. Dissatisfied
4. Others()

If the picture of your TV is in ***ill condition***,
how do you feel it?

1. Satisfied
2. Neutral(neither satisfied nor dissatisfied)
3. Dissatisfied
4. Others()

Fig. 5 Attractive Quality Questionnaire for “Picture” of A TV Set [6]

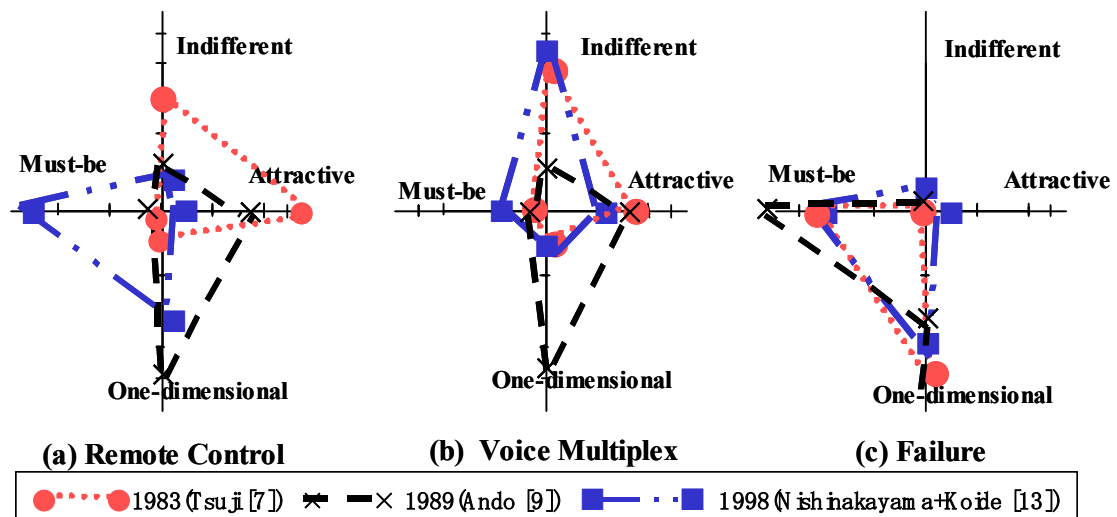


Fig. 6 Life Cycle of Quality Elements for A TV Set; 1983, 1989 and 1998

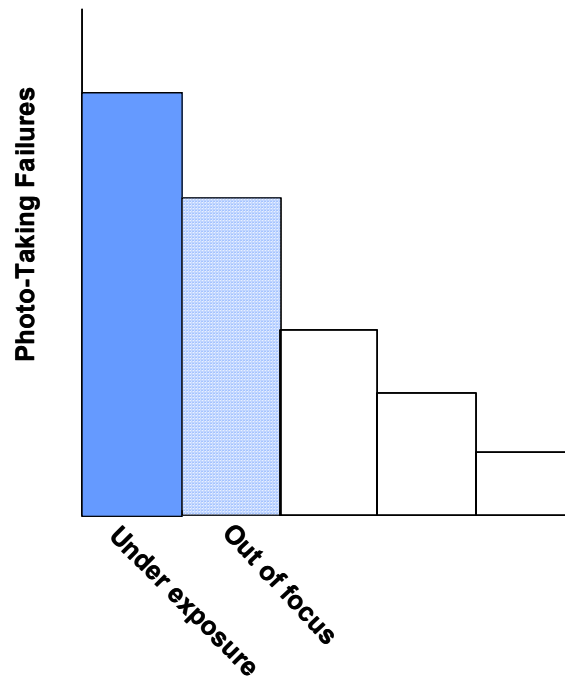


Fig. 7 Photo-Taking Failures Found in Lab
(Prepared due to the Talk of T. Yoneyama)

