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ORIGINAL ARTICLE

Using a Kansei-driven Approach for New Concept Development Activities: What It Implies for Industrial Projects

– Different Patterns of Design Activities and Design Information Conveyed –

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Abstract: In this article, twenty-seven experience-centered industrial design projects leading to kansei representations were analyzed. Information was gathered from interviews with former project team members and from an analysis of the projects' final reports. All of the projects involved at least the Toyota Motor Europe – Kansei Design (TME-KD) division. Three types of projects were identified: "exploratory concept," "product lining strategy," and "pre-development direction." For each project groups, the analysis detailed specificities in terms of context (purpose, design team members), design activities (information, generation, evaluation & decision, communication), and regarding the nature of their outputs (kansei representation) and the type of design information they conveyed. This led to a comparison of the different types of projects and a discussion about the kansei-related design information exchange in early design stages. A model of kansei-related design information based on these discussions is finally presented.

Keywords: *Kansei Design, Design Information, New Concept Development, Industrial Context, User Experience*

1. INTRODUCTION

In the consumer goods industry, design teams include members with diverse profiles, such as marketing product planners, engineers, and styling designers. Initially, the design team usually identifies problems and defines challenges in a document often designated as the "brief." Before any concrete aspects (e.g., shape, technology specification) of the product to be designed are fixed, other representations appear in the process. These representations (e.g., mood-boards, target customer description, technology demonstrators, etc.) convey intentions and possible directions. They can be seen as communication tools to increase mutual understanding of the concept and facilitate discussions about specific topics between the diversely skilled members of a design team.

These representations all touch on aspects of user experience, but they never communicate any clear intention related to it. Nevertheless, user experience is at the boundary between the three main functions involved in design teams (marketing, engineering, styling) as it relies on an affective link between a user (i.e., market) and the environment (including the product, the interaction, the context). Users' experience with products recently became a major differentiation factor between competitors and can greatly influence the success of a product. Karapanos and Martens [1] stated that decisions made at the conceptual design stage have the highest impact on the final user experience (UX) and eventually on UX failures. From this statement, we postulate that taking experience into account and discussing it early in the design process increases the chances that the final product will have a positive impact on the qualities perceived by its users.

2. LITERATURE REVIEW

The first section of the literature review will create a link between the complementary notions of user experience and kansei process. The second section will detail the early phase of the industrial design process. The third section will discuss design activities and the final section will investigate the literature related to the design information exchanged within a design team during this phase.

2.1 User experience and the kansei process

Ortíz Nicólas and Aurisicchio [2] analyzed 11 user experience frameworks from the literature in an attempt to bring together in a consistent overview the rapidly growing and disjointed literature on the subject. The

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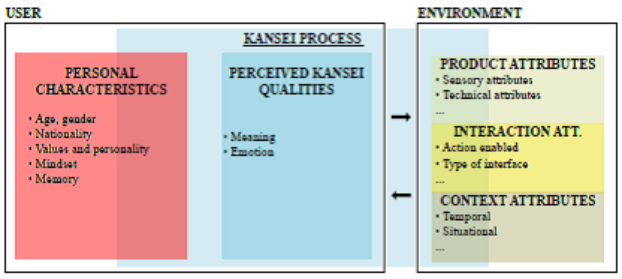

Figure 1: Kansei-Experience framework

conclusion of this research suggested that even if the perspectives and focus points of the 11 researchers were different, common constituent elements (user, interaction, artifact, and context) and aggregates (subjective, conscious, emotional, interconnected, dynamic) of user experience were acknowledged by the majority of the perspectives reviewed. The situation described with the term user experience can be understood in relation to the definition of the kansei process. Lévy, Lee, and Yamanaka [3] described the latter as the function of the brain related to "emotions, sensitivity, feelings, experience and intuition, including interactions between them" (p.9). It is further described as originating in one's sensory perception and personal characteristics (kansei means) and providing as output a qualitative meaning and value of the environment (kansei result). Notably, Lévy et al. indicated that the flow between kansei means, process, and results is not strictly linear and that these different aspects influence each other. Figure 1 represents a framework that combines the notions of user experience and kansei process. It represents the main entities of an experience during the interaction between a user and a product. The personal characteristics and attributes of the environment (product, interaction, context) cover what has been previously defined as kansei means, whereas the perceived kansei qualities are direct consequences of kansei results. Notably, the framework also retains the four constituent elements of an experience identified by Ortíz Nicólas and Aurisicchio [1]. More details about the creation of this framework can be found in another publication [4].

