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KANSEI INFORMATION APPROACH FOR AN INTERDISCIPLINARY DESIGN METHOD PROPOSAL BASED ON INTUITION

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Keywords: kansei, interdisciplinary design, intuition, evoked metaphor

1. Introduction

Considering the complexity of the artefact (*artefact* means here human construction, to be opposed with the Nature construction. It gathers objects, processes, services and their systems), great design improvements can succeed thanks to an interdisciplinary approach. However, interdisciplinary knowledge sharing encounters many issues, due to disciplinary ontology and human subjective understanding. For designers to adopt an interdisciplinary behaviour, a method is required. This paper introduces a methodological solution, based on intuition.
An application of the method can be found in [Lévy 2004], for the design of *MATiK*.
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2. On *Kansei* Information

Looking for a comprehend definition of *Kansei*, Harada [Harada 1998] collected definition of the word *Kansei* provided by researchers involved in the research related to *Kansei*, and analyzed the responses statistically. Then, he proposed five major dimensions of *Kansei*:

- *Kansei* is a subjective and unexplainable function;
- *Kansei*, besides its innate nature, consists of the cognitive expression of acquired knowledge and experience;
- *Kansei* is the interaction of intuition and intelligent activity;
- *Kansei* is the ability of reacting and evaluating external features intuitively;
- *Kansei* is a mental function creating images.

This proposition of definition of *Kansei* shows the multi-dimensionality of *Kansei* and is composed of multiple elements such as ‘subjectivity’, ‘expression of the inner (knowledge and experience)’, ‘intuition and intelligent activity’, ‘reacting toward external stimuli’, and ‘reflective images’. Therefore, *Kansei* is a higher function of the brain, involved in the construction of intuitive reaction to external stimuli. To approach *Kansei,* various disciplines are required: design is concerned with the creation of artefacts which are perceived; cognitive sciences are concerned with the information processing; psychology is concerned with people’s knowledge and experience; anthropology and behaviourism are concerned with human reaction and behaviour.
In most of the English literature, *Kansei* is assimilated to subjectivity (or related words such as emotion or affect). However, as notices Yoshikawa, subjectivity is different from *Kansei* in the way that subjectivity does not include only mental feature, but also all individual differences in processing results [Yoshikawa 2000]. *Kansei* is a Japanese word that does not have proper equivalent in English.

Therefore, the term *Kansei* would be described as close to '*mental sense of subjectivity*', being a high order function of the human brain. This cognitive function is taking part to all cognitive processes in which subjectivity is involved.
Kansei Information is the part of *Kansei* studies that is interested in the way human brain processes information. Information entering the brain provokes a cognitive process, which ends on a brain reaction making. This reaction may not have a consequence such as visible or conscious behaviour, but still, it does exist. *Kansei* is involved in this process starting from the first information arrival in the brain and ending on the reaction. *Kansei* Information is aiming at figuring out this process.

2.1 *Kansei* and communication

Figure 1 illustrates the indirect impact *Kansei* on the interpersonal communication process:

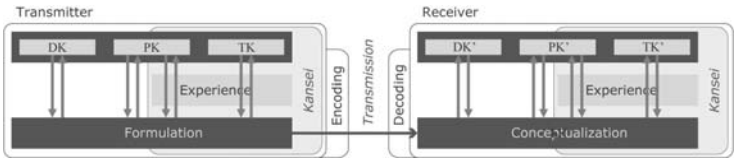

Figure 1. Influence of Kansei on the communication process

- On the first hand, when the transmitter formulates a message, she/he requires acquired knowledge during the formulation process. Three fundamental kinds of knowledge are involved: the explicit one, the prescriptive one, and the tacit one (respectively representing by EK, PK, and TK on the Figure 1) [Vincenti 1984]. Experience is highly related to tacit knowledge, and partially to prescriptive knowledge. Experience can be the one that has been the event providing the individual to gain this knowledge, or it can be the current one in which the individual is formulating the message. In the first case, experience influences the way knowledge is acquired and then remembered through *Kansei*. In the second case, experience is used in the memory re-aggregation in the process of formulation [Nadel 1998]. In both of these processes *Kansei* is involved since *Kansei* and experience are fundamentally linked.
- On the second hand, after the receiver received the information, she/he decodes it in order to conceptualise it. The interpretation of this information is at least partially subjective and is depending on the context the information is acquired. Thus experience and *Kansei* are also involved in this process. Note that the receiver's knowledge is noted DK', PK', and TK' to differentiate it from the transmitter's one.

