Converting the participants' verbal expressions into design factors

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Abstract

Investigating and extracting users' desires and aspirations often conduct design researchers to a great deep challenge. Therefore, the designers usually examine several ways to get closer to these unrevealed feelings. These ways include applying various qualitative and quantitative techniques. Amalgamation of these techniques might be the most desired technique among designers in revealing deep inside feelings. But once a qualitative technique is applied, the design researchers deal with the difficulties of making the outcome data, including verbal and visual expressions, comprehensible enough in order to be used in the subsequent steps of design or to be conveyed to product developers. So, their usage of such qualitative techniques would be subject to misconception and misunderstanding, and here, the expertise of designer will have a crucial effect. Consequently, designers often find qualitative data formats as imperfect reports as they might not be applied convincingly throughout the design process.

This paper presents some encountered complexities of a pilot survey titled "Designing and Implementing an Artificial Design Tool Based on Improved Kansei Engineering" which, due to its concept, involves applying intermingled quantitative and qualitative methods. In addition, this paper is an effort to describe the borderline between quantitative and qualitative methods and their transformation point, and also to describe some practical solutions suggested by the authors.

Within any mixture of quantitative and qualitative techniques, there are two participants: human in one side (both as designer and also the focused and target group) and machine (computer) on the other side. In other words, within any combination of these two techniques, we encounter the qualitative data expressed by the target group and self perception of designers on one hand, and the quantitative data produced or required by the machine on the other hand. And then, the problem will be how to take advantage of these two sources for the analysis and concept generation phases. Surely the future methods of design together with the future design-assistant machines will raise this fundamental question: how can we overcome the rigid borderline between qualitative and quantitative methods and make a seamless concept of co-qual-quant model which will bolster the real human-machine connection. It is one of the design complexities of the time and one of the requisites of the future. We have come up with a solution through a conducted case study, in which we have made a bridge between the human and computer. So, we have used some qualitative methods on the human side (for example PPP and Mood Board) and some quantitative techniques (such as AHP) on the other side and we have tried to infer some co-qual-quant model-based parameters to inject to the design machine as a pure quantitative instrument.

Keywords

User-centric design, qualitative techniques in design, design problem solving, Kansei engineering, AHP in Kansei Engineering, co-qual-quant model in KE

Emotional bonds between users and products are an essential element that can determine the commercial success of a product. Eliciting user desires and emotions often presents a challenge to design researchers. Users can offer a valuable design resource to support the designing process. However, such involvement can be perceived as problematic. This is partly because users find it difficult to conceptualize and express their ideals and wishes, and therefore, they need to be supported. Product functionality as such is closely interwoven with social and cultural values. Users are not always conscious of their needs or may not regard particular pieces of information as useful. Likewise, users are not always able to verbalize their emotions and reflections. Coates distinguishes between the idea of the stereotype (what a typical product is currently like) and the ideal (the imagination of how an object should be like). New designs aim to come reasonably close to the ideal, whilst not leaving the perception of the stereotype (standard) too far behind. Coates criticizes the use of focus groups in market research based on its preoccupation with stereotypes instead of ideals, because the stereotype is what participants know best about and agree most upon. Ideals are “fuzzy” as they vary across people and are not necessarily conscious. *Blue-sky* and *what-if* possibilities are therefore more difficult to reflect upon and verbalize.

So, it is important to give users many different channels through which they can express their requirements and ideals. Several qualitative techniques like Mood Board and Product Personality Profiling have been proposed and employed recently to retrieve peoples' ideals rather than their stereotypes to overcome these shortcomings. A methodological “trick” to trigger novel ideas was employed by encouraging people to consider the “future”. By assisting users in *suspending reality*, new ideas and wishes may emerge. People begin to think more creatively and disclose their wishes and ideals more freely.

These techniques broadly use Images and enable communication of intangible emotions such as happiness, sadness and calm, beyond linguistic restrictions. Images are a powerful resource to convey meanings, particularly emotional values and experiences. Especially, abstract imagery which is applied in Mood Boards is often more successful in this than figurative images which can have strong literal interpretations. As they tend to be purely visual, they transcend linguistic restrictions. Their application can serve as an important tool to communicate values that cannot be expressed easily through words.