2.2 The new concept development phase of the industrial design process

Scholars usually divide the industrial design process into two major phases: the new concept development (NCD) phase and the following new product development (NPD) phase [5]. The NPD phase then leads to the commercialization of the new product. Gero [6] described an innovation as the introduction or uptake of intellectual property (created during the NCD phase) into NPD projects (during which the consumable artifacts are designed). This means that both phases (NCD and NPD) are necessary for the innovation process. This definition of innovation also corresponds to that of Van de Ven [7]: "new ideas that have been developed and implemented" (p.590). Depending on the changes they involve, innovations can be range from incremental innovation to radical innovation. Their nature also impacts the typology of products to which they are related [8]. In that sense, the nature of the intellectual property created determines the product development strategy that will be adopted by the project managers [9].

Wheelwright and Clark [8] distinguished between three main types of new products: breakthrough products, platform products, and incremental products. These project-types characterize products based on the extent of product and process change induced by their development.

- Breakthrough products involve the most product and process changes. In the automotive industry, the introduction of the first hybrid vehicle in the 1990s and electrical vehicle in the 2000s are good examples of breakthrough products (in these cases, the breakthrough innovation came from the engine).
- At the other extreme, incremental product developments involve only few process and product changes. In the automotive industry, such developments correspond to small vehicle updates that occur usually three years after the launch of a new vehicle. They involve minor styling and performance changes (but not deep architecture changes).
- In between these two extreme types are platform product developments. These developments establish a basic architecture for a next generation of product or process and are substantially larger in scope than incremental products [10]. The introduction of a new vehicle and the addition of new body styles (e.g., coupe, convertible, station wagon) are the result of platform product developments.

Verganti [11] described three types of context for innovations: market pull, technology push, and design driven innovations. Market pull innovations correspond mostly to incremental products and are based on needs expressed by customers. Criticisms from scholars regarding this type of innovation are that customers (the market) have a short-term view and that their requirements are neither fully explicit nor stable [12]. This is why market pull innovations alone cannot induce the changes and intellectual property necessary for the development of new platform products and break-

through products. In recent years, new platform as well as breakthrough products (and services) providing new and well-achieved experiences gained in importance (e.g., Nintendo Wii, Apple music and app ecosystems) [11]. When dealing with NCD activities, organizations are shifting from a technology only focus (the two examples given previously do not necessarily have the most advanced technical specifications) to a combination of technology- and design-driven approaches. The latter approach enables organizations to better deal with user experience and concepts that radically influence the meaning of the product. Scholars indeed highlighted both the nonsense of NCD processes focused only on users and their needs, and the importance of considering the UX at the conceptual stage [1, 12].

2.3 Design activities

The basic model of design activity often used in the contemporary literature transcribes [13, 14]. It is represented in Figure 2. It is composed of four symbiotic design activities: information, generation, evaluation and decision, and communication. Notably it is also referred to as the design informational cycle as it describes the way design team members process design information (collect, transform and generate, communicate).

Experience-centered tools and methodologies have been created to support the different design activities [15]. They have as common characteristics the fact that they contribute to improving the user experience (through information, generation, or evaluation and decision activities). They differ in the different ways described below. One of these characteristics is the way they treat potential future users. Depending on the tool or methodology, he/she can either be treated as a subject (observed and questioned) or as a partner (participatory design). When treated as a subject, "users" are either directly (e.g., interviews) or indirectly (e.g., field observations, desk research) involved in the design

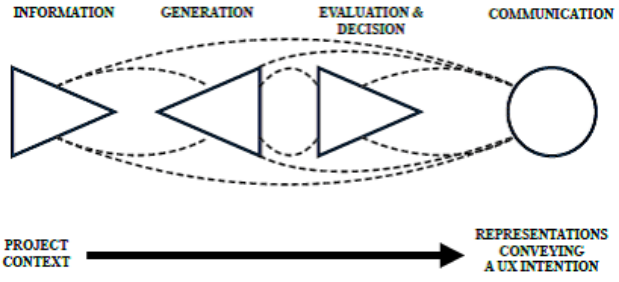

Figure 2: Design activities (adapted from Bouchard & Aoussat [13], and Cross [14])

activities [16]. The tools and methodologies can be based on scientific (based on quantitative data analysis, based on induction and deduction) or abductive reasoning (based on qualitative data, able to deal with ambiguity, one of the characteristics of "design thinking" [17]). Some of them also combine both and can be referred to as originating from integrative thinking approaches [18]. A wide variety of tools exist. Some authors have published reviews and classifications [19]. When used in the early stage of the design process, these tools lead to the creation of early representations. These kansei representations can either be visual (persona, mood boards, visual theme board [20]), multi-sensory (MSD approach [21], Mood boxes [22]), narrative [23], or interaction [24].