Since it was shown that *Kansei* is involved in both content formulation and content understanding of an interpersonal communication, we can conclude that *Kansei* has an impact on communication process itself. Its impact is not direct since *Kansei* is not involved in the information flow itself, but on the way information is formulated and then understood. That is all the more important since the content of the information and its understanding is influencing human reaction, influencing then social behaviour, influencing finally the social context itself (its structure and its way of being processed). Therefore, the impact of *Kansei* on the society and the way information is transported and understood should not be neglected. In this way, *Kansei* Information appears as an interesting path to solve some of the issues related with human subjectivity in social context.

3. Problem

3.1 Interdisciplinary design

The artefact, considered in its context (users and environment), becomes a very complex entity [Lévy 2003]. Design unceasingly tries to create artefacts by taking into account of their complexity. However, it was suggested that the designer cannot take all these aspects related to the complexity of the artefact into consideration. An interdisciplinary behaviour is required to insure a correct enlargement of the designer's consideration on the artefact.

The designer does not acquire too much knowledge, which he could not fully use. A design-centred interdisciplinary structure can be created to permit to choose judiciously new solutions for the design of industrial artefacts. The 'interdisciplinary' solutions create (or emphasize) one (or several) solution for one (or more) aspect related to the artefact's complexity. These aspects are not distinctive: all interact of course between themselves. The principal mission of the designer is to coordinate them in order to extract some new artefacts, which improve in their social and human dimensions without disturbing formal, functional and emotional qualities of the artefact [Lévy 2003].

3.2 Issues related to interdisciplinary context

Communication is one of the fundamental tasks in group constitution and operation. Intrinsically, a group cannot exist without communication. The specificity of interdisciplinary groups is that the communication is not based on a single ontology (The term '*ontology*' is defined as a specification of a domain, of all that 'exists' in a domain, including terms, concepts, entities, axioms, theorems, laws, rules, and actions that can be performed on everything within the domain as well as how to reason about the domain), but on as many ontologies as the number of disciplines gathering in the group. This specificity affects both tacit and explicit knowledge.
The specificity affects TK and PK directly related with *Kansei*, since each discipliner's experience is partly coming from the activity in the discipline. As ontology also gathers links between artefacts, and rules and actions being performed in the activity, it influences the way the activity is performed and tacitly understood. That is all the more important that explanations and trials aiming at resolving any issues related with TK cannot directly be expressed explicitly, whereas conflict can occur because direct experience conflict.
Interdisciplinary sharing affects explicit knowledge since it involves concepts or methods that may be defined differently for each ontology (i.e. the same word may mean different things in different disciplines). Communication on concepts or methods defined specifically to each discipline is a barrier for the interdisciplinary group communication process. Indeed, divergence of definition for a similar concept or method can lead easily to misunderstandings and frustrations between members. This issue is independent from the kinds of interdisciplinary groups and from the involved disciplines.

4. Design Method

4.1 On intuition

Concisely, the term of *intuition* would be defined as *the ability to understand or know something immediately, without conscious reasoning*. For Kant, intuition is one of our basic cognitive abilities. He talks of *our intuiting space and time, in a way which is direct and entirely free from any mediation by the intellect - but this must be distinguished from an alleged pure reception of 'raw data' from the senses; the intuiting is presupposed by, and so cannot depend upon, sensory experience* [Honderich 1995]. In the *Critique of the Pure Reason*, he aims at showing how reason determines the conditions under which experience and knowledge are possible. Instead of making our concepts match the nature of objects, we must allow the structure of our concepts shape our experience of objects. This turn of mind helps a lot to understand the way intuition works and the purpose of it.
The intuition is the human primary understanding of the environment. So, it is highly related with our own experience, integrating both objects and consciousness over space and time. It is the way we can perceive and conceptualize the world without required prior knowledge.