As the subject of design becomes more novel and complex, it would be more difficult for the users to think and imagine the hidden aspects of the subject, and also their unrevealed desires. Here, Qualitative techniques play an important role. They are more powerful tools in helping people visualize the current and future context of design and their imaginary and ideal products. Therefore, applying them seems crucial, but also interpreting their result might be a bit of minefield. So, in some occasions converting these qualitative data to quantitative data will bring about confusion and should be solved using combination of appropriate techniques. This is the main approach which will be discussed in this paper.

Framework of the paper:

As a descriptor for the applied technique, we propose a framework which governs all parts of the model. Here, the framework and its basis will be described.

The technique mainly combines AHP, Mood Board and PPP to provide the optimization algorithm with the necessary input parameters (attributes) and also importance weights (final weights resulted from AHP) of those parameters. The novelty of the design subject also made usage of Mood Board inevitable, because we had to reduce the representative objects in the questionnaires (sample products) into more sensible ones for the users. We used Mood Board for simplifying and reducing the representative objects from a complex, concrete and real world object (for example image of some green cars) to some simple and abstract images. Also it helps us to communicate with the unawareness of the users. In addition, we have further used our findings from both Mood Board and PPP in defining AHP criteria. Then, the final extracted weights of importance from AHP were inputted as the

coefficients of the fitness function in Genetic Algorithm optimization, the project's synthesis phase.

We will split the whole framework into some modules and will describe them separately. These segments include "attribute gathering", "attribute reduction" (includes two sub-segments), "verification", "importance weight extraction and final quantification", and "result convergence".

Case study:

This section is assigned to parts of a conducted project titled "Designing and Implementing an Artificial Design Tool Based on Improved Kansei Engineering" in which we examined application of Mood Boards and Product Personality Profiling as two qualitative techniques in some phases of Kansei engineering parallel to routine exploited quantitative tools. Further, we assessed the results by repeating the procedure with the conventional quantitative approach. The detailed procedure of case study in the first approach is illustrated in the following flowchart. Each block will be discussed separately in the following statements.