2.4 Design information

Bouchard, Kim, and Aoussat [25] studied the design information expressed by design team members when discussing and brainstorming about design intentions during early NCD design-driven activities. The authors gathered design information from empirical studies. They organized it into different design information categories, which were structured into three different groups depending on their abstraction level. The three groups identified corresponded to low, middle, and high levels of abstraction. Each category of design information has originally been defined and exemplified. Additional categories were later identified by Gentner [4]. An description of the categories used in this experiment can be found in Table 1. Notably, the categories all relate to the different entities of the intended experience (user's personal characteristics, perceived kansei qualities, product attributes, context attributes).

3. RESEARCH QUESTION AND HYPOTHESIS

The research question is related to the notion of experience-driven NCD project introduced in the literature review. It can be formulated as follows: How can experience-driven new concept development projects be characterized and compared?

One hypothesis was identified in order to discuss the research question. It combines the notions of "experience," "new concept development," "design activity," and "design information" described in the state of the art:

H - The nature of design activities undertaken and the design information exchanged during experience-driven new concept development projects depends on the context and purpose of these projects.

Table 1: Categories of design information [4]

Category name	Description	Example	Related UX entity
Value [O] (H)	These words represent final or behavioural values.	Ambitious, open-minded	User's personal characteristics
Semantic descriptor [C] (H)	Adjectives related to the meaning and characteristics.	Playful, romantic, traditional	User's perceived kansei quality
Emotion [N] (H)	Targeted emotion to be felt by the user	Joy, surprise, interest	User's perceived kansei quality
Style [O] (H)	Characterization of all levels together through a specific style.	Edge design	Product attributes
Lifestyle [N] (M)	Combination of values of the user	Work hard and play hard	User's personal characteristics
Interface characteristic [E] (M)	Underlying logics, engagement required	Mental engagement, physical and direct interface	Interaction attributes
Action enabled [E] (M)	Function, usage	Create, relax, communicate	Interaction attributes
Product characteristic [E] (M)	Components, ways of functioning, spatial organisation	Mechanical handle, roominess	Product attributes
Sector/object [O] (M)	Object or sector being representative for expressing a particular trend	Tennis, wearable computing	Product attributes
Physical context [X] (M)	Physical elements surrounding the product	In a modern living room	Context attributes
Temporal context [X] (M)	Notion of time in the interaction	Narrative description on an interaction	Context attributes
Culture [N] (L)	The culture of a user covers his/her age, gender, nationality, function, and organisational affiliation.	Young (20-29) Europeans	User's personal characteristics
Morphology [N] (L)	Related to the outward appearance of the user	Body shape, structure, handicap	User's personal characteristics
Gesture [E] (L)	Movement of a part of the user's body used as input	Hand and body movements	Interaction attributes
Feedback [E] (L)	Communication to the users that is influenced by prior inputs	Blinking light and sound	Interaction attributes
Visual attribute [C] (L)	Overall shape or component, shape size, and chromatic properties	Square, long and thin, Light blue, Pantone 17-5641 Emerald	Product attributes
Tactile attribute [X] (L)	Material, temperature, texture	Plastic, stripped surface, rough	Product attributes
Auditory attribute [N] (L)	Rhythm, timber, etc.	Irregular, high pitch	Product attributes
Olfactory attribute [N] (L)	Scent families and facets	Citrus, woody, floral	Product attributes

(H) : High level of abstraction
(M) : Middle level of abstraction
(L) : Low level of abstraction
[O] : Category originally presented by Bouchard et al. [24]
[E] : Extracted from an original category
[C] : Combination of original categories
[X] : Extension of an original category
[N] : New category

4. PRESENTATION OF THE EXPERIMENT

The projects were selected because their outputs described a user experience intention using various types of what can be called kansei representation. For each of them, the projects' material (including a description of the design process and final reports) was analyzed and used as an input. Interviews related to each project were also conducted with at least one member of the original project team. The interviews were semi-directed. Approximately 30 minutes were spent for each project. Similar questions were asked each time to clarify the context of the projects. Discussions focusing on the output material (early representation) were then initiated. This part of the interview permitted the gathering of additional information related to the category of design information on which the resulting early representations were focusing.