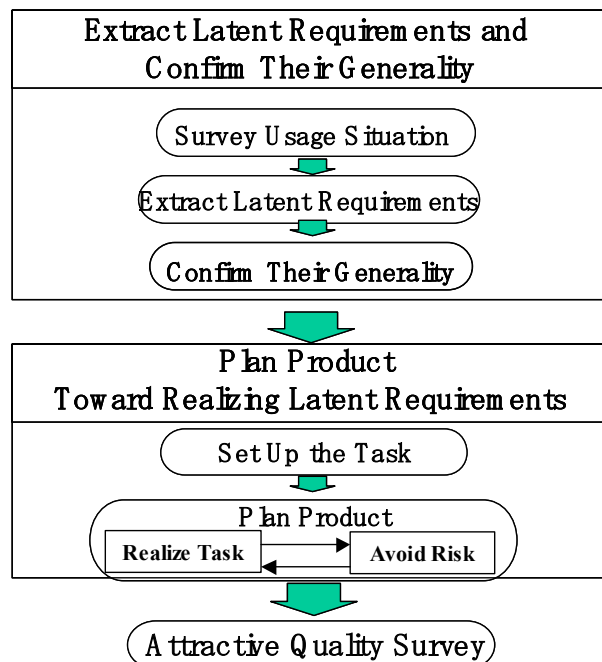
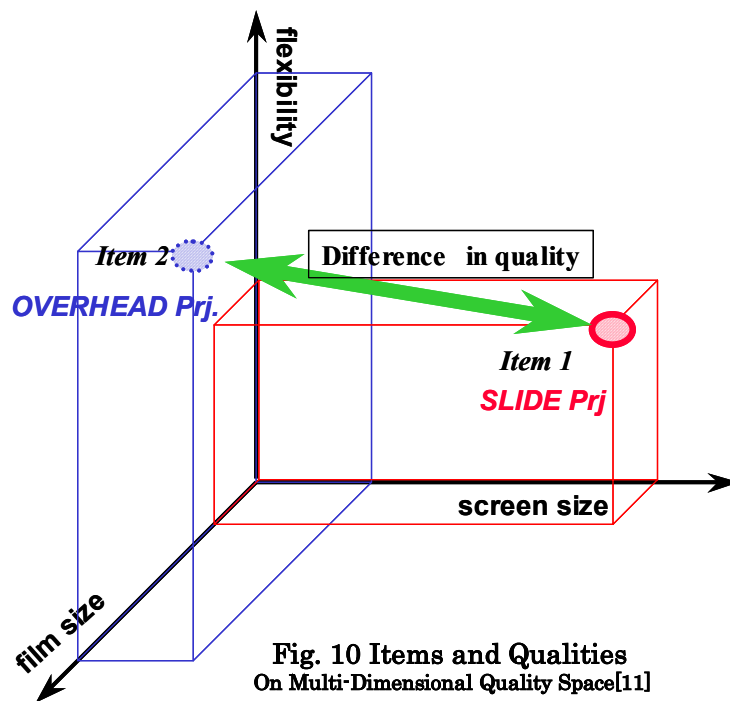


Fig. 8 Process for Attractive Quality Creation

quality \ item	<i>Slide Projector</i>	<i>Overhead Projector</i>
screen size (x)	large	small
film size (y)	small	large
flexibility (z)	less	more

**Fig. 9 Comparison of the Qualities
between Slide and Overhead Projectors[11]**



**Fig. 10 Items and Qualities
On Multi-Dimensional Quality Space[11]**

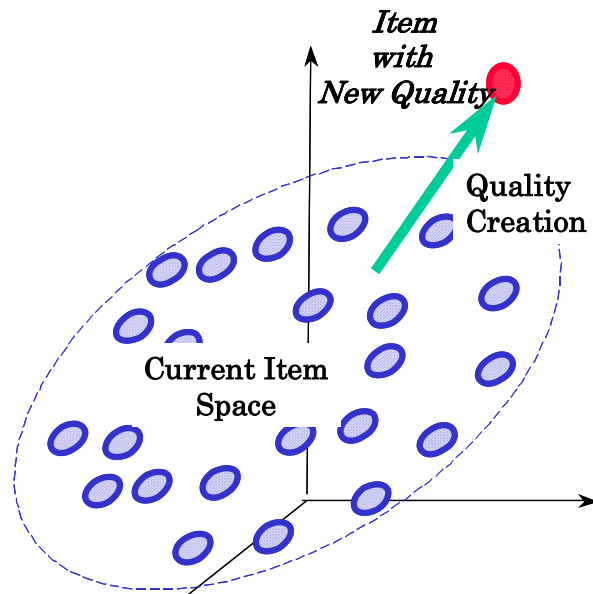


Fig. 11 Concept of Quality Creation
On Multi-Dimensional Quality Space[11]



Fig. 12 All Weather Knapsack For Mother with Baby(AWKMB) [15]