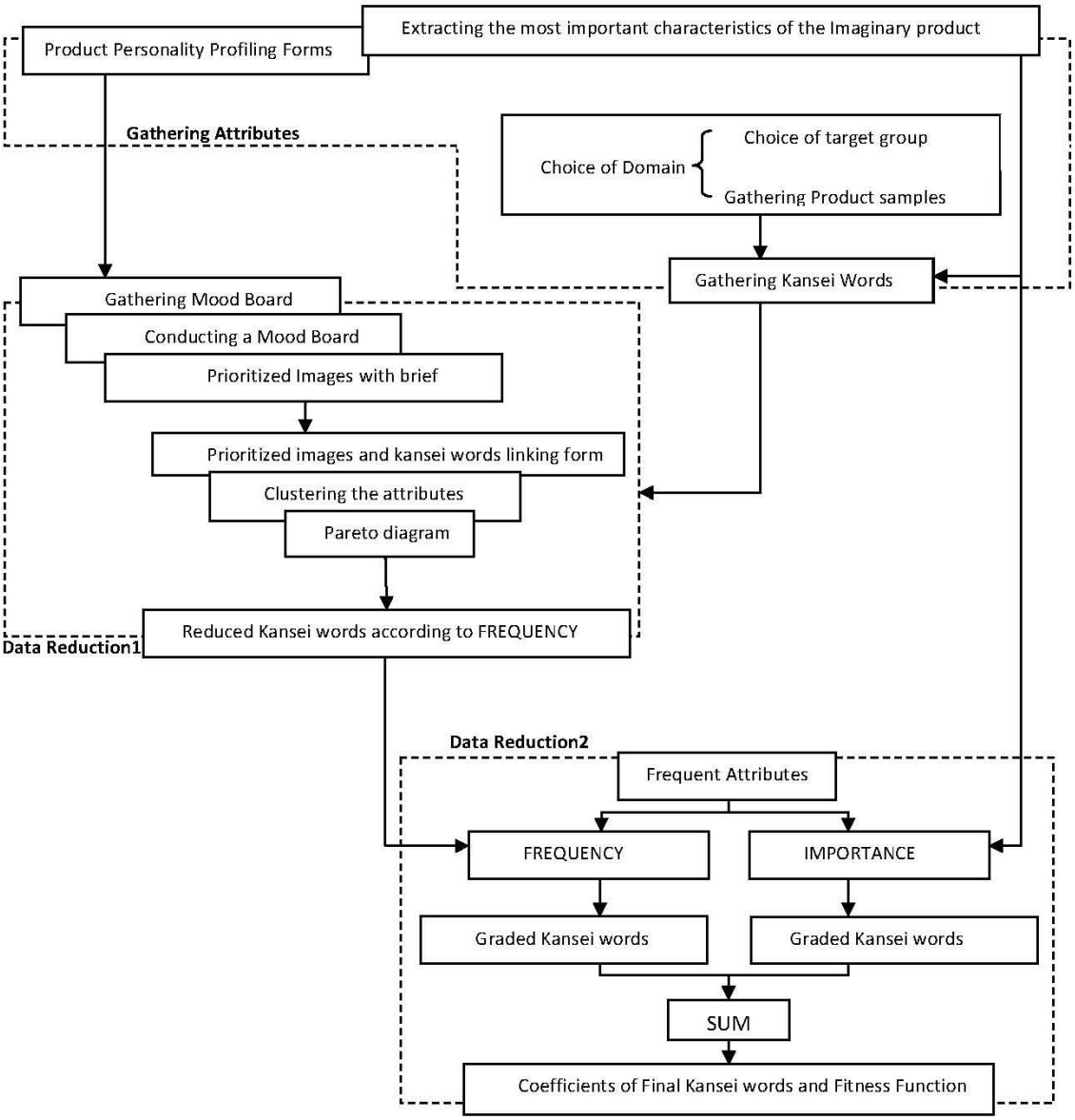

Figure 1. An overview of the whole process

Gathering attributes (Kansei words)

Commonly, the procedure of KE initiates with choice of domain in which the target group and sample products are chosen. The target group included 20-40 Iranian women and sample products ranged from electric and hybrid urban vehicles of renowned manufacturers to some new concepts. In the phase of gathering the Kansei words which is portrayed in the first dashed box in figure1, first all of the related sources such as internet, magazines, pertinent literature, experts, experienced users, relating Kansei studies, ideas, and visions were investigated, also a discussion group was held consist of 20 industrial design girl students in which they were asked to talk about the product samples and choose 3 most preferred ones in accordance with the project. All chosen samples were graded respecting their frequency and 3 of them were applied in the later PPP analysis. Then, we conducted a PPP session which included 20 participants who were shown PPP forms. This form included 3 columns for 3 selected products and also one more column for describing the imaginary product. One sample of this form is presented in figure 2.

Imaginary product	Product C	Product B	Product A	participant	
					sex
					age
					occupation
					lifestyle
					car
					personality
					Family environment
					clothes
					newspaper
					pet
					Favorite TV program
					Music
					Food
					Name
					Role in the family
					Favorite Cartoon Character
					Perfume
					Do you like to buy this product?
					Color

Figure 2. A sample of PPP form

Through PPP analysis we extracted a series of the most important attributes for imaginary products which were useful to be included with other gathered Kansei words. This analysis was also helpful for “data reduction phase”, the next step in KE.

Reduction of attributes, Phase 1:

The outline of this phase is shown in the second dashed box in figure1. Instead of regular application of marketing tools in this phase, Mood Boards was applied. At this point, previous PPP analysis was supportive in helping the design team to have much better visualization while gathering abstract images for Mood Boards. Afterward, one Mood board session

consist of the same former 20 participants was held. A variety of images numbered as 778 from various categories were chosen. These images reduced to 271 images in the second classification. Then, all the participants were asked to set a layout of their 7 preferred images and also to prioritize them in accordance to their importance and relevancy to the Mood board question. They were also asked to express a short brief for each of their choices. Some of the advantages of using Mood Board were noticed as high enthusiasm among participants in fulfilling the task, and quicker understanding of the subject. One of these layouts is shown in figure 3.

Figure 3. A sample of a mood board layout used in the case study

The next task was to convert these qualitative responses to some fathomable values for the synthesis phase while reducing the number of Kansei words to the most important ones. Therefore, firstly all the gathered attributes were clustered and then linking forms were planned. This form included a list of all the new attributes and was presented to the participants to be marked for each of their 7 selected images. The list of attributes printed in the form is shown in the table 1.