The projects were structured according to their position on the overall operation procedure of the company. Three types were identified from the 27 design-driven NCD projects analyzed. These types are related to the creation of "exploratory concept", "product lining strategy", and "pre-development direction." During the interviews, the context of the project (in regards to one of the three below types) was discussed and specific attention was paid to the project's purpose, the composition of the design team (culture and affiliation of the members), and the audience addressed by the project.

- The "exploratory concept" group is composed of design-driven NCD projects that intend to explore innovative possibilities able to provide new pleasurable experiences, including new meanings [11]. These projects intend to influence the development of breakthrough products as defined by Wheelwright and Clark [8].

- "Product lining strategy" projects are NCD projects meant to impact upcoming platform product development projects (e.g., hybrid vehicle NPD projects). Their outputs highlight kansei directions and related design strategies. They provide material related to user experience that enriches downstream NPD information activities.
- The purpose of "pre-development direction" projects is to prepare an upcoming incremental product NPD project. Similar to "product lining strategy" projects, they intend to communicate kansei directions and related design strategies. As the focus here is on user experience and not on style, these strategies are centered on the kansei qualities that can be expressed by different variations (or grades) of a vehicle update.

The information gathered about the projects also covered the different design activities that were undertaken. The reasoning approach of the information, generation, and evaluation & decision activities will be discussed. Regarding the communication activity, the analysis focused on the nature of kansei representations used for intermediate and final outputs. Four different types of representation were identified: visual, multisensory, narrative, and interactive. The audience to which to projects were presented corresponded to the other type of data collected regarding the communication activity.

In order to classify the design information conveyed by the kansei representations created in the projects, the 19 categories presented in the literature review will be used (Table 1).

5. ANALYSIS

In this section, the results of the analysis of each typology of design-driven NCD projects will be presented one by one. The results focus on the context of the projects (purpose, design team, audience), and on the design information conveyed by their output representations. The results will then be discussed together in section 6.

5.1 "Exploratory concept" (EC) projects

Eleven of the 27 projects analyzed were described as "exploratory concept" projects. These include, for instance, the "Window to the world" project, which proposed to tackle the interaction between car occupants and their environment in a poetic and seamless way. An kansei representation resulting from this project (storyboard, video, and prototype pictures) can be found on the Internet (http://bit.ly/15sb6A3 and http://bit.ly/114Gwhq).

The outputs of EC projects were concepts offering new experiences of mobility. Their focus was on mobility itself or on the interactions between a human and the environment (including other humans) supported by a mobility device. They can be regarded as NCD projects providing experience design-driven outputs for future breakthrough products. For all of these projects, the design teams involved were rather small (around 5 persons) and varied a lot from one project to another. They were always multicultural (multi-nationality, multi-gender, multi-function). The functions covered included design, business, and engineering, as well as complementary functions such as social sciences and computing. Most of the projects (73%) involved design team members external to TME. These external members were affiliated with organization such as consultancy firms or universities.

The information, generation and evolution & decision activities of these experience design-driven NCD projects were dominantly based on abductive approaches. They were mostly based on qualitative data and relied in some part on intuition and experience. The potential users were treated as subjects (directly or indirectly) except for information activities, which could also involve participatory design sessions.

- Information: The most used tools and methodologies were desk research, field observation, discussions with "users," longitudinal studies, brainstorming, and bodystorming. The latter two tools included in some cases participatory design sessions. In some other cases, they used the "kansei card" tool. Generally speaking, these tools and methodologies were mostly used to gather insights and inspire the design teams.
- Generation: Using the information and insights gathered various creativity tools were used to generate concepts.
- Evaluation & Decision: In order to evaluate concepts the design teams mainly relied on expert panels (discussions, voting sessions). For this type of projects, many iterative cycles occurred between generation and evaluation & decision activities.
- Communication: For every project analyzed, part of the final audience was unknown at the start. The audience finally reached was nevertheless much wider than that of the other types of projects. The audience reached depended on the topic tackled but also on the advice and recommendations received during the communication process. It was generally high up in the organizational scale. The educational dimension of the communication material was therefore reinforced. Narration was used 82% of the time. It was done with the help of storyboards, digital animations or videos. Interactive representations were also used 27% of the time. They are meant to provide "explicit innovative new experiences and give a