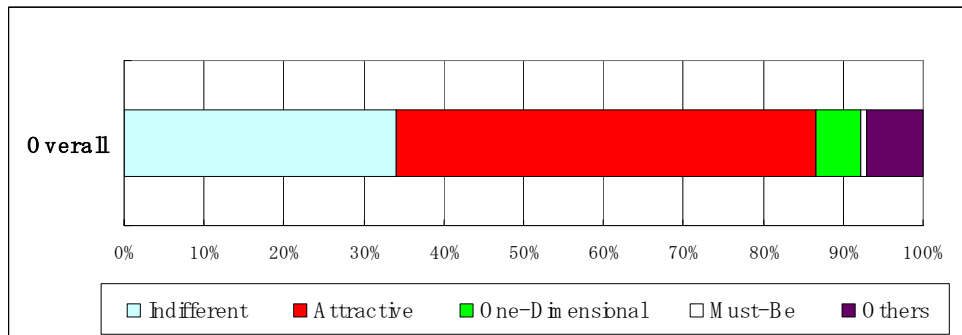


Fig. 13 Overall Evaluation of Attractive Quality Survey [15]

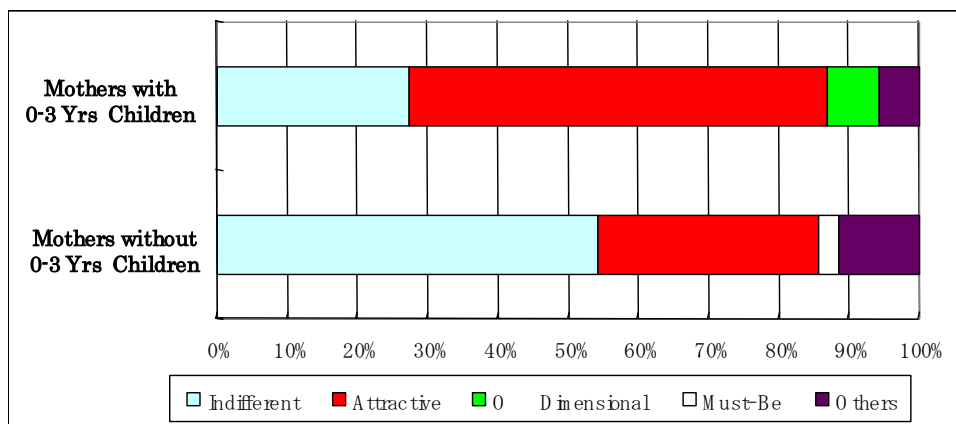


Fig. 14 Contrast of Overall Evaluation for AWKMB by Mothers with/without 0-3 Years Old Children [15]

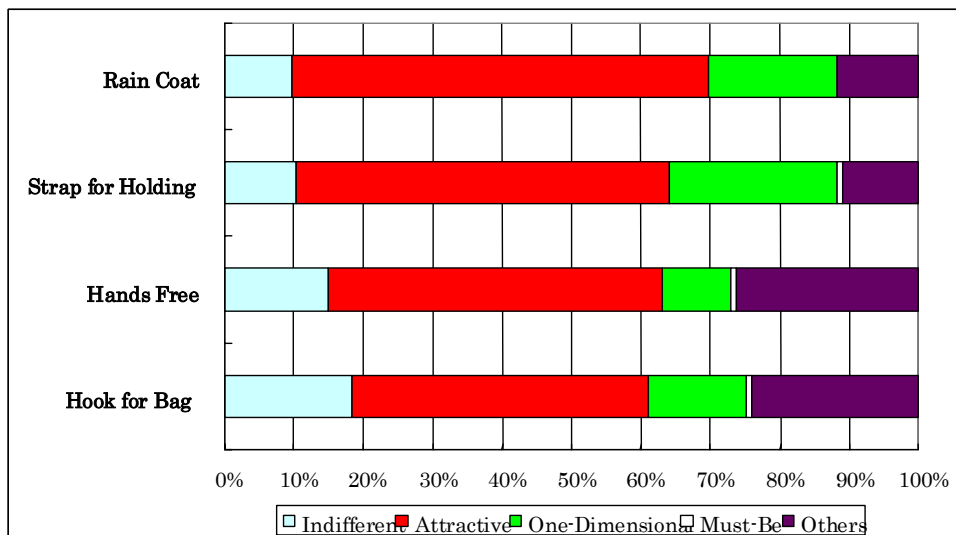


Fig. 15 Evaluation for AWKMB by Added Functions [15]