4.2 Using intuition in interdisciplinary communication

The Chapter 3.2. was pointed out the difficulties of knowledge communication in interdisciplinary groups. These difficulties may concern descriptive and PK because of the ontologies proper to each discipline. They may also concern prescriptive and TK because humans are communicating.
The impact intuitive process can have on communication and on explicit knowledge sharing is immediate. Indeed, as intuition is not based on prior explicit knowing, it does not require the use of disciplines' ontology. If the transmitter's formulation process output is such as the receiver's

understanding process (cf. Figure 3) being based predominantly on intuition, then the discipline ontology issued cited previously is minimized.
On the other hand, the way intuition process can help experience related knowledge-sharing issues (tacit or experienced related PK) is very different. Actually, intuition is the regular understanding process used to gain TK. TK and intuition work together. However, formulation can be processed such as receiver's understanding process would be eased by favouring intuition. In other words, if one can explain one's point of view in a way that others understand it well intuitively, then the knowledge sharing would be more successful.
Thus, intuitive process can help the sharing of all varieties of knowledge. In order to reach this goal, it was shown that formulation has to be realized and structured for the understanding process to be highly intuitive. Structuring the knowledge-sharing process, based on intuition is then a solution for the problem focused by this paper. The communication process, based on the mechanism described in Chapter 2.3, should be structured considering the intuitive mental process. From this consideration, a proposal can be propounded.

4.3 *Ba* and SECI Model

The term *ba* comes from Japanese philosophy [Nishida 1992], and define it as a 'shared space' for knowledge, i.e. a place where interpersonal interactions are possible, and where knowledge creation is possible: *For those unfamiliar with the concept, ba can be thought of as a shared space for emerging relationships. This space can be physical (e.g. office, dispersed business space), virtual (e.g. e-mail, teleconference), mental (e.g. shared experiences, ideas, ideals), or any combination of them. What differentiates ba from ordinary human interaction is the concept of knowledge creation [...]. According to the theory of existentialism, ba is a context which harbors meaning.* - [Nonaka 1998].
This description suggests that *ba* is more than a place of meeting and interaction. Knowledge is included in the *ba* and is intangible (outside, it becomes information and is mainly tangible). It is actually the place of exchanging knowledge, acquiring by one's own experience or reflection on the experiences of others. *Ba* is defined as a frame, in the mean that it has borders of space and time. In this frame, knowledge and its flow are source of creation.

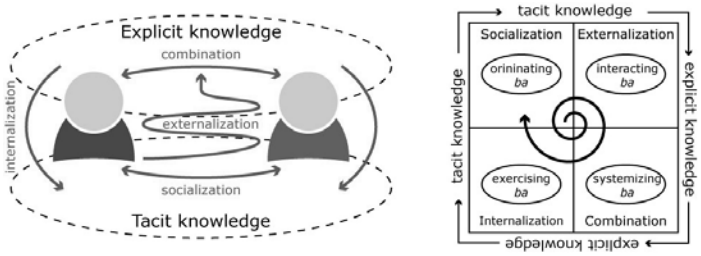

Figure 2. The SECI Model and its four *ba*

Nonaka proposes a spiralling interaction between explicit and tacit knowledge as a knowledge creation process [Nonaka 1998]. The process is described following four steps (cf. Figure 2): The socialization, the externalization, the combination, and the internalization ones (SECI Model). Each step is a conversion process from one of the two types of knowledge to the other one:

- Socialization involves the sharing of tacit knowledge between individuals. The tacit knowledge is shared by being in a common environment, rather than explicit path of communication (written or verbal). Socialization is the process of acquiring tacit knowledge through direct interaction, by tacit knowledge dissemination.
- Externalization is the expression of tacit knowledge for other to understand it. During this step, the individual (one's intentions and ideas) merges with others to become the unity of the group in which tacit knowledge is converted into explicit knowledge. Externalization process is mainly supported by two factors: the conversion of tacit knowledge into explicit knowledge involves techniques which help to express one's ideas, and the deductive, inductive, and/or abductive reasoning to provide an understandable form to expression.