Table 2: Categories of design information conveyed by EC projects resulting kansei representations

Abstract. level	User's personal characteristics	User's perceived kansei qualities	Interaction attributes	Product & context attributes
High	- Value	- Semantic word - Emotion		
Middle	- Lifestyle		- Interface characteristic - Action enabled	- Sector/object - Physical context - Temporal context
Low	- Culture		- Gesture [EM] - Feedback [EM]	

[EM]: Emerging category

more tangible context for an audience that is often focused on short term concerns" (extracted from the interview of project #4).

The main design information categories conveyed by final outputs of "exploratory concept" projects are presented in Table 2. The table organizes categories according to their abstraction level (vertically) and the experience entity to which they refer (horizontally). As shown in this table, it appears that the kansei representations created mostly cover abstract design information. Most of the categories corresponding to high and middle levels of abstraction are covered (all except style and product characteristics). Notably, no concrete design information categories related to the product to be designed are covered. The narrative and interactive outputs relied on concrete elements in order to communicate the experience intention, but these characteristics did not belong to the main design information that were intended to be communicated.

5.2 "Product lining strategy" (PLS) projects

Ten of the 27 projects analyzed fit in the "product lining strategy" project type. These projects include, for instance, the methodologies and outputs such as those presented by the authors in other publications [22]. "Product lining strategy" projects are meant to impact specific upcoming platform product development projects (e.g., hybrid vehicle NPD projects). Their outputs were meant to be used by upcoming NPD teams (internal or supplier R&D teams). Compared to EC projects, the profiles of the multi-cultural design teams were much more structured. Only product planners, designers, and engineers were involved in PLS projects. They also involved fewer members affiliated with external organizations (30% and only as support). In the case of PLS projects, the balance between scientific and abductive reasoning was more even than for EC projects. Most of the time, users were treated as subjects (directly involved or not) but they could also be involved as partners. This happened mostly for generation activities and sometimes for information activities.

- Information: For PLS projects, this activity combined quantitative and qualitative research. The ones presented in EXP 2 (respectively, results from EXP 1 and image search) were for instance used in two projects. The most used tools and methodologies were desk research, interviews, and exploration activities (including participatory design sessions).
- Generation: Four projects out of ten (40%) involved participatory design sessions with potential future users. In this case, "users" were guided in their generation activity with sensory stimuli (low abstraction level) and keywords related to kansei qualities (high abstraction level). The other tools and methodologies used were abductive creativity tools.
- Evaluation & Decision: The concepts were either evaluated by a panel of potential users or by decision makers from the organization (expert panel). In cases where potential users were involved, quantitative evaluations were used. Additionally to psychological measurements (self-reported questionnaires), behavioral measurements were done in some cases (eye-tracking).
- Communication: The kansei representations created were meant to be used by upcoming NPD teams (internal or supplier R&D teams). The audience was composed of both managerial (as for EC projects) and working-level Toyota employees. The interviewees expressed therefore the importance of having the experience directions and strategies conveying information that could be used directly by engineering, business, and design departments. In 80% of the cases, multi-sensory representations were used. They made it possible to convey concrete UX-related design information. Narration started to be used for some projects dealing with interactions (20%). For all the projects, visual-only versions of the output representations also existed and were used for distant communications (e.g., video conference). The visual material typically included keywords, pictures and/or figures.

Table 3: Categories of design information conveyed by PLS projects resulting kansei representations

Abstraction level	User's personal characteristics	User's perceived kansei qualities	Interaction attributes	Product and context attributes
High	- Value [EM]	- Semantic word - Emotion		- Style
Middle			- Action enabled [EM]	- Sector/object - Product characteristic [EM]
Low	- Culture - Morphology [EM]		- Gesture [EM] - Feedback [EM]	- Visual attribute - Tactile attribute - Auditory attribute - Olfactory attribute [EM]

[EM]: Emerging category

The main design information categories conveyed by the kansei representations resulting from PLS projects are presented in Table 3. The scope of information covered is wide. All experience entities except the context are covered with low to high abstraction categories (when a category exists). The kansei representations contained information to guide and inspire styling (e.g., semantic word, emotion, style, visual attribute, tactile attribute, and other sensory attributes) and interaction design activities (e.g., semantic word, emotion, gesture, feedback). They could also be used by product planners interested in information about markets (e.g., value, culture) and product package (e.g., sector/object), as well as by engineers working on topics such as material developments (e.g., emotion, semantic, style, visual, and tactile). Notably, many categories of design information are currently emerging in PLS projects (noted as EM in Table 3).