Lightness	Particularity	Power	Slowness	Fun	Excitation	Complexity	Sensible
Heaviness	Ordinary	Softness	Rapidity	Seriousness	Calmness	Simplicity	Ornamental
Delicate	Sturdy	Sport	Spacious	Kind	Stylish	Compact	Happy
Sad	Mature	Childish	Feminine	Masculine	Smartness	Silliness	Unfriendly

Table 1. List of attributes

In the next step, these data were processed and the most frequent attributes were determined using Pareto diagram. The most frequent attributes in the first three priorities is illustrated in figure 4. These frequency values built the **Frequency** criterion for the second data reduction step.

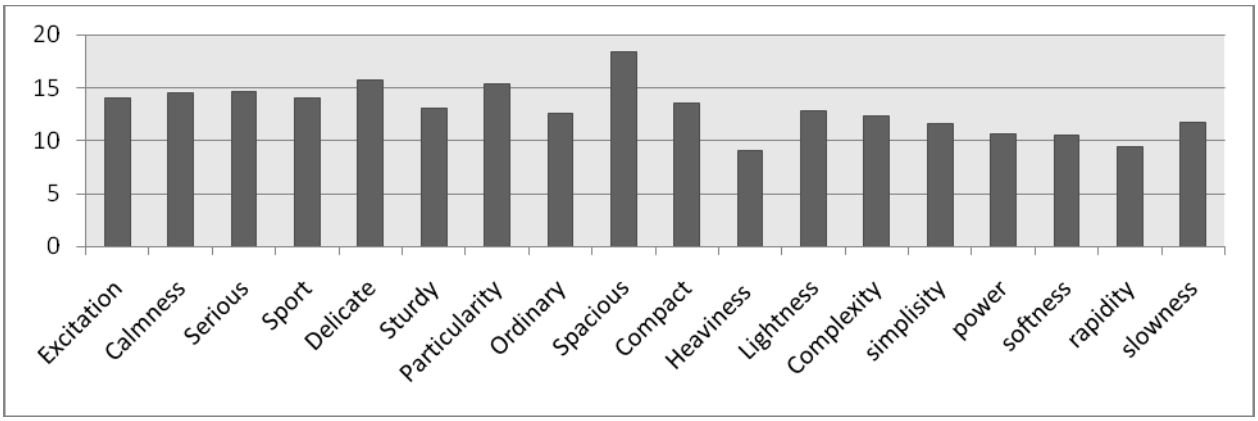

Figure 4. Comparative chart for frequency of attributes

Reduction of attribute, Phase 2:

In order to assign inclusive values to the attributes based on ideas of both participants and design team (the human side of design procedure), another reduction was conducted applying AHP. This phase is shown in the third dashed box of the figure1.As it was discussed in previous section, the output of the first reduction phase was used in defining the frequency criterion in the second step. Also, most of these attributes were in contrast with one another in the meaning; therefore, the attributes were rearranged to polar Kansei words like Spacious-Compact, Excitation-Calmness before being processed.

On the other hand, the **Importance** criterion was defined in accordance to the results gained from PPP analysis based on the designer's viewpoint and interpretation. Within this free point of manipulation, designers will be able to incline the results with respect to the main objectives of the project. For example if designers wish to orient towards a highly delicate final concept, they can assign a greater importance degree to the delicate attribute while processing it in AHP.

Furthermore, the partial scores for each attribute in both criteria were added together and the final scores were determined. Table 2 presents the first 5 attributes with higher final scores. These values were further used as coefficients of fitness function in the synthesis phase based on Genetic algorithm optimization.

FINAL SCORE	ATTRIBUTE
0.17	Spacious-Compact
0.114777	Sturdy-Delicate
0.088467	Particularity-Ordinary
0.083879	Serious-Sport
0.082718	Excitation-Calmness

Table 2. Final score of attributes based on co-qual-quant model

Verification:

In order to evaluate the quantification procedure of qualitative input data, a parallel process was conducted. Within this process all the attributes were graded using seven grade scales, and then the ten highest scored attributes were used in the first step of fuzzy survey. Figure5 shows a frame of the interface of this survey in which all the samples were scored with respect to attributes.