- Combination consists in the conversion of explicit knowledge into more complex sets of explicit knowledge. By being diffused and systemized, the knowledge transcends the group. Capturing, integrating, editing the explicit knowledge are the main activities in this step.
- Internalization is the conversion of newly created explicit knowledge into group's tacit knowledge. The individual absorbs relevant knowledge. Philosophically, it is said that the individual find oneself in a larger entity. Experimenting, trying, training are possible methods.

The SECI Model is describing a dynamic process in which tacit and explicit knowledge flows and are shared by members situated in the group. In a workgroup, the *ba* can be generated thanks to an organizational effort. By adopting the SECI Model as a guideline, this organization can support its members to share and to create knowledge. The Chapter 3.2 showed that interdisciplinary characteristic of the workgroup which this dissertation is focusing on meets problems during the sharing of both tacit and explicit knowledge. Then, the *ba* can be an adapted support for the interdisciplinary group if it includes a tool to ease tacit and explicit knowledge sharing. The Chapter 4.2 showed that intuition, which everybody can use and disciplinary independent, could be a path to solve such issue. Then, we propose to use intuition as a basis to create a supporting concept to support sharing knowledge in the *ba*. This concept, called 'Evoked Metaphor' (EM), will make possible the efficient use of *ba* for interdisciplinary workgroups. Then, the *ba* and its included EM will be the frame for an interdisciplinary workgroup working process method.

4.4 Evoked Metaphor

4.4.1 Description of the evoked metaphor

The proposal is to create a metaphor, related to the project on which the interdisciplinary workgroup is working on. This metaphor, called the 'Evoked Metaphor', is defined as a *set of intuitively transferable and validated information and operating laws* (cf. Figure 3):

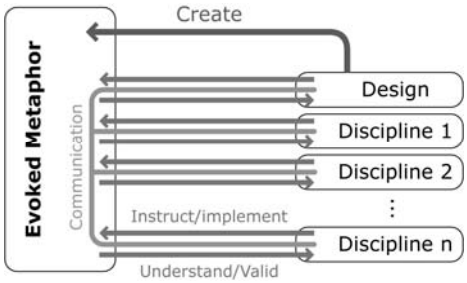

Figure 3. The Evoked Metaphor Model

- *Intuitively transferable* - The EM is based on intuition and its process, which are supporting knowledge sharing in the interdisciplinary group. The main requirement for this metaphor is that members can understand it and interact with it intuitively. In other words, this EM would be an image analogue to the current problem, which each member would be able to understand not due to disciplinary skills, but thanks to intuition.
- *Validated information and operating laws* - One of the most important aspects to be considered while designing the EM is its analogy between the EM and each of the disciplines' points of view involved in the workgroup. This analogy means that the 'relation' between the EM and each discipline is two-ways: The discipline has to be able to validate the structure of the EM and its processes in full; Any discipline should be able to include in the EM an aspect of the discipline's paradigm (i.e. to instruct the EM), without creating contradiction among the various processes existing already in the EM. The EM is not static throughout the project. The spiral cycle of the SECI Model provides the opportunity to be dynamic and to evolve at each cycle. Its evolution means its maturity and its increasing relevancy.

As it is based on intuition, the understanding of the EM should not require any specific disciplinary knowledge. The EM has to refer to concepts understandable by anybody, thanks to their own intuition

and/or their own experience. The EM has to be a meeting point between disciplines in their quest of sharing knowledge. If that succeeds, thanks to conversation and open minds, these differences can become the richness of the group, and a vector of its creativity. Following this process, during the entire process, would help each discipline to participate, or at least to follow and comment each step of the project, finally making the latter a fully interdisciplinary project.