5.3 "Pre-development direction" (PDD) projects

Six projects could be described as PDD projects. They will be described in terms of context and design information conveyed. The UX-related design information that these projects provide was preparing upcoming NPD projects (short-term). These representations expressed directions and strategies focused on the kansei qualities that could be expressed by different grade variations of a future vehicle updates. The particularity of "pre-development direction" projects is that they were directly related to a new incremental product development project (NPD). The design teams involved were multi-cultural. In the teams' composition, a stronger accent was usually put on the function that would later be the most involved in the NPD projects (e.g., more styling designers were involved when preparing styling oriented projects). Notably, this typology of projects only involved members working at TME. In the case of PDD projects, the balance between scientific and abductive reasoning approaches was almost even. Users were treated as subjects (directly involved or not) rather than as partners.

- Information: Quantitative data from market research (user involved as subject) appeared to be crucial at this stage. Information related to potential customers (i.e. target users) was studied and could lead to further analytical reasoning activities in order to translate it into high-level design information [26]. Previous style-related NCD concepts could be used as starting points (e.g., concept cars). Finally, inspirational desk research was also used in order to put together design information from the different abstraction levels.
- Generation: The creation of character directions followed an iterative process. Refinement occurred cycle after cycle. The generation activity was in most of the cases led by styling designers sensitive to UX. Co-creation tools involving the entire design team could also be used.
- Evaluation & Decision: Team members evaluated initial ideas and concepts using their expertise. Questionnaires and votes could also be used to assist the evaluation activity. Final decisions concerning directions and strategies occurred at specific milestones and involved the project's top management.
- Communication: As mentioned in the context, the audience of "pre-development direction" projects was very specific. It covered managerial and working-level Toyota employees. The kansei representations always took the form of visual mood boards. They included multi-sensory samples when they were related to upcoming parts or material development projects (33% of the time). Narrative and interaction types of representations were never used. Their audiences were composed of specific function-oriented (styling, product planning, engineering) NPD project teams, as well as development teams from part or material suppliers.

The main design information categories conveyed by the kansei representations resulting from PDD projects are presented in Table 4. It can be observed that whereas all product attributes are covered, no design information categories related to interaction attributes are tackled. This can be put in perspective with the fact that the original role

Table 4: Categories of design information conveyed by PDD projects resulting kansei representations

Abstraction level	User's personal characteristics	User's perceived kansei qualities	Interaction attributes	Product and context attributes
High	- Value	- Semantic word - Emotion		- Style
Middle	- Lifestyle [EM]			- Sector/object - Product characteristic
Low	- Culture			- Visual - Tactile attribute

[EM]: Emerging category

of TME-KD was related to sensory quality perception. The experience resulting from static perception appears to remain the domain of activity of the division the most established for the projects that are the closest to the NPD phase.

6. DISCUSSIONS

The three types of projects will now be discussed together. Table 5 summarizes this discussion. By construction, the purposes of the three types of projects are different (this is the definition of EC, PLS, and PDD projects). Similarities could nevertheless be observed regarding the nature of the design teams involved. It appeared that they were all composed of a similar number of members. Five seemed to be the average number, regardless of the project type. The different design teams also had in common the fact that they were multi-cultural. Functions traditionally less related to the industrial context (e.g., human sciences, computing) could only be found in EC projects. The involvement of people outside the company in the design team was the highest for projects related to long-term innovations (EC projects). Their involvement decreased progressively for PLS and PDD projects (when the commercialization date becomes more and more clear). In these design activities, all projects combined abductive reasoning and scientific reasoning.