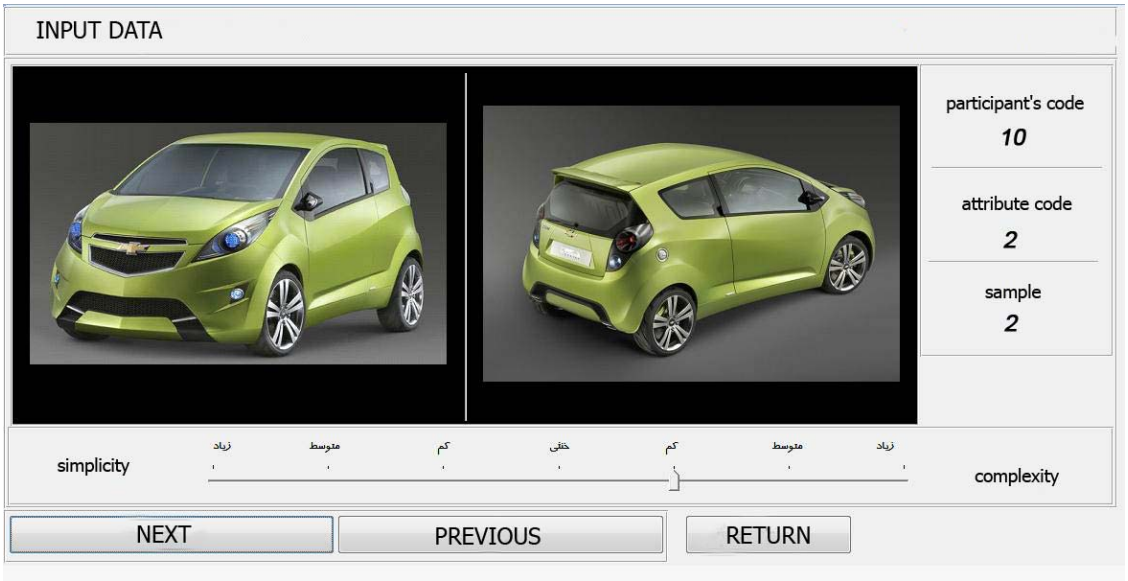

Figure 5. Fuzzy survey interface sample (Phase 1)

The output matrix of the first fuzzy step was categorized and reduced using Factor Analysis. By applying factor analysis the dependant variables or attributes were recognized and merged into one unique group, and then new name was given to this group of attributes. Interestingly, it was possible to categorize and name the main extracted attributes within similar five attributes obtained in the previous procedure like Spacious-Compact, Sturdy-Delicate, Particularity-Ordinary, Serious-Sport, and Excitation-Calmness.

In the second step of fuzzy survey, the data base obtained from the first step was used in order to give the participants a chance for comparing (and making a convergence between the mental concepts of Kansei terms), and also enhancing the accuracy of their choices. A frame of the survey interface is shown in figure 6. All participants were asked to firstly score the vehicle in the left side of the screen and then click the Enter button to see the car with the closer score to her choice. She was then free to change in her assigned scores according to her preference and was able to see the changes in data base accordingly. She was able to continue the procedure as long as she would feel pleased by her scores.