4.4.2 Evoked Metaphor in the practice of ba

For an efficient knowledge sharing in the interdisciplinary workgroup, the EM has to be included into the SECI Model. However, the first cycle is dedicated to the creation of the EM. Therefore, this 'initial' cycle is different than in the following ones. The four steps of the first cycle are as follow (cf. the left part of the Figure 4):

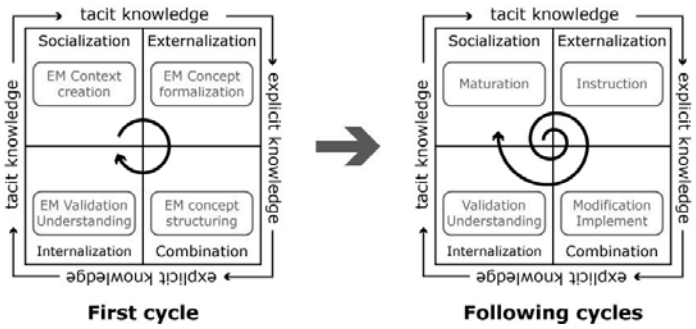

Figure 4. The Evoked Metaphor in the SECI Model

- At the very beginning of the project, the EM does not exist. Nevertheless, it is a crucial step since the designer (of the EM) will get to know other members of the group and to 'feel' the group. Then, this step of socialization corresponds to the context of early gestation of the EM.
- The next step corresponds to the first concrete action of the designer: the basic concepts and objects of the EM are defined.
- Then, objects are gathered and articulations (or mechanisms) between them are defined. The entire set {objects, mechanisms} forms the EM.
- Finally, EM has to be validated by the members of the workgroup. This validation endorses that the EM (i.e. its objects and its mechanisms) is compatible with each discipline's paradigm involved in the project.

The following cycles are structured on the pattern illustrated on the right part of the Figure 4:

- During the socialization step, the individual is 'infusing' or being 'infused' in/by the originating *ba*. Concerning the EM evolution, it is a step of maturation of its tacit aspects.
- During the externalization step, the interacting *ba* is supporting the expression of tacit knowledge among members. As for the EM, new elements, brought by the maturation step, need to be expressed, to be instructed in the EM, and to be included in the project.
- During the combination step, the explicit knowledge expressed in the previous steps is combined in the systemizing *ba*. As for the EM, it is modified to implement new elements expressed during the previous step.
- During the internalization step, the individual embodies explicit knowledge and convert it into tacit knowledge. That is the time for each member to validate new implementation in the EM on the point of view of one's own discipline.

It is interesting to notice here that the shift between tacit and explicit knowledge in the SECI Model is preserved in the EM: The maturation step is an evolution of tacit knowledge; The instruction step helps the tacit knowledge owned by each discipliner to be converted and output into explicit knowledge; The implementation step is the systemizing process to integrate tacit knowledge into the EM; The validation step is required for the intuitive understanding of discipliners, which means a partial conversion of explicit knowledge to tacit knowledge.

4.4.3 The Evoked Metaphor and the design process

It was shown how the EM fits perfectly within the SECI Model in order to propose an efficient knowledge sharing system in the interdisciplinary workgroup, thanks to intuition as a mental process. To finish this introduction of the EM, it is now required to describe it in the industrial process (as introduced by Owen [Owen 1993], illustrated on the left side of the Figure 5).