Table 5: Summary of the experiment

		Exploratory concept	Product lining strategy	Pre-development direction
Context of the projects	Purpose	Propose new experience concepts for future *breakthrough products*	Identify user experience logics and directions for future *platform products*	Prepare grade and character strategies of future *incremental products*
	Design team	- Multi-cultural - Members from inside and outside the company	- Multi-cultural - Mostly members from inside the company	- Multi-cultural - Only members from inside the company
Design activity	Type of representation	*Visual*: For intermediate output (co-creation session) *Multi-sensory*: No use *Narrative*: For intermediate and final output *Interactive*: For final output	*Visual*: For intermediate and final output *Multi-sensory*: For intermediate and final output *Narrative*: Limited use *Interactive*: No use	*Visual*: For intermediate and final output *Multi-sensory*: For final output *Narrative*: No use *Interactive*: No use
	Audience	- Wide but fuzzy - Mostly management level	- Specific - Management and working levels	- Very specific (development team) - Management and working levels
	Summary			
Design information conveyed	High level	PC: Value KQ: Semantic descriptor, emotion	PC: Value KQ: Semantic descriptor, emotion PA: Style	PC: Value KQ: Semantic descriptor, emotion PA: Style
	Middle level	PC: Lifestyle IA: Interface characteristic, action enabled PA: Sector/object CA: Physical context, temporal context	IA: Action enabled PA: Sector/object, product characteristic	PC: Lifestyle PA: Sector/object, product characteristic
	Low level	PC: Culture IA: Gesture, feedback	PC: Culture, morphology IA: Gesture, feedback PA: Visual, tactile, auditory, olfactory att.	PC: Culture PA: Visual, tactile att.

PC : Personal characteristics
KQ : Kansei qualities
IA : Interaction attributes
PA : Product attributes
CA : Context attributes

EC projects used the most abductive reasoning approaches in comparison with scientific reasoning approaches. It is justified by the ambiguity of their context: for this type of project there were no clear and definitive contexts ("you don't know what you don't know"). The fuzziness of the context also led to very different types of representations. For EC projects, narrative and interactive representations were mostly used for final outputs. They seemed to better communicate concepts conveying a radical change in experience. These types of representation were very rarely used in PLS projects and never used in PDD projects. For these projects, the design teams relied mostly on visual and multisensory representations. These types of representations conveyed design information using material more established in the organization (e.g., keywords, pictures, figures, material samples). They also communicated more information of direct use to the working-level employees involved in other NCD or NPD projects. Indeed, whereas EC projects mainly targeted managers dealing with vision and strategies, PLS and PDD projects' audience covered both managerial and working level employees. The clearer link between PLS or PDD projects and new industrial development projects (i.e. upcoming platforms and incremental development processes) is also reflected in the approach taken. Scientific reasoning is more used during the design activities. These approaches are meant to create knowledge about UX that is more explicit and that is proven with quantitative data ("you know what you know"). This type of output appeared necessary in order to convince an audience to take decisions related to the implementation of new concepts in NPD projects. In table 5 the summary figures located in the design activities section graphically present the different uses of abductive and scientific reasoning for the information, generation, and evaluation activities of the three types of projects. The size and fuzziness of the audience reached by the communication activity are also represented.

The kansei representations resulting from the different types of projects had in common the fact that they effectively covered abstract design information categories and that they related these categories to design information categories with a lower level of abstraction. All the types of projects expressed an intention regarding kansei qualities (emotion, semantic descriptor). They also referred the abstract design information related to the potential user (value) and to the product to be designed (style). Outputs from EC projects were nevertheless the only ones to convey design information related to all five UX entities and sub-entities. PLS and PDD projects lacked information about intentional contexts of use (temporal, physical), and PLS projects did not covey any intention related to interaction attributes.

For EC projects, the design information related to the product to be designed remained abstract. On the contrary, this type of design information was very present for PLS and PDD projects. This is indeed the experience entity that appeared to be most directly impacted by the NPD projects that followed. This might be because it is where new meanings and experiences are traditionally created in the automotive industry (e.g., interior layout, materials, features).