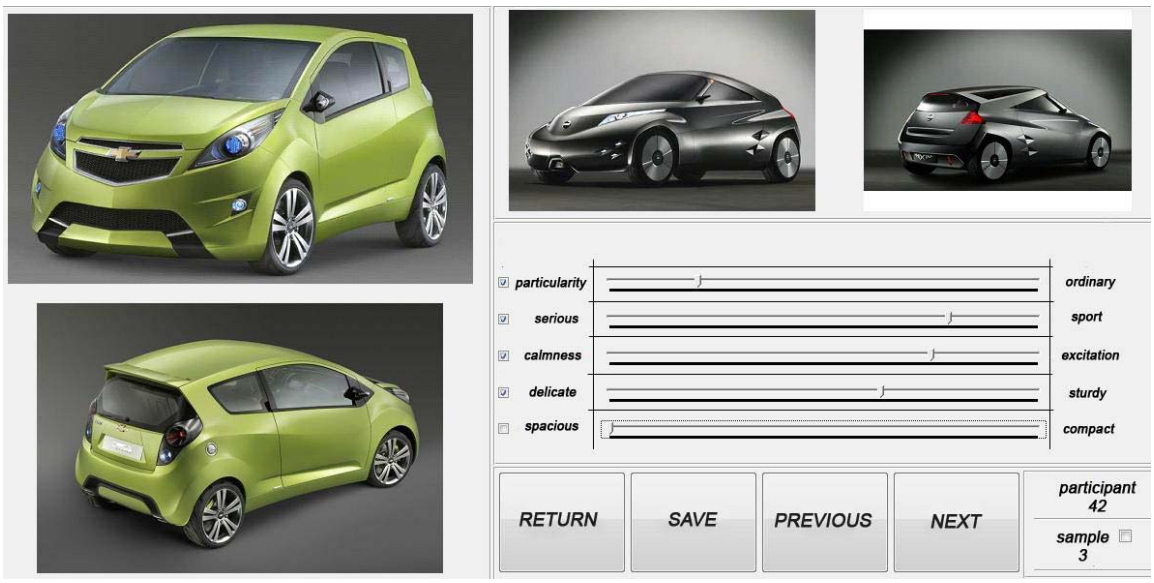

Figure 6. Fuzzy survey interface sample (Phase 2)

Importance weight extraction and final quantification

Due to the overall positive meaning of all of these attributes, in the next task they were all graded based on variance, which means that attributes with lower range of variance are of the most importance and have balanced mixture of both polar attributes, and vice versa. So, the attributes were again prioritized and scored applying AHP based on variance. Table 3 presents the new degrees of these attributes after AHP.

FINAL SCORE	ATTRIBUTE
0.177954	Spacious-Compact
0.088992	Sturdy-Delicate
0.077788	Particularity-Ordinary
0.09352	Serious-Sport
0.06641	Excitation-Calmness

Table 3. Final score of attributes based on pure quantitative procedure

Results Convergence:

After comparing the result of both methods (the pure quantitative method and the new co-qual-quan-titative method), it seemed that there was a meaningful correlation between the two sets of results. It was also expected that there would be such correlation and similarity between the results, because we have had selected a concrete and previously well defined object as the object of the design: a car. But it should be clearly mentioned that for different design objects or methods (for example for pure conceptual or state-of-the-art objects of design or for methodologies which use pure conceptual medium objects) there will be no guarantee for the convergence of the two results, indeed there will be a degree of divergence from a little difference between outputs of two methods up to total different sets of results.

Conclusion:

The new methods of design require the designer to use the numeric and quantitative tools. On one hand the daily developing use of CAD tools and computers and on other hand the need for satisfying the public interest, both force the designer to use computational and quantitative methods. This surely will save a lot of time and expenses in the manufacturing and designing industries, and accordingly will guarantee predicted success for the product.

But on the other hand, this may rise up some new problems in the design area: the designer role will be diminished and the users may show a faulty or unaware response to the quantitative design tool. This requires the methodology designers to revise the methods for overcoming this method.

On of the solutions is to inject some sort of “unconscious” awareness to the tool, and on the other hand there should be always enough role be left for the radical or intended presence of the designer.

As the result of such intention, we have re-designed some parts of a classic “Kansei Engineering” methodology to fulfill these needs. We have added some qualitative methods (as mentioned above, including PPP, MoodBoard and AHP) to the methodology and tried to expose the participants to some fully conceptual aspects and meanings of the object of design. Also we have tested the results in a real-world implementation, a project entitled “Designing and Implementing an Artificial Design Tool Based on Improved Kansei Engineering”.

As the final verification method, and as long as the subject of our project permitted us, we have rechecked the whole results with a pure quantitative and tested method and the result was to a compelling degree consistent. Despite what was mentioned above, in different design solutions or objects, the results might not be convergent like the mentioned project. However, as it seems that the philosophy of the modified methodology is enough reasonable and obvious, we suggest the usage of co-qual-quant techniques in such kind of complexities; for instance, a conceptual and ambiguous object or a culturally unfamiliar one. Not to mention the fact that surely there would be other combinations of such approaches, mixture of qualitative and quantitative approaches, which would yield the appropriate results.

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