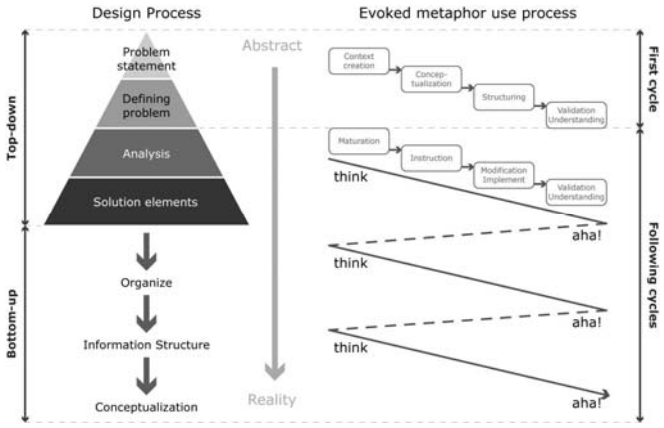

Figure 5. The Evoked Metaphor and the design process

In this design process, the first cycle of the EM (right side of the Figure 5) is operated during the problem definition. The first cycle is used to define, structure and validate the EM. Therefore, there is a strong parallelism between the design goal creation (i.e. defining the problem) and the EM one, which explains and is explained by the analogical aspect of the link between the design and its EM.
Concerning following cycles in the top-down part of the design process, the EM's progression follows that of the design project's one. Each analysis should be accompanied by a cycle of the EM process:

- The Maturation step takes place during the pre-analysis information gathering step;
- The Instruction step takes place during the information structure;
- The Modification/implement action step happens during the actual analysis process;
- The Validation/Understanding step accompanies the validation step of the analysis, emerging the characterization of a new function (the first aha! result), part of the solution elements.
- The unconscious (although important) time located between the Validation/Understanding and the Maturation steps (represented by the dot lines) is the time required for information to settle its position in each one's mind, before one is able to relaunch a new cycle. However, this step is not properly part of the EM, as it is an individual inner process.

During this period (analysis and solution elements), EM's cycles should be as numerous as the quantity of functions to analyse, and may be processed in parallel. This would result in the structured list of functions fully 'translated' and validated in the EM.
For the bottom-up process, cycles are much less numerous since they only aim at helping and partially validating the information structuring process. The information clusterisation can be also applied to the EM, as a creative process, to end on new mental representation of the EM, source of creation (the second aha!). Finally, output of the information structure process, emerging on the conceptualization and being the most creative step of the design process, can be interdisciplinary understood and validated by each member thanks to the last cycle.
To conclude, it can be now argued that the set SECI Model/EM can be fully integrated to the industrial design process, preserving and fitting to the design steps.

5. Conclusion

The *ba*, leaning on the SECI Model, is a sharing knowledge structure particularly well adapted for design workgroups. It permits a constant and interactive flow between tacit knowledge and explicit

one. Thanks to its cyclic process, the workgroup finds in it a dynamic organization to manage the combination, the diffusion, and the diffusion of knowledge. Nevertheless, even if it helps the management of knowledge, it does not satisfy the problem related with knowledge sharing in interdisciplinary context. Therefore, it has to be supported by a tool for knowledge management which is able to satisfy interdisciplinary constraints. This is the purpose of the EM. On a functional point of view, the EM permits tacit and explicit knowledge sharing thanks to the mental process of intuition. On a structural point of view, the EM is adapted to the structure and the cyclic dynamics of the SECI Model, and is synchronized to the process of exchange between tacit knowledge and explicit one (Externalisation and Internalization), and to the evolution of both (Socialisation and Combination).
Then, the interdisciplinary design workgroup finds in it a tool for the knowledge management and creation satisfying knowledge sharing constraints, and workgroup aspiration. However, this tool is delicate to use, for a few reasons:

- It requires strictness concerning the quality of the metaphor, i.e. on its analogy with the ontologies of the disciplines involved in the interdisciplinary project.
- It demands to each member an additional effort to operate the EM properly, and to process a correct transformation of the knowledge to share.
- It requires to workgroup members a certain tolerance and flexibility of mind.

This methodology has not yet got to the 'time of maturity' and has to be evaluated, and certainly optimized, by its application to concrete *project*s, as for *MATiK* [Lévy 2004]. Others should follow.

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