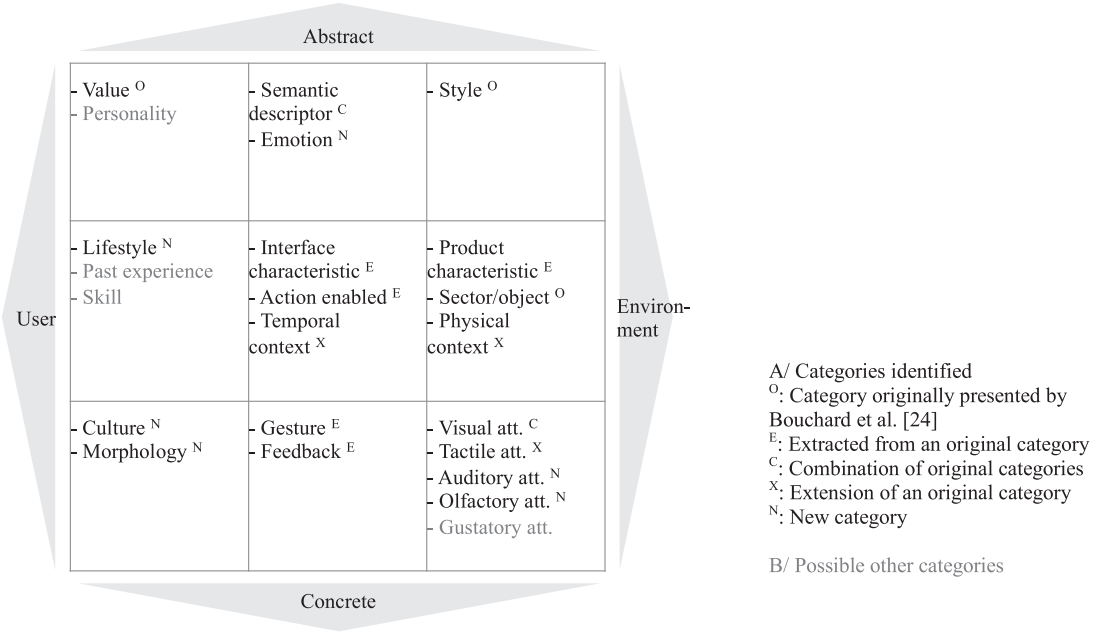

Figure 3: Model of kansei-related design information

EC projects and, increasingly, PLS projects conveyed design information related to interaction attributes. They covered categories such as gesture, feedback, interface characteristic, and action enabled (action enabled only for EC). The reasons for this were nevertheless different. On the one hand, EC projects proposed concepts with radically new UX (in the sense of Verganti [11]) that included new interaction propositions, and on the other hand PLS projects increasingly sought to investigate the influence that different interfaces (e.g., button vs. touchscreen) have on the perceived kansei qualities in conventional vehicle environments. In the latter case, the interaction related design information enriched the recommendations provided by the resulting kansei representations. As highlighted previously, the kansei representations resulting from PLS and PDD projects did not express any specific intentions related to the contexts of the intended experiences. One reason for this is that the temporal and physical contexts of new platform and incremental products resemble that of current vehicles. This aspect is therefore not the center of attention of these project types.

7. CONCLUSION

It this experiment, 27 industrial NCD projects conveying intentions in terms of user experience were analyzed. Their outputs can be referred to as kansei representations as they link intended kansei qualities with personal characteristics of targeted users and attributes of the environment of design. The three types of projects identified ("exploratory concept," "product lining strategy," "pre-development direction") were described and compared in terms of context, design activities, and design information categories conveyed by their outputs.

This experiment enabled us to validate our hypothesis (H - The nature of design activities undertaken and the design information exchanged during experience-driven new concept development projects depends on the context and purpose of these projects.). Indeed, it appeared that the three types of experience-driven NCD projects (different in terms of purpose and context) could be characterized with specific information, generation, evaluation & decision activities (tools, methodologies, reasoning), communication activities (audience, type of early representation used) and design information conveyed. Although this experiment covered 27 industrial design projects, one limitation that can be identified is that these projects were all related to the same organization (TME-KD).

A model of kansei-related design information has been created in order to better picture the contributions of this experiment and to facilitate future researches of the subject. The design information categories in Table 1 are presented according to two dimensions (two axes). The vertical axis corresponds to the abstraction level (low, middle, high). The anchors of the horizontal axis are labeled "user" and "environment." The left column corresponds therefore to design information describing the targeted user (i.e., personal characteristics) and the right column to design information describing static aspects of the environment (i.e., intentional product attributes, physical context). Finally, the center column corresponds to the information related to the intended user-product interaction (i.e., kansei qualities, interaction attributes, and temporal context). The related categories neither describe to the targeted user, nor the intended product and environment of use. The model shows a representation of the experience originating from a human-product interaction (see "Kansei-Experience framework" in Figure 1) from the perspective of the design information exchanged during concept creation activities. Besides describing the design information exchanged within a design team, the model also facilitates comparisons and discussions related to our research question (What are the design information categories that kansei-focused activities can cover in the early concept creation phase?